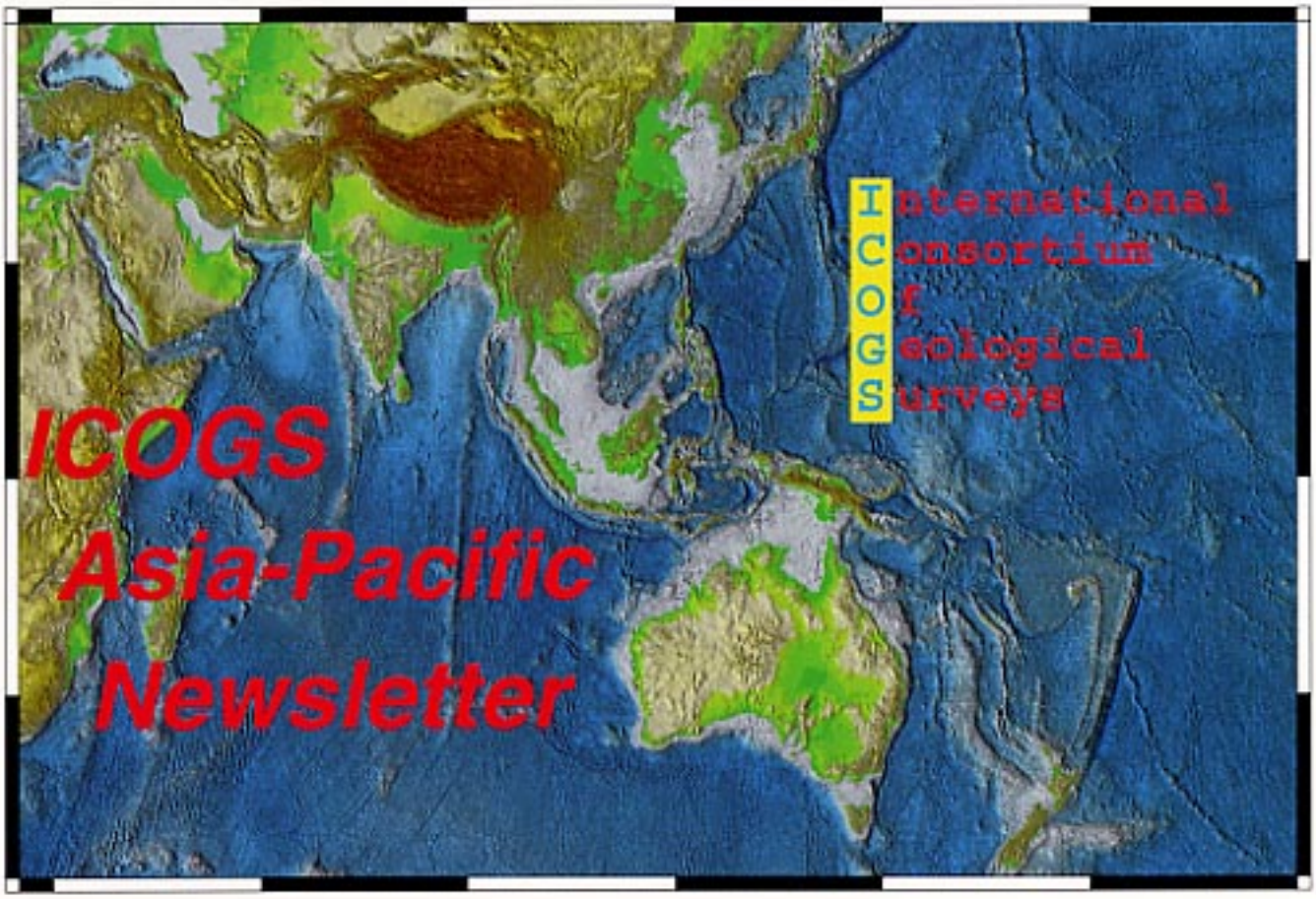

ICOGS ASIA-PACIFIC NEWSLETTER

No. 5, October 2002

CONTENTS

From ICOGS Secretary for Asia and the Pacific

It is our great pleasure to send you the fifth issue of the ICOGS Asia-Pacific Newsletter and offer you information from geological survey organizations in four Asian countries: China, Nepal, Pakistan and Sri Lanka. We would like to express sincere appreciation to the contributors to this issue.

The Geological Survey of Japan celebrated its 120th anniversary in June this year. For this occasion, we invited distinguished guests from the China Geological Survey (CGS) and United States Geological Survey. The first article, "Role and Activity of China Geological Survey", is based on the speech given at this celebration by Prof. Zhang Hongtao, Deputy Director General of the CGS. We reproduced the speech for inclusion in the newsletter since we believe that this article is also interesting for other geological survey organizations.

The second article from Nepal, "Achievements and Planned Activities", was chosen from the booklet "Department of Mines and Geology: Achievements and Prospect (2000)". For this reproduction, Mr. N. R. Sthapit, Director General of the Department of Mines and Geology, kindly sent the latest information to correct and add to the article for the editor.

Mr. S. H. Gauhar, Director General of the Geological Survey of Pakistan (GSP), submitted an original article to the newsletter, "Reorganizing the Geological Survey of Pakistan". In this newsletter, we also included some of short articles chosen from the GSP Newsletter, vol.8, No.1 and Vol.9, No.1-12, which Mr. Gauhar kindly sent to the editor.

In response to our request for new articles, the Geological Survey and Mines Bureau of Sri Lanka sent the "Sri Lanka Minerals Yearbook 2001" last year and "Yearbook 2002" this year. This Yearbook is a very informative publication on their resources. We feel that the geology of Sri Lanka is unique, the country is endowed with mineral resources not common in other countries, and these mineral resources might be of interest to the members of ICOGS Asia and Pacific. Thus we are pleased to introduce the Yearbook in this issue. Since the length of the newsletter is limited, we have decided to excerpt and edit the Yearbook for presentation to the members. The tables quoted in the text are from the Yearbook 2002. We hope that this abridged version will give readers an idea of the mineral resources of Sri Lanka and recommend the original publication to interested readers for more details.

We would like to continue publishing the newsletter regularly. Any kind of information which may be of interest to other geological survey organizations will be accepted as an article for future issues of the newsletter. Short articles such as news on recently published maps and other publications would be fine. We particularly welcome information such as new trends in your country and organization. All correspondence relating to the ICOGS Asia-Pacific including its newsletter should be addressed to:

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People's Republic of China
CHINA GEOLOGICAL SURVEY

This article was based on the speech by Prof. Zhang Hongtao, Deputy Director General of the China Geological Survey, given at the celebration of the 120th anniversary of the Geological Survey of Japan on 7 June 2002 in Tokyo, Japan.

ROLE AND ACTIVITY OF CHINA GEOLOGICAL SURVEY

Shou Jiahua and Zhang Hongtao
China Geological Survey, Ministry of Land and Resources
People's Republic of China

1. History of China Geological Survey

The China Geological Survey (CGS) has about a 90-year history. In 1913, the Geological Survey under the Ministry of Agriculture and Commerce was set up. Chinese geologists carried out the preliminary studies of petrology, stratigraphy, paleontology, tectonics and mineralogy in China and found some mineral deposits such as the Anshan Iron Ore Deposit, Jiapigou Gold Deposit, Fushuen Coal Deposit and Yumen Oil Field. During that time, some geologists from the United States, Japan and Germany also did the geological investigations in China.

In 1949, the People's Republic of China was established, and the Ministry of Geology was set up in 1952. Following that, systematic regional geological mapping, mineral exploration and hydrogeological investigation were carried out throughout the country. By the detailed geological work, minerals such as petroleum, natural gas, iron, copper, tungsten, tin and rare earth have been discovered. At same time, many important results of geoscientific research have been achieved too. The cooperation with international geoscientific organizations was started such as the projects of the Baiyinchang copper exploration with Russia and geophysical exploration with France and the United States in the Qinghai-Tibet Plateau. In 1976, the name of the Ministry of Geology was changed to the General Bureau of Geology under the State Planning Commission. In 1986, the name of the Ministry of Geology was resumed. In 1994, the Ministry of Geology and Mineral Resources was named. Due to geological work operations in the public and commercial sectors for long time, the evils of the operation affected the development of geological work in China. Problems such as the geological investigation group was overstaffed, up to 1.1 million people, operating expenses increased every year, but the geological work decreased, and geological equipment and instruments could not be replaced timely in this system. The organization could meet the needs for the transition from a planned economy to market economy so reform of this situation should be made.

In 1998, the Chinese government made an important structure reform, 44 ministries were reduced to 29 as the Ministry of Geology and Mineral Resources was abolished. The Ministry of Land and Resources was set up based on the former Ministry of Geology and Mineral Resources, State Bureau of Land Administration, National Bureau of Oceanography, and National Bureau of Surveying and Mapping. The Ministry of Land and Resources (MLR) is responsible for the planning, administration, conservation and rational utilization of land, mineral and marine resources within the territory of the People's Republic of China and marine areas under its jurisdiction. The reform of geological work at the central and provincial levels took place according to the separation of government and enterprise management. The management of the geological investigation group that belonged to the former Ministry of Geology and Mineral Resources, Ministry of Metallurgical Industry, Ministry of Coal Industry, China National Nonferrous Industry Corp., China National Nuclear Industry Corp., and other industrial agencies were transferred to the provincial level. They independently operated, developed and benefited under a market economy and gradually operated as enterprises on a commercial operation basis. Some of them, according to different situations, became a part of the metallurgical geological exploration and engineering company group, coal geological exploration and engineering company group, and Mingda chemical industry mining company group. Some were merged into the China nonmetallic industry company group and China salt industry company group.

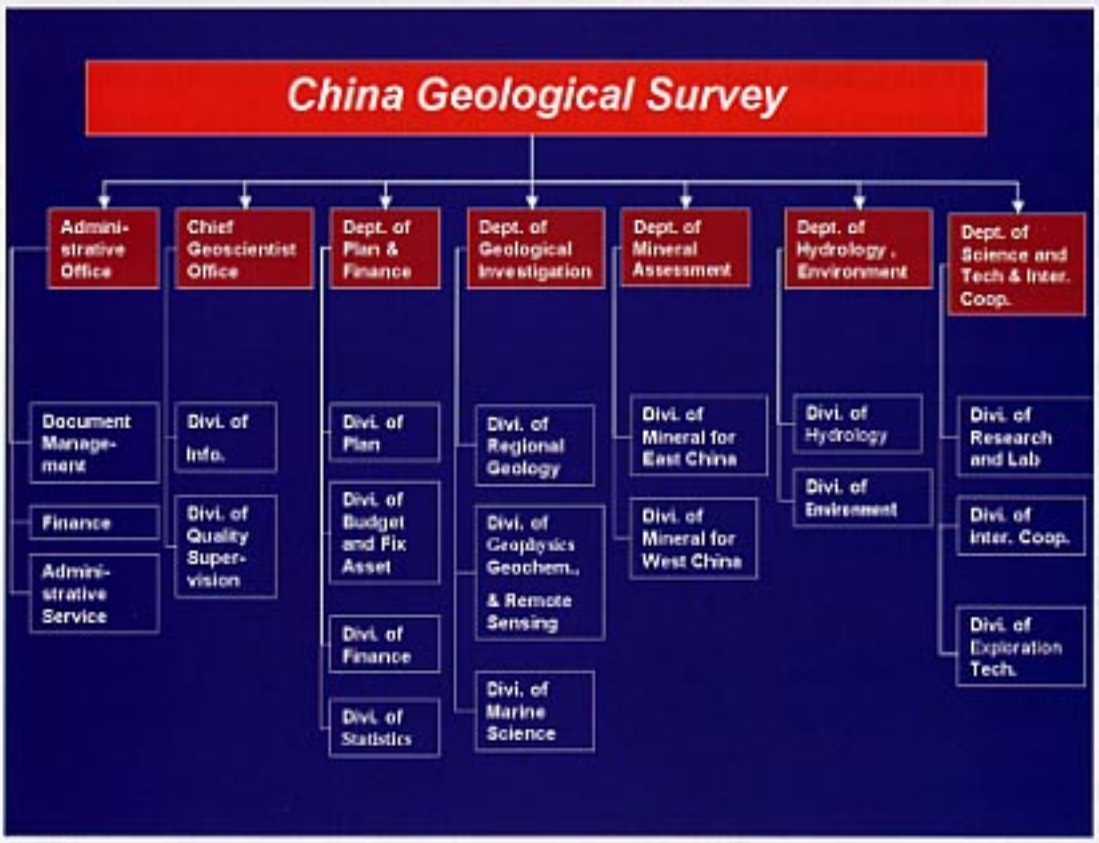


Figure 1

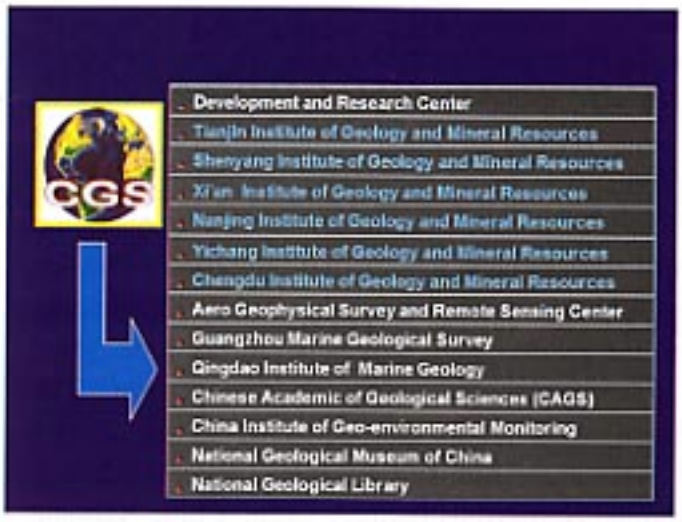


Figure 2

As another important reform of the national geological work in China, the China Geological Survey (CGS) was formally set up on July 16, 1999 (Figure 1). Its main functions are to undertake, organize, and carry out basic and public geological investigations and strategic mineral exploration. In November 2001, the China Geological Survey was reorganized as the Chinese Academy of Geological Sciences, China Institute of Geo-Environmental Monitoring, National Geological Museum of China, National Geological Library were merged into the China Geological Survey. Now 27 institutions are under the China Geological Survey after its reorganization (Figure 2). It performs geological investigation, geoscientific research and public service.

At present, the China Geological Survey has 6,500 staff members in total, and annual budget of RMB1.5 billion (about US$18 million) allocated by the central government for geological work. In the budget, RMB 1 billion (about US$12 million) is allocated for a special national program of "new round investigations of land, mineral and marine resources". The geoscientists from the national geological investigation group, universities and research institutions are participating in this program.

2. Progress of Geological Work in China

Figure 3

In the past 50 years, Chinese geoscientists carried out regional geological mapping, mineral exploration, geophysical and geochemical exploration, hydrogeological, engineering geological and environmental geological investigations, marine geological survey and geoscientific research, which covered the inland and part of the offshore. They have made great achievements in these fields through their hard work.

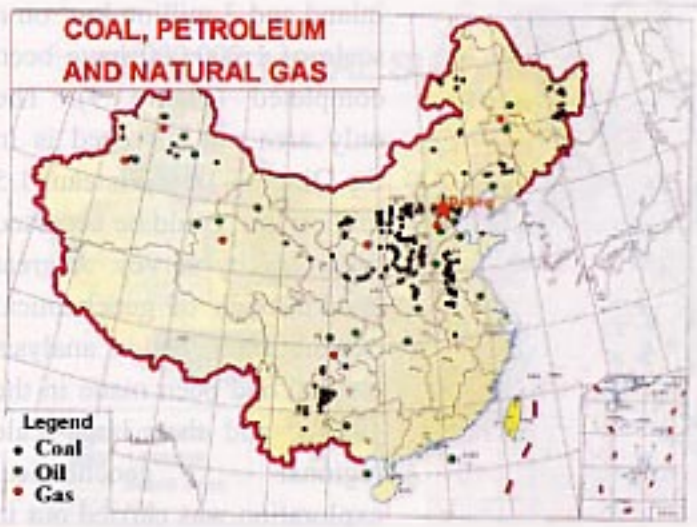


Figure 4

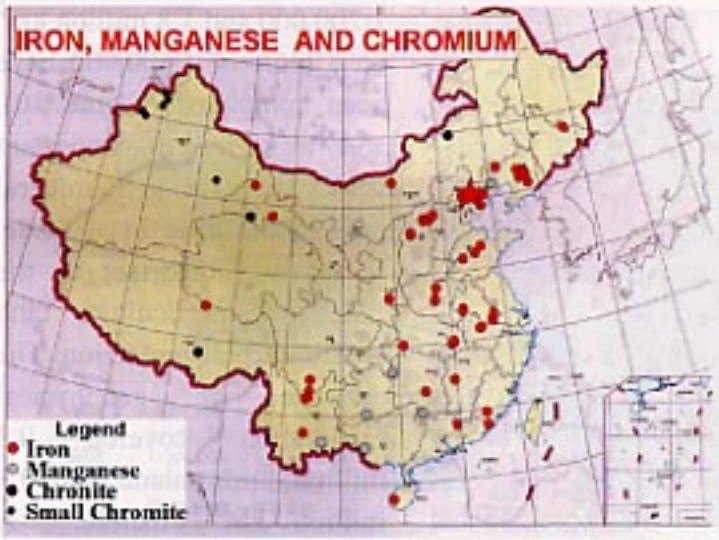


Figure 5

Figure 6

Until 1999, China has completed the regional geological mapping of 9,473,800 km^2 on a scale of 1:1,000,000, about 98.7% of the accessible mapping areas. Regional mapping of 6,910,000 km^2 on a scale of 1:200,000 was completed except for most of Tibet, the south part of Xinjiang, west part of Qinghai and northeast part of Inner Mongolia, which was 72% of the access areas. About 1,590,000 km^2 on a scale of 1:50,000 was mapped or 16.6% of the access areas (Figure 3) and 225,000 km^2 is on a scale of 1:250,000.

Through the large scale of geological investigations, mineral prospecting and exploration, 171 kinds of minerals have been discovered so far in China. There are 155 minerals having proven reserves that are classified as follows: 8 energy minerals, 54 solid minerals, 90 nonmetallic minerals and 3 water and gas (Figures 4-8). It is about 12% of the total amount of the world's proven reserves. The tungsten, tin, molybdenum, antimony, rare earth minerals, fluorite, barite are the dominant minerals in China.

For regional geophysical and geochemical exploration, gravity surveys of 7 million km^2 on a scale of 1:1,000,000

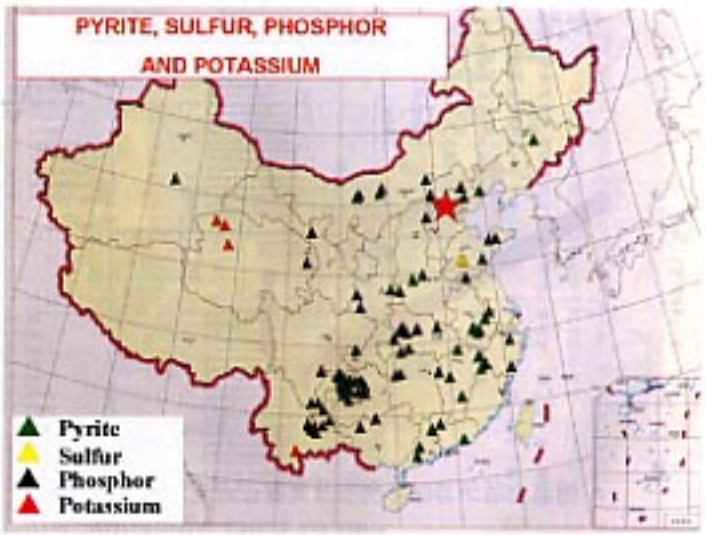


Figure 7

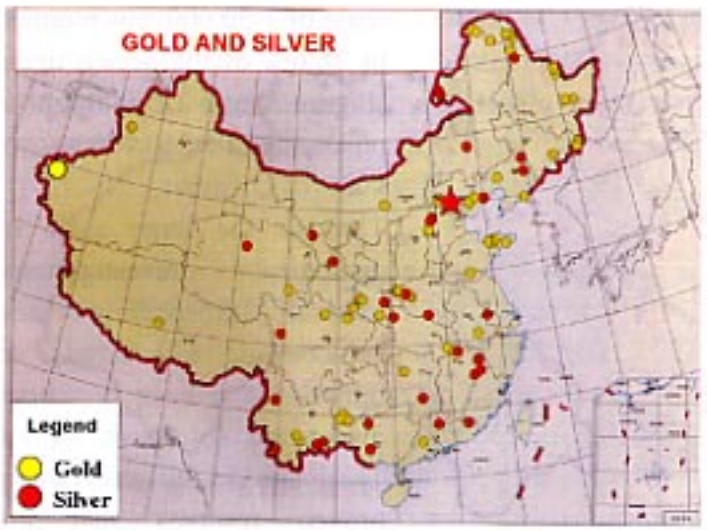


Figure 8

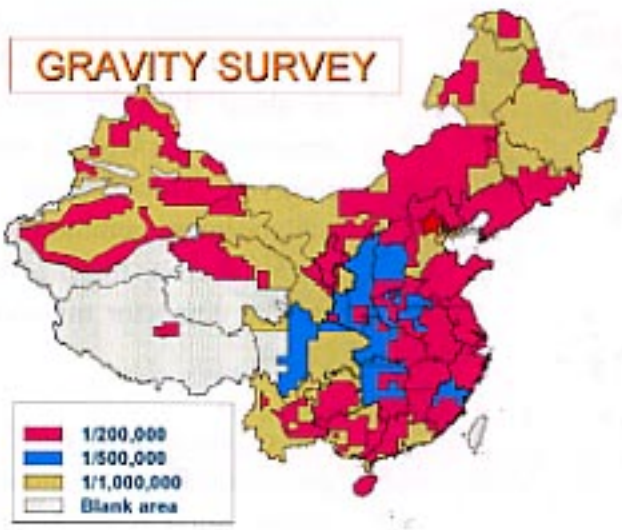


Figure 9

inland and 3 million km^2 on a scale of 1:200,000 have been completed (Figure 9). The only area not surveyed is in the Qinghai-Tibet Plateau; 1.5 million km^2 could be accessed for a gravity survey. A great breakthrough of geochemical exploration and analysis method had been made in the 1980's, and then large-scale regional geochemical exploration was carried out in China. This exploration on 4.6 million km^2 on a scale of 1:200,000 and 1.8 million km^2 on a scale of 1:500,000 have been completed (Figure 10), and a series of important achievements in mineral prospecting have been made. It is very important to the fields of agriculture and environmental protection. The airborne geophysical exploration covered 9.3 million km^2 onland and 2.3 million km^2 offshore. A total of 214,719 km lines covering 1.2 million km^2 were completed from 1998 to 2000 (Figure 11).

The first round investigations of the regional hydrogeology and groundwater resources, which cover 5,723,000 km^2 on a scale of 1:200,000, 1,852,700 km^2 on a scale of 500,000, and 2,001,900 km^2 on a scale of 1:1,000,000, have been completed in China (Figure 12). About 1.4 million km^2 of hydrogeological

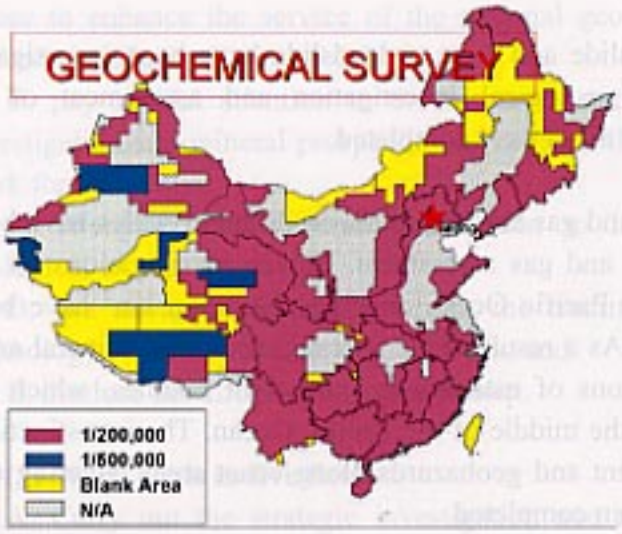


Figure 10

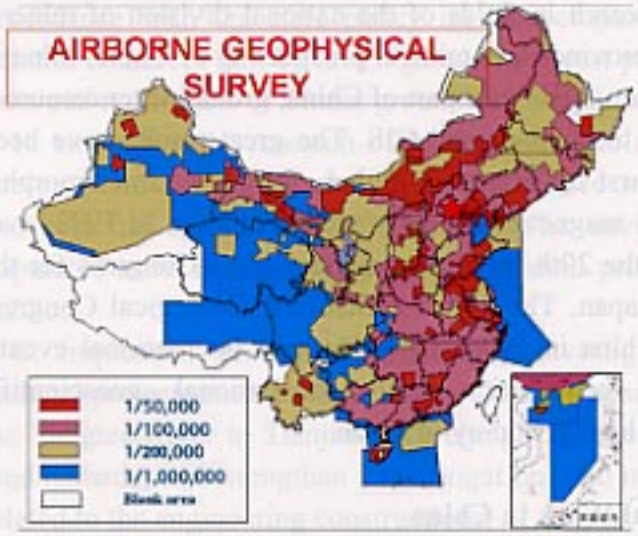


Figure 11

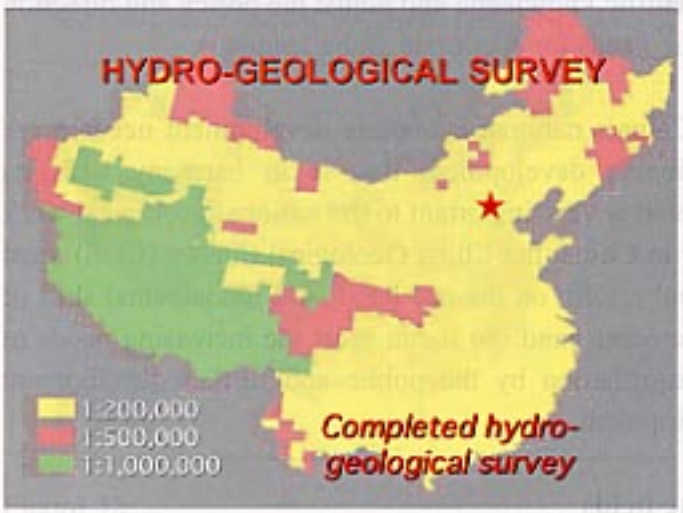


Figure 12

exploration for farmland irrigation on a scale of 1:100,000 have been planned in the northern 17 provinces. The dynamic monitoring system of the nation's groundwater has been set up. About 2,748 geothermal fields have been discovered, and 6.77 million km^2 of geothermal exploration was carried out. In addition, the mineral water investigation and assessment of mineral water sites have been done. More than 20,000 groundwater monitoring stations have been set up, 1,000 of them are operated by the central, provincial and local governments. Twenty-eight balance test sites of groundwater have been set up too.

In the economic development zones, the investigation of engineering geology on a scale of 1:200,000 or 1:500,000 has been conducted, and the long-range plan of engineering geology has been finished. The investigations of engineering geology and environmental geology on scales of 1:500,000 and 1:200,000 have been carried out in more than 100 cities along the Yangtze r, Yellow, Pear Rivers and coast areas. In addition, more than 200 typical dangerous geohazards, which include the Lian-Zi-ya

dangerous rock, Huang-la-shi landslide and Ji-pa-zi landslide have been investigated and secured. The environmental geological investigation and assessment of 18 important land-use and development areas were completed.

The 1,800,000 km^2 of offshore oil and gas investigations on different scales have been fulfilled, including the offshore oil and gas assessment. Eleven investigations on the equator, mid-and east-basins of the Pacific Ocean covering 2 million km^2 have been carried out by geophysical vessels. As a result of the investigations, two mineral areas over 300,000 km^2 with 2 billion tons of manganese and cobalt nodules, which are economic, have been delineated in the middle of the Pacific Ocean. The investigations of the marine geological environment and geohazards along coast areas covering 600 km^2 on a scale of 1:100,000 have been completed.

At the same time, the China Geological Survey pays great attention to the geoscientific research and has carried out the research in fields of the national division of mineral resources; the major minerogenetic province and mineral prospecting of China; mineral resources investigation and assessment in the west part of China; groundwater resources; environmental geology; exploration technology and GIS. The great results have been obtained in continental dynamics, karst environment, global change, ultrametamorphic belt, regional geochemistry, airborne magnetic, the early vital evolution. In 1992, over 300 Chinese geoscientists attended the 29th International Geological Congress for the first time that was held in Kyoto, Japan. The 30th International Geological Congress was successfully held in Beijing, China in 1996. Through these international events, China further strengthened the cooperation with international geoscientific organizations including with the Geological Survey of Japan.

3. Development Trend of Geological Work in China

Every geological survey organization in the world faces common issues on the method to make the public aware of geoscientific knowledge and adjust the policy and direction of geological work in terms of public needs for economic globalization.

Like other developing countries, China's national economic development needs more mineral resources. China's sustainable development that is in harmony with its population, resources and environment is very important to the national geological work. As the largest geoscientific agency in China, the China Geological Survey (CGS) must pay special attention to the structural reform on the one hand, and fundamental shift of the national geological work on the other hand. So it can meet the increasing needs of geoscientific knowledge and geoinformation by the public and further development based on economic and social development.

(1) Strategic adjustment in five fields

A. Solve the present and strategic issues from the substantial results and tactical

issues to enhance the service of the national geological work to the national micro decision-making;

B. pay special attention to the resources and environment from the geological investigation and mineral prospecting to enhance the service of the national geological work for the public;

C. strengthen international cooperation to increase the level of the national geological work;

D. use advanced technology from the traditional methodology to improve the technology of the national geological work; and

E. disclose geoinformation to the public..

(2) Work goals in five fields

A. Carry out the strategic investigation and assessment of mineral resources to ensure the nation's economic development. The exploration of petroleum, natural gas, copper, lead, zinc, chromite, and potash in the west part of China will be strengthened in accordance with the state policy on "Development of Western China". Alternative mineral resources will be investigated in the east part of China except old mines. In the west and north parts of China, groundwater exploration will be strengthened;

B. strengthen the research of fundamental geology, environmental geology, disaster geology, and agriculture geology in accordance with the strategic aim of the national and regional sustainable development. The environmental geology of the densely populated areas in the east part of China shall provide direct or indirect service to the public;

C. implement geological engineering investigations for the construction of key national projects such as Three Gorge Dam, Qinghai-Tibet railway, division works from the Yangtze River to Tianjin and Beijing, oil pipeline from Xinjiang to Shanghai, and land hazards; and strengthen investigations and monitoring of geological environment related to the engineering constructions;

Figure 13

D. adjust the traditional geological work, explore new ways that can provide geoscientific knowledge and information to the public, use new technology to refine and reprocess geological data and provide a series of geoscientific results and popular science products to the public; and

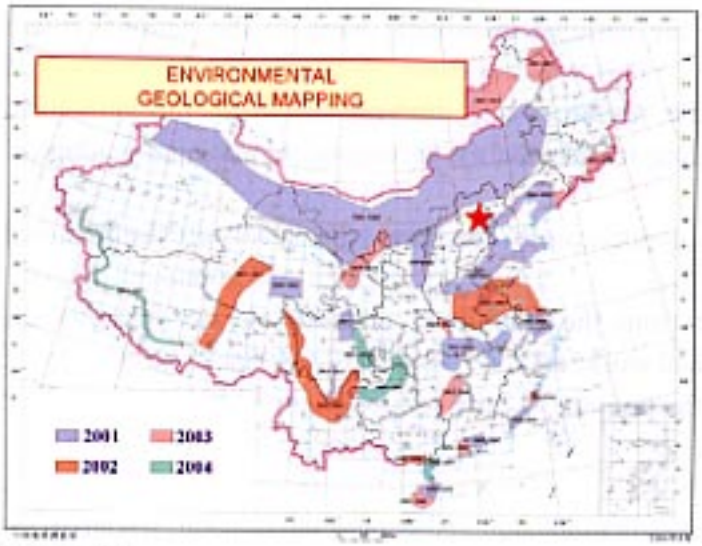


Figure 14

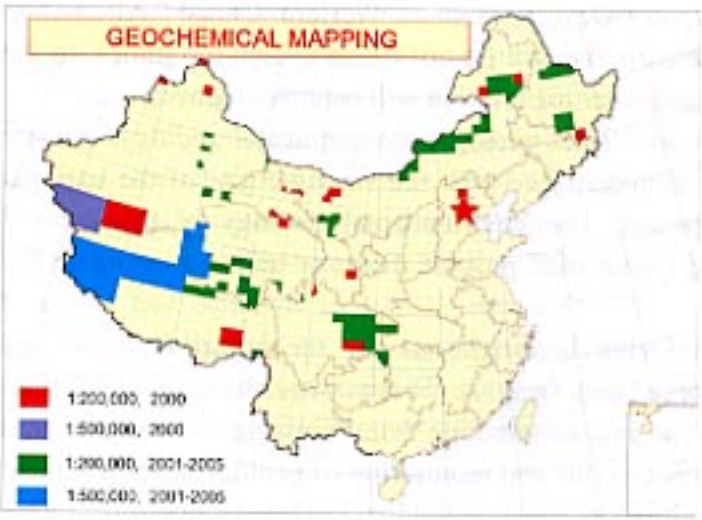


Figure 15

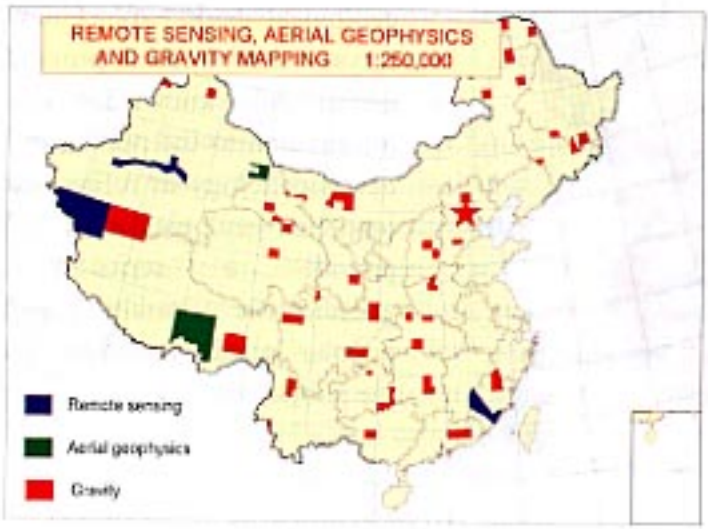


Figure 16

E. promote geoscientific research including research and development of geophysical and geochemical methods, remote sensing, GPS and GIS technology, and data processing and integration.

(3) Plan of national key projects

A. Complete the regional geological mapping on a scale of 1:250,000 in the Qinghai-Tibet Plateau from 2002 to 2005, and publish the first set of geological maps on a scale of 1:250,000 in 2008 (Figure 13);

B. execute the multi-purpose integrated geological and geochemical mapping into serve the agricultural, environment protection and engineering industries (Figures 14,15);

C. conduct strategic investigations and assessments of polymetallic copper deposits along the Yaluzangbu River in the south part of the Qinghai-Tibet Plateau; polymetallic copper deposits in the areas of the Lancangjiang Jinshajiang Nujiang Rivers of southwest China; copper and gold deposits in the Tianshan area of Xinjiang Province; and tin deposits in the Nanling area of southeast China (Figure 17);

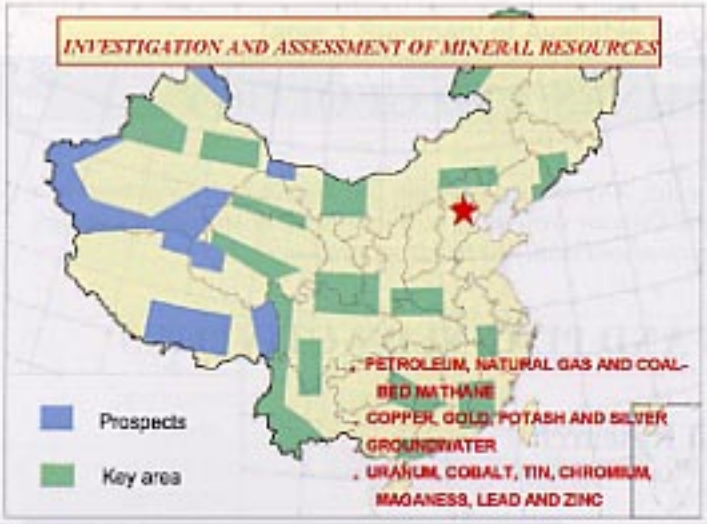


Figure 17

Figure 18

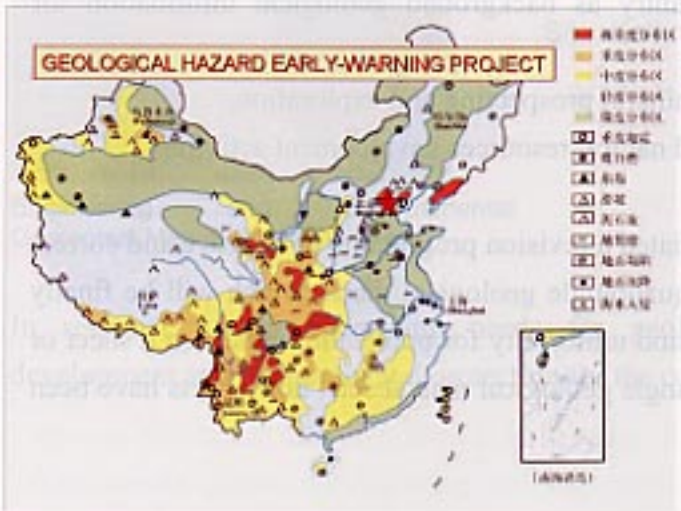


Figure 19

D. initiate the regional geological survey on a scale of 1:1,000,000 in the sea area of China;

E. carry out strategic exploration of marine gas hydrate;

F. implement monitoring and research of new tectonics movement, which can affect the national key project;

G. conduct the groundwater exploration in Erdos Basin;

H. complete the second round of groundwater assessment (Figure 18);

I. establish the monitoring network system of the national geological environment and geohazards (Figure 19);

J. finish the designing of the integrated system for GIS, GPS, remote sensing and data processing that is used for the geological data acquisition in the field, and put it into production;

K. set up the database and network system for fundamental geology of China; and

L. conclude the continental scientific drilling project in the ultra-high pressure metamorphic belt in Donghai, east part of China before 2005.

Nepal
DEPARTMENT OF MINES AND GEOLOGY

This article is from Chapter 3 of the booklet "Department of Mines and Geology: Achievements and Prospect (2000)", which Mr. N. R. Sthapit, Director General of the Department of Mines and Geology, kindly sent to the editor, with a few corrections and additions by his instruction.

ACHIEVEMENTS AND PLANNED ACTIVITIES

1. Geo-scientific Studies and Research

1.1 Geological Mapping

Terrace Deposit, Pokhara

Although the geological study on the Nepal Himalayas was first carried out in 1854 by Hooker, the geology of the Kingdom of Nepal remained unknown until 1950. Between 1951 and 1967, extensive geological mapping was carried out under the International Technical Assistance Program and by individuals. However, the coverage of the country by systematic geological mapping was only initiated by the Nepal Geological Survey after 1967. A total of 147,181 sq.km. of the country and various areas have been covered by geological mapping at different scales. The coverage status of geological maps available for the whole or part of the country is presented in Table 1. The maps were prepared to address the regional geology and tectonics of the country as background geological information for applications in:

I. identification of targets for mineral prospecting and exploration,
II. planning of infrastructure and natural resources development activities.

From 1995, the department has initiated a revision programme to improve and correct discrepancies in existing original quadrangle geological maps, which will be finally upgraded to an approved standard and uniformity for publication either on a sheet or compiled form. Among 162 quadrangle geological map sheets, nine sheets have been revised and published.

Table 1 Summary of Available Geological Maps

S. No	Title	Scale	Coverage Sq. km.	Status	Year	Remarks
1.	Geological Map of Nepal	1:500,000 to 1:1,000,000	Whole Country	Published and unpublished	1962, 1972, 1981, 1982, 1993 &1994	Maps are available in black &white and color prints
2.	Geological Map of Development Regions	1:250,000	75,000	Published	1984 & 1987	Maps are available for 5 sheets in color
3.	Quadrangle Geological Map	1:63,360 & 1:50,000	105,000	Published and unpublished	1996 & 1999 2000 2002	Among 162 sheets, 11 sheets are published in color

1.2 Engineering and Environmental Geology

Engineering and Environmental Geological Map of Pokhara Valley

Barrier Potential Map for Waste Disposal Site, Kathmandu Valley

In response to the increasing needs for geological inputs in infrastructure development and environmental protection for the country, the DMG established the

Table 2 List of Published and Unpublished Engineering and Environmental Geological Map of a Scale 1:50,000

S. No.	Title	Year	Remarks
1	Engineering and Environmental Geological Map of Kathmandu Valley	1999	Published
2	Engineering and Environmental Geological Map of Pokhara Valley	1999	Published
3	Landslide Hazard Zonation Map of Phewa Lake Catchment Area	1998	Computer print
4	Potential Areas for Waste Disposal in the Kathmandu Valley	1998	Computer print
5	Barrier Potential Map of the soil of the Kathmandu Valley	1998	Computer print
6	Barrier Potential Map of Sediments in the Kathmandu Valley at Depth of 0-7m	1998	Computer print
7	Barrier Potential Map of Sediments in the Kathmandu Valley At Depth of 0-50m	1998	Computer print
8	Environmental Geological Map of Kathmandu Valley	1998	Computer print
9	Environmental Geological Map of Pokhara Valley	1998	Computer print
10	Engineering and Environmental Geological Map of Butwal Area, Scale 1:25,000	2000	Computer print
11	Engineering and Environmental Geological Map of Dharan Area, Scale 1:25,000	2001	Computer print

Engineering and Environmental Geology Section in 1993. The new section was charged with carrying out related geological studies effectively. In cooperation with the Federal Institute for Geosciences and Natural Resources (BGR), Germany, the newly created section initiated its activities with the production of engineering and environmental geological maps of two rapidly growing urban areas, of the Kathmandu and Pokhara valleys using RS/GIS techniques. The purpose of such mapping works was to provide geo-scientific information to planners, engineers, decision-makers and other users.

The DMG has objectives to prepare similar maps for other fast growing urban areas requiring geo-scientific information for urban planning and environmental protection. Such mapping is in progress and also planned for the Lumbini-Butwal, Dharan-Biratnagar and Dang valleys. The published and unpublished engineering and environmental geological maps presently available are presented in Table 2.

1.3 Seismological Research

The National Seismological Network started in November 1978 as a single seismic station established on the Pulchocki hill-top, which is situated on the southern border of the Kathmandu valley. Today it consists of 21 short period telemetric seismic stations covering the entire country. As in other parts of the world, the seismic

Table 3 List of Published Seismic Maps and Poster

S. No	Title	Scale	Year Remarks
1	Microseismic Map of Nepal Himalaya and Adjoining Region (March 1944- December 1966)	1:2,000,000	1996
2	Epicentre Map of Nepal Himalaya (March 1994-December 1977)	1:1,000,000	1998
3	The National Seismic Network of Nepal (Poster)		1999
4	Seismic Hazard Map of Nepal	1:1.500.000	2002

A Seismic Station in Taplejung

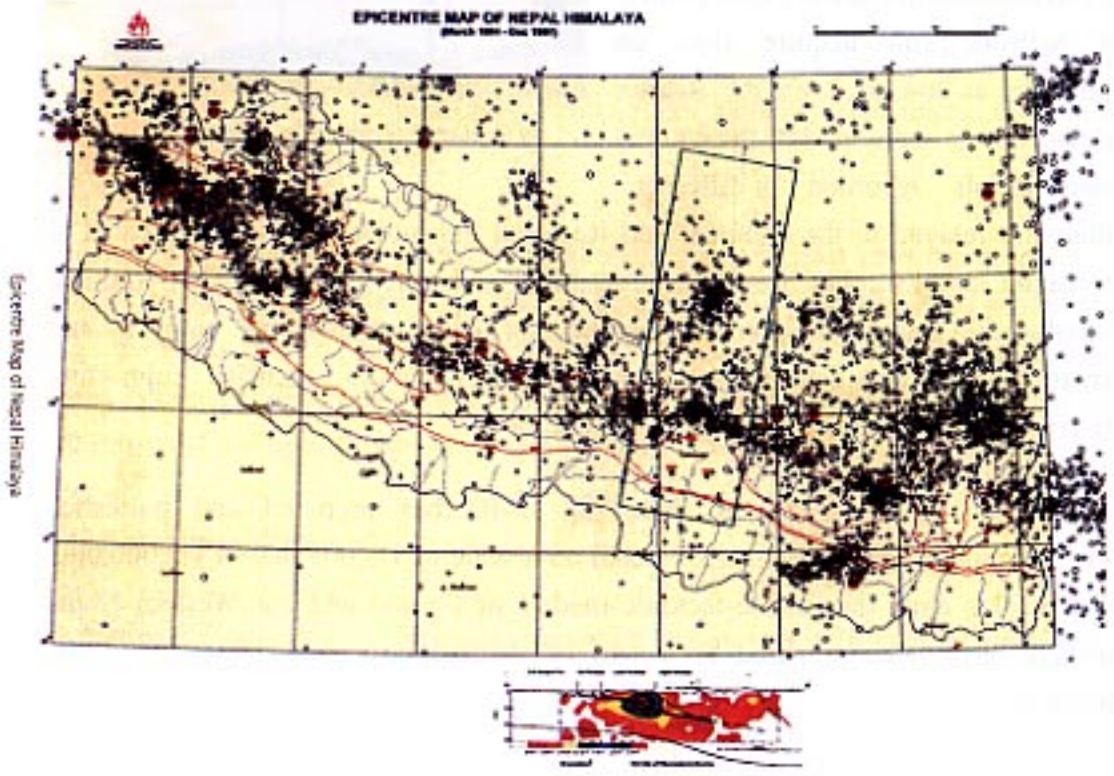
stations have been installed with the objectives of monitoring and evaluating seismic activity to better understand the causes and effects of earthquakes and ultimately to be able to mitigate the associated destruction. The National Seismological Network was established in collaboration with the Laboratory de Geophysique Applique (LGA) and presently is working in collaboration with the Department Analyse, Surveillance and Environment (DASE), Paris, France. The network can acquire data on magnitudes as low as 2 on the Richter Scale occurring in any part of the country. Seismic signals recorded at different stations are relayed to the National and Regional Seismological Centres located at Kathmandu and Surkhet for data processing and interpretation. The National Seismological Centre disseminates earthquake data to different national and international agencies. It also makes data available to agencies supporting infrastructure development activities in the country.

Based on the micro-seismicity data, the DMG has prepared and published Micro-Seismicity Epicentre maps of Nepal on a scale of 1:1,000,000 to 1:2,000,000. Based on this data, the seismo-tectonic models of Central and Far Western Nepal Himalaya have been prepared as a part of the seismo-tectonic research in the Himalaya.

In the present context of the country, the instrumentally recorded earthquake data are

National Seismological Network

very important for the assessment of earthquake hazards and disaster mitigation. Data are equally significant for planners and engineers who need to take remedial measures in designing earthquake resistant infrastructures such as dams, bridges, buildings and power transmission lines.



Epicentre Map of Nepal Himalaya

Seismic Hazard Map of Nepal

2. Mineral Exploration and Development

2.1 Metallic Minerals

Systematic prospecting and exploration activities have been carried out for different metallic minerals including gold, copper, lead, zinc, iron, nickel, cobalt, molybdenum and uranium since the sixties. Such exploration activities with the reconnaissance geochemical survey and investigation of base metals undertaken with the assistance of United Nation Development Programme from 1975 to 1980 and subsequent similar works carried out by DMG could be considered as the major activities in the mineral exploration programme in Nepal. The activities covered the Lesser Himalayan region. As a result, some economic and sub-economic deposits of lead, zinc, copper and iron were discovered.

The activity status and development stage of identified mineral resources, production and revenue are presented in Tables 4, 6 and 7. The mining history of metallic

Ganesh Himal Lead and Zinc Mine
at 4110 m altitude

Primary Gold Bearing Carbonate Rock,
Rolpha

minerals indicates that metals like gold, copper, lead, nickel, iron and cobalt were mined albeit at a small scale. Among these commodities, copper, iron, nickel and cobalt were even exported to Tibet and India as recently as 1950.

Today the metal mining activity in Nepal has declined for all metals with the exception of artisanal mining of gold placers.

However, the Department of Mines and Geology is continuously making efforts to generate new mining activities for metals like gold, copper, lead and zinc. As a result, the Nepal Metal Company, a joint venture project was established in 1975 to mine and mill 400 tons of ore per day, which is based on lead and zinc deposit located at Ganesh Himal. The deposit contains 0.85 million tons of ore at 12.08-13.6% of zinc and 1.4-2.3 % of lead. The deposit is not currently commercially viable due to the inadequate proven reserves. There is a great potential to augment substantial tonnages of new ore reserves by supplementary exploration activity which is presently hindered by the unavailability of funds.

The potential of finding primary gold resources in Nepal is quite high. Identification of gold mineralisations in bedrock exposures in Western and Far Western Nepal considerably supports this perception. However, the systematic exploration for an economic gold resource has not been performed due to lack of appropriate expertise and funds.

Table 4 Commercially Important Mineral Deposits Available for Investment

S.No.	Name and Location	Proven Resources (million tons)	Average Grade (%)	Infrastructure	Development status
1	Kharidhunga Magnesite Deposit, Sindhupalchok district	32.00 180.00 (probable)	High grade refractory	33 KVA power supply and black topped road passes through the deposit	Nepal Orind Magnesite (P) Ltd. was established in 1979 to produce 50,000 tons of dead burnt magnesite per annum. Trial production in 1987 as well as subsequent plant improvement works were not successful
2	Phulchoki Iron Deposit, Kathmandu district	4.00-6.80 (probable and possible)	55.75	Gravel road intersect the deposit and 33 KVA transmission line is 8 km away	Establishment of 50,000 tpa capacity iron and steel plant was indicated technically feasible. A pre-feasibility study to make sponge iron revealed marginal feasibility for 150,000 tons capacity plant.
3	Ganesh Himal Zinc and Lead Deposit, Rasuwa district	0.7 0.15	Zn-13.6 Pb-2.3 Zn-12.08 Pb-1.4	Gravel road exists up to Somdang and 11 KVA line is up to Dhunche.	Nepal Metal Company Ltd. was established in 1975 to mine and mill 400 tpd ore. Proven reserve is inadequate for commercialization. Exploration works are carried out to prove more reserve.
4	Chaukune Limestone Deposit, Surkhet district	31.6	CaO-47.9 MgO-2.3	Located at 159km and 52 km respectively from the Kohalpur and Chisapani on East West Highway and 132 KVA national grid	Negotiation is underway with a private investor for the establishment of a cement industry of 1000 tpd capacity.
5	Narapani Limestone Deposit, Argakhanchhi district	17.44	CaO-47.5 MgO-3.15	Situated at 49km from the East -West Highway and 132 KVA national grid.	The deposit has been granted to the private investor toinstall a cement Industry of 800 tpd. capacity
6	Gandari Limestone Deposit, Dang district	10.00	CaO-47.0 MgO-1.5	Situated at 50 km from the 132 KVA national grid and East-West highway	Exploration suspended after completion of about 900m drilling activities.
7	Nigale Limestone Deposit, Dhankuta district	10.00	CaO-51.78 MgO-1.02	Lies at 13 km away from the gravel road and 30 km from 33 KVA power transmission line.	Feasibility study to establish cement and other mineral based industries is being carried out through NIDC under SAARC programme
8	Salandu Limestone Deposit, Dhading district	4.31	CaO-47.81 MgO-0.91	It is situated at a few km away from the road and power transmission line	The area has been leased for exploration.
9	Katari-Galtar Limestone Deposit, Udaypur district	18.74	CaO-52.29 MgO-1.29	The deposit is located at a few km away from the road and power transmission line	The area is under mining lease.
10	Udaipur Dolomite, Udaipur district	4.8	CaO-31.9 MgO-18.3	Surface road and rope line systems and 33 KVA power supply reach to the deposit	The reserve is open for mining and development.
11	Kajeri Limestone Deposit, Sallyan district	20.00	CaO-52.1 MgO-1.92	Gravel road exists at 8 km from the deposit	The deposit will be offered to private sector for establisment of a cement plant in near future.

Table 5 Existing Mineral Based Industries

S.No	Name and Location of Deposit	Proven Reserve (million tons)	Industries	Capacity (tpd)	Establishment year
1	Beldanda Limestone Deposit	2.21	Annapurna Quarry (P) Ltd	30	1985
2	Bhainse (Padrang) Limestone Deposit	1.50	Lime Industries (P) Ltd.	150	1974
3	Bhainse Limestone Deposit	10.00	Hetauda Cement Industries Ltd.	750	1986
4	Chobhar Limestone Deposit	14.50	Himal Cement Company Ltd.	400	1976
5	Jogimara Limestone Deposit	0.95 3.61(probable)	Agriculture Lime Industries Ltd.	18000 * 2500*	1977 1980
6	Kakaru khola Limestone Deposit	1.00	Maruti Cement Industries	50	1990
7	Okhare Limestone Deposit	10.00	Hetauda Cement Industries	750	1986
8	Sindali Limestone Deposit	72.00	Udaipur Cement Industries Ltd.	800	1993
9	Godavari Marble Deposit	1.00	Godavari Marble Industries (P) Ltd.	800 cu.m (blocks) and 30,000 cu.m slabs	1976
10	Kharidhunga Talc Deposit	0.30	Nepal Orind Magnesite Ltd.	10,000 *	1982

Note : tpa (Ton per annum) - *

Table 6 Major Minerals Production and Revenue from 1990 to 2000

Sr. No.	Minerals	Unit	1990-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-2000	00-01
1	Copper Metal	Mt	3.5	2	2.33	NA	NA	NA	NA	NA	NA	NA	NA
	Copper Ore	Mt	21	12	23	NA	NA	NA	NA	NA	NA	NA	NA
2	Clay	mt	8850	15403	8950	10126.5	8224.86	10000	5129.35	4663	3119	4600	NA
3	Flag Stone	sq.m	Na	15747	20000		-	-	-	-	-	-	
4	Stone Boulders	m3	Na	77916.5	6000	NA	-	-	-	-	-	NA	NA
5	Sand	m3	-	35163	71655.8	NA	-	-	-	-	-	NA	NA
6	Lime Stone (Chem. Grade)	mt	19700	19700	25820	14514	14004	13000	NA	NA	9400	19360	15587
7	Lime Stone (Cem. Grade)	mt	221920	368175	296269	417788	411942	488883	368666.0	484153.8	401700	352060	287810
8	Marble aggt.	cu.m.	31948	40264	49529	35588.7	34778.7	40040.3	NA	34966.34	37283	39400	41211
9	Marble Chips	kg	1036150	567100	292360	393.7	308.2	548290	635950	0.61288	660.16	654.82	5997
10	Marble Craggy	Sq.m.	6464	6429	2940	2844.9	1413.6	2690.3	58095.68	267.4	2092	1530	1333
11	Marble Raw Stone	cu.m.	25230	25202	17757	NA	-	22499.8	3708.94	965	NA	NA	NA
12	Marble Slab		24749	20368	27948	16196.9	33245	688841.1	950766.9	65622.47	70475	79700	54834
13	Magnesite	mt	-	-	-	-	-	-	19.8	4861.56	-	1640	
14	Quartz Crystal	kg	1062	6000	5000	2204	1864	1500	3000	2000	3200		I.Q. 123mt G.Q. 1130Kg
15	Salt	mt	7.3	6.5	6.6	6	6.5	6.5	6.55	6	1.01	1.525	5
16	Tourmaline	I.Q./ kg.	4	-	0.25	NA	2.05	2	500	20	10		
		G.Q./ kg.	0.5	0.1	0.05	NA	-	0.95	-	0.5	0.5	1	
17	Talc	mt.	3170	2817	1343	1363	2363	5323.2	6809	5552.56	6157	5852	3923
18	Coal	mt	200	1900	1187	1904.1	5847.92	5979.22	8163.49	15770	10594	17530	16589
19	Lignite	mt	10150	14080	3908	290	200	744	785	350	312	52	
20	Gas	cu.m.	116690	N.A.	N.A.	45493.6	1436.55	530	-	-	-		
21	Kyanite												I.Q. 1.0 mt G.Q. 100 Kg
	Revenue	Rs.	173420	907605.8	257850	287426	248723	1087982	769400.4	909284.5	848918	3131267.6	4187685

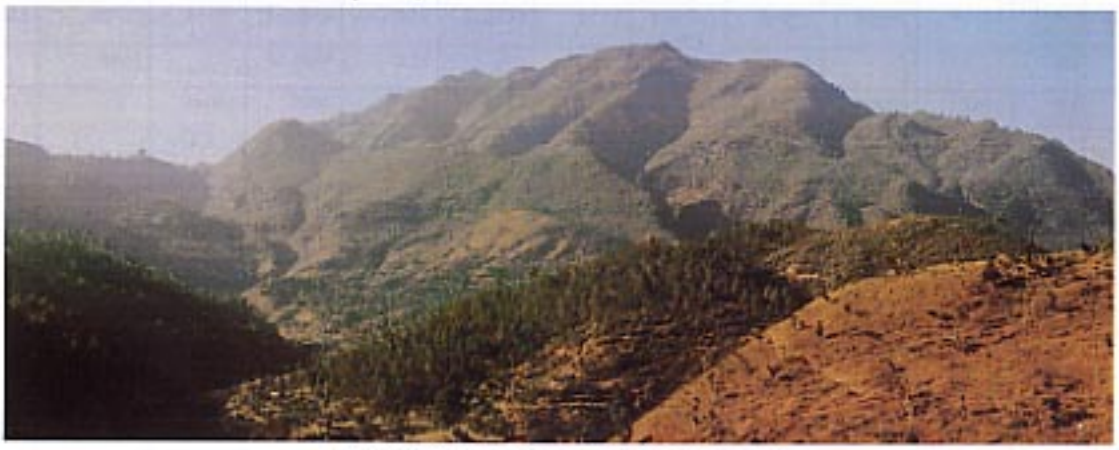
Note-- IQ - Industrial Quality, GQ - Gem Quality

2.2 Nonmetallic Minerals

The Department of Mines and Geology conducted exploration for nonmetallic minerals such as limestone, marble, dolomite, talc, magnesite, ruby, sapphire, polychrome tourmaline, aquamarine, garnet, quartz and slate since 1965. From the exploration, commercially viable resources of cement and chemical grade limestone, marble, dolomite, talc, and magnesite are known today. The exploration activities also revealed the existence of ruby, sapphire, aquamarine, tourmaline and quartz of gem and industrial quality.

Chaukune Limestone Deposit, Surkhet

Narapani Limestone Deposit, Arghakhanchi



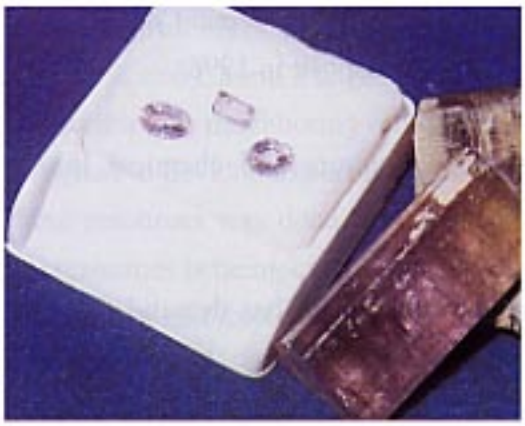
Kajeri Limestone Deposit, Sallayan

Three Cement Companies currently in production, namely (i) Himal Cement Company Ltd. with a 400/tpd capacity (ii) Hetauda Cement Industries Ltd. with a 750/tpd capacity and (iii) Udaipur Cement Industries with an 800/tpd capacity are based on limestone deposits containing a total reserve of 104.5 million tons. A few mini-cement plants are also contributing a small amount to the total cement demand. The cement industries of Nepal meet 40% of the present domestic consumption. Therefore, there is a great potential for the establishment of more cement companies

in Nepal.

Limestone Quarry, Himal Cement Industry

Gem Quality Ruby, Chumar, Dhading

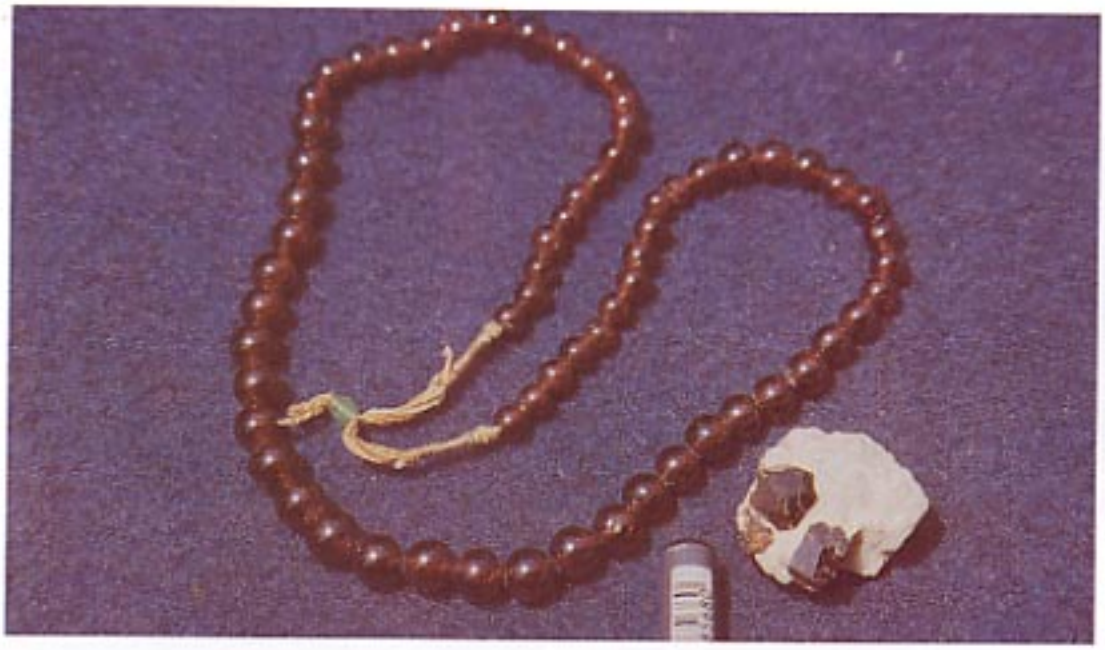


Gem Tourmaline, Sankhuwasabha

Marble Quarry, Godavari

Gem Aquamarine, Taplejung

Recently, the Department has awarded licenses and negotiations are underway for feasibility studies and establishment of cement companies based on 31.6 million tons of reserve at the Chaukune limestone deposit, Surkhet and 17.44 million tons of reserve at the Narapani limestone deposit, Arghakhanchi. One more cement grade limestone deposit was identified recently at Sallyan and is also



Garnet Crystal and Bead, Sankhuwasabha

in the process of advertising for a feasibility study to establish a cement operation. Surface and subsurface exploration was completed on this deposit in 1998.

A few other limestone deposits also support the agriculture and chemical lime industries.

The Godavari marble deposit is producing marble slabs, which has demand that is appreciably large in the local market and abroad. Similarly, one talc company produces 10,000 tons of powder talc annually from the 0.3 million ton deposit at Kharidhunga. The country needs continued exploration activities for commodities like limestone, marble, dolomite, talc and magnesite. The potential areas of non-metallic minerals have not been completely examined to establish the resources available in the country. It is likely to discover some new resources of economic importance. Gem quality ruby, sapphire, aquamarine and tourmaline have not been satisfactorily explored in the past even though the geological condition is favorable to find commercially significant resources. These particlular commodities require a detail examination of potential areas.

The development and production status of some important resources identified during exploration are shown in Tables 4 and 5.

2.3 Construction Minerals

Limestone, dolomite, marble, quartzite, granite, syenite, slate, boulder, gravel, sand and clay occur extensively and are the main construction materials in the country. They are produced on different scales to mainly fulfill domestic demand and for exports to India.

Impure limestones and dolomites of chemically inferior quality but having high strength constitute important construction materials in the country. Such resources are found extensively distributed throughout the Mahabharat Range and have potentiality for future quarry development. Their importance will be secondary to the boulder and gravel resources of the country. Granite and quartzites resources of similar geographical distribution have also equal importance for the production of the construction aggregates and block stones.

Abundant resources of boulder, gravel and sand are widely found in the rivers of Terai belt and Churia Range. In many rivers, boulders are potentially productive and exportable to neighboring countries. No conceptual frameworks have yet been designed to develop export markets based on such resources. The initial evaluation of these resources was done for all the rivers during the eighties. The re-evaluation of the resources is being carried out to establish the actual reserve due to changes caused by flooding and the removal of these materials for construction purposes in the past.

2.4 Petroleum Exploration

Petroleum is categorized as the national priority commodity for exploration and development. The Petroleum Exploration Promotion Project (PEPP) constituted under the Department of Mines and Geology in 1982, functions specifically to promote petroleum exploration and development activities in the country. The southern Terai plains and adjoining Siwalik Range have been divided into ten different blocks, each of nearly 5000sq.km, for the petroleum exploration and development.

Composite data packages for the individual blocks are available to potential investors at a fixed cost on the fulfillment of the prescribed rules and regulations. The Data Sales Packages (DSP) can be purchased at the Data Center at Kathmandu. Photo-geological, aeromagnetic, gravity and seismic interpretations, general reports,

or borehole logs are contained in these packages. A prospective investor must purchase a DSP-A at a cost of US$ 5000 to be eligible to bid on the acreage.

Petroleum Exploration Blocks in Nepal

His Majesty's Government realizes that the participation of a potential investor, national or foreign, is essential to the exploration and development of petroleum in Nepal. In April 1985 the Department of Mines and Geology initiated a global bidding process to attract potential companies to explore and develop petroleum in ten exploration blocks.

The Shell Company from the Netherlands conducted exploration work in block no.10 situated in eastern Nepal after winning in the first auction held in 1985. One drill hole was drilled down to a depth of 3,520 m after the evaluation of seismic and other surface data during 1986-90. It was a dry hole. However, the data derived from the hole was utilized to update the information.

In December 1998, after the fulfillment of the evaluation, negotiation and agreement process outlined for global bidding, His Majesty's Government awarded the right to carry out the seismic and geological studies in block nos.3 (Nepaljung) and 5 (Chitwan) to the Texana Resources Company of USA. Presently, the Company has

initiated the activities defined in the agreement. The other blocks remain open to potential investors for exploration bidding.

Drilling for Petroleum Exploration in Block No. 10, East Nepal

Model Gas Storage Tank, Kathmandu

2.5 Natural Gas Exploration

Natural gas associated with groundwater exists in the lake sediment of the Kathmandu valley. The Department of Mines and Geology initiated drilling activities for these methane gas resources in 1978. The purpose was to assess the reserves and possibility for utilization as an alternative energy. Initial drilling operations were carried out with the assistance of Japanese International Co-operation Agency (JICA). Subsequently, DMG performed further exploration activities independently. From these activities, the presence of 300 million cubic meter of methane gas was proved over an area of 26 sq. km. The feasibility study was conducted in 1996/97 by a private consultant. The study concludes that the use of methane gas is viable for both domestic and industrial purposes.

Based on the above results, the DMG invited potential investors to bid for the development and commercialization of the gas resources for the benefit of society. The department has received proposals that are being evaluated.

2.6 Coal Exploration

Existence of peat, lignite and coal are known in different parts of the country. Among various occurrences examined in the past, the coal seams identified in the Dang Valley and surrounding area seem to be the most significant for utilization as an alternative fuel in the country, though the resource is very small. Other economic coal deposits in favourable formations are yet to be explored.

A Coal Mine in Dang

Table 7 Yearly Cumulative Revenue from Mineral Production (From 1988/89 to 1997/98)

Year	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98
Revenue in Rs. thousands	41.953	58.057	137.42	907.605	257.805	287.426	248.723	1,087.982	769.400	909.284

Pakistan
GEOLOGICAL SURVEY OF PAKISTAN

This article was submitted by Mr. S. Hasan Gauhar, Director General, Geological Survey of Pakistan, in September 2002.

REORGANIZING THE GEOLOGICAL SURVEY OF PAKISTAN

S. Hasan Gauhar
Geological Survey of Pakistan

The National Geological Survey Organizations (NGSOs) are among the oldest governmental research organizations in most countries of the world. They originated because the governments realized that they need geological information both to govern effectively and spur development of economies based on natural resources. Therefore, their evolution which started with the establishment of the British Geological Survey in 1835, is generally reflective of the history of scientific thought and state policies for national development adopted by different countries in the territories under their jurisdiction and control. This evolution has progressed from the classic frontier exploration phase to the gradual development of an information base for use in environmentally sustainable exploration and development of natural resources. These resources include, but are not confined to minerals, fuels and water. Land has also now become a precious resource.

With the advent of the 21st century, there has been a growing realization on a global scale of keeping a balance between the exploitation of natural resources and a sustained working of the earth's eco-system as an "organic" entity. Consequently, most of the NGSOs have now an increasing thrust towards environment-related activities in addition to their traditional role of a resource agency. This is being done by collecting, synthesizing and disseminating geoscience information through inter and multi-disciplinary research involving a large array of field and laboratory studies. In short, a modern National Geological Survey acts as a knowledge-based organization and is the major provider of geoscience information according to the changing needs of society. Like the other NGSOs, the Geological Survey of Pakistan (GSP) is also now in the reorganization phase to make it able to perform geoscience activities according to the short-and long-term national priorities. The immediate major thrust will be on the provision of information needed for increasing investment in exploring and developing mineral and other natural resources without adversely affecting the fragile environmental equilibrium.

Mission

Under the new organizational plan, the GSP has been assigned the mission to develop, interpret and provide geoscientific information about the country in all pertinent details leading to the prudent and environmentally sustainable management of its natural

resources thus contributing to the security and prosperity of the people of Pakistan.

Charter

As the nation's premier earth-science research agency, the GSP is now chartered to study the geology of the country in increasing greater details by undertaking multi-disciplinary research involving:

1. geological mapping and other geoscientific surveys;
2. appraisal and assessment of mineral, energy, land, and water resources; and
3. geohazards and environmental baseline studies.

Within the broader framework of this charter and to re-activate the mineral sector in the country, the GSP is entrusted with the priority task of:

a) making an inventory of the know mineral deposits of the country and to assess their quality and quantity; and
b) to conduct intensive research for new mineral deposits and other natural resources.

The results of the GSP's scientific pursuits and multi-disciplinary research are supplied in several forms such as reports, maps, and digitized data bases providing descriptions and analyses of mineral, energy, and water resources; the land surface; the underlying geological structures; and the dynamic processes of the earth operating within the territory of Pakistan. This in turn will lead to sustainable resource development; natural hazards' monitoring, prediction and mitigation; environmental protection and conservation; public safety, security and health; and balanced socio-economic growth along with scientific and technological progress.

Organizational Structure

The geological Survey of Pakistan has the unique honour of being the only research organization which came into being with the creation of Pakistan on August 14, 1947. It now functions as a department in the Federal Ministry of Petroleum and Natural Resources. It has its headquarters at Quetta and regional offices in the provincial capitals. The regional offices are responsible for systematic geological mapping in their respective areas and to keep active liaison with the provincial and local governments for their geoscience information needs and requirements. Advance research facilities and technical support services are primarily located at Quetta and Islamabad. Fig.1 shows the new organizational structure of GSP along with the facilities planned for addition in the near future.

At present GSP has 270 scientists including 150 geologists and a supporting technical and administrative staff of 850. In the next few years, number of the scientists is expected to increase to 300 while the number of the supporting staff will be reduced to 600. This is a better ratio of scientists and staff coupled with fast track computerization are likely to result in enhanced output and still better performance of the department.

Activities and Plans

With an area of about 800,000 sq. km. of which nearly 60 percent is composed of hilly and mountainous terrain, the GSP has achieved commendable progress for geological mapping in Pakistan. The entire outcrop region has been mapped on 1:1,000,000 and 1:250,000 scales. In addition, about half of the outcrop region has been mapped on a 1:50,000 scale. Under the reorganization plan, the entire outcrop region of the country will be mapped on a 1:50,000 scale by 2010. Environmental and Quaternary geological map on a 1:50,000 scale are also being prepared for major cities and sites of heavy construction and/or industrial and infrastructure development. Similarly, District Geological Maps are being produced to help local/provincial Governments in undertaking integrated and environmentally sound development in their respective regions.

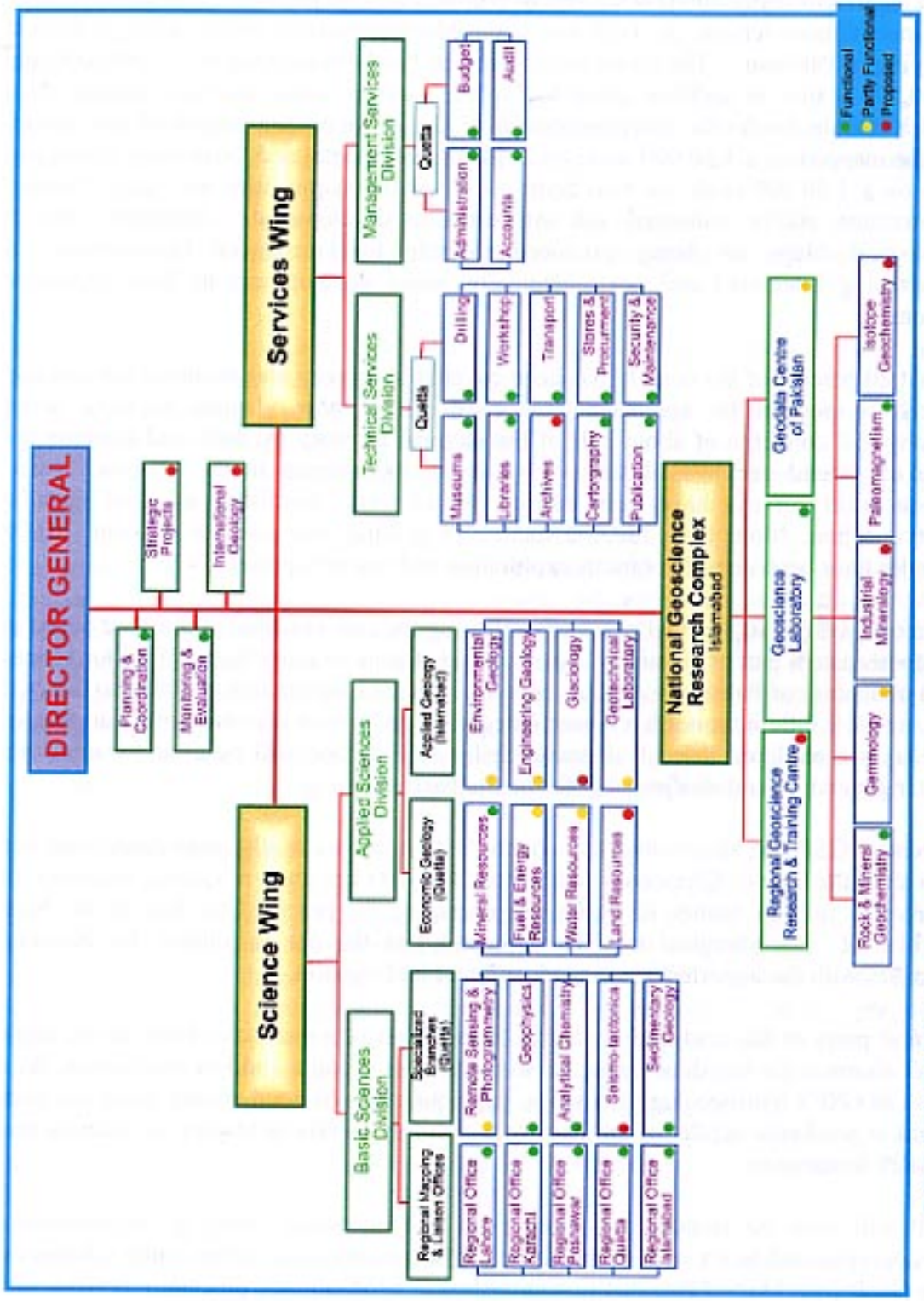
About 20 percent of the country has been covered by gravity and magnetic surveys and nearly 10 percent by aeromagnetic survey. It is now planned to have aerial geophysical converge of about half of the national territory by 2005 and increase the pace of ground geophysical surveys by about 300 percent in the next two years. Geochemical surveys have been carried out in some promising areas of metallic mineralization. More than 150,000 meters of drilling and analysis of over 70,000 samples have been done for various exploration and research projects.

Currently, GSP is in the final phase of evaluating the coal potential in the Thar desert in the southeastern part of country. A resources potential of more than 175 billion tonnes of lignitic coal of Paleocene age has been established over an area of 9,000 sq. km. Of this, about 9 billion tonnes have been categorized as proven reserves within an area of 300 sq. km explored through intensive drilling. This coal will be used for mine-site power generation and also possibly for in-situ gasification.

Recently, GSP has discovered the country's first economically exploitable iron ore deposit at the base of Cretaceous sediments about 100 km south of Quetta. Existence of about 200 million tonnes of oxide ore averaging 35 percent iron has so far been established. Metallurgical tests have proved that the ore is suitable for blending purposes with the imported ore to produce sinter and pig iron.

Several parts of the arid and semi-arid Balochistan province have been facing acute water shortage for last three years due to continuous drought and low precipation. As a result of GSP's hydrogeological studies, large quantities of good quality water has been found at workable depths in the hard rock aquifers mostly belonging to Jurassic and Tertiary limestones.

GSP will soon be launching in both print and electronic forms a comprehensive Bibliography and Index of the Geology of Pakistan containing about 8,000 references. The Geological Map of Pakistan first published in 1964 is in the process of revision and updating. Its new version is expected to be published by March, 2003. This will be followed by the publication of other thematic maps at the same scale such as the Tectonic, Seismotectonic, Metallogenic, Mineral Resources and Hydrogeological Maps of Pakistan.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Palaeomagnetism
Industrial Mineralogy
Gemmology
Rock & Mineral Geochemistry
Functional
Partly Functional
Proposed
ORGANIZATIONAL STRUCTURE OF GEOLOGICAL SURVEY OF PAKISTAN

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GSP Website: **www.gsp.gov.pk**

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Magnetic survey of Lahore-Kasur-Okara-Bahawalnagar-Faisalabad and Sheikhupura districts, Punjab, Saleem Javed, Rashid Pervaiz; I.R.No.723.

Status and application of various techniques for gold analysis, Heshamul Haque, Hyder Kamal and Ghulam Muhammed; I.R.No.725.

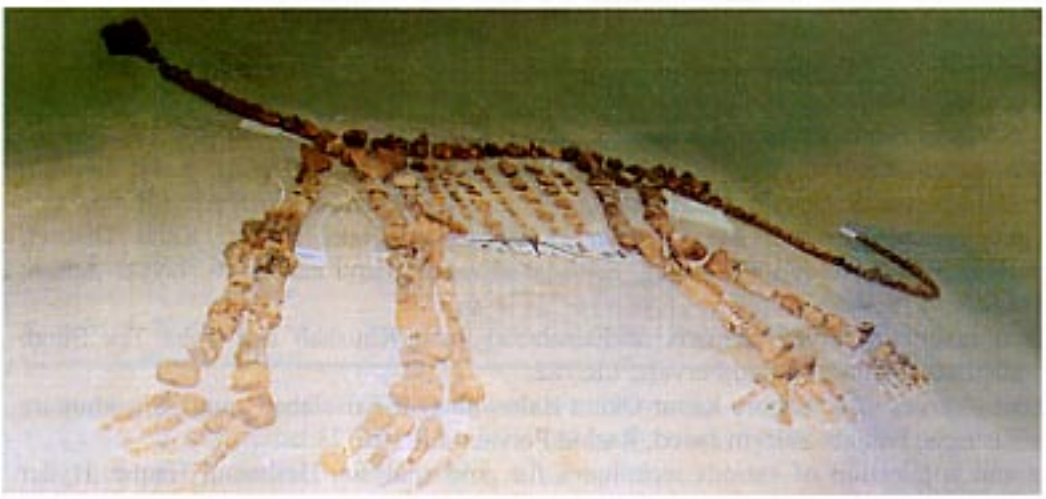
Discovery of first dinosaur fossil in Pakistan, Barkhan District, Balochistan, Sadiq Malkani and Muhammad Anwar; I.R.No.732.

DISCOVERY OF DINOSAUR FOSSILS IN PAKISTAN BY GSP

A team of geologists from the Geological Survey of Pakistan (GSP) has made the first ever discovery of dinosaur fossils from the northeast of Vitakri area, Barkhan district, Balochistan. The fossils were first reported by M. Sadiq Malkani, Assistant Director and Chaudhry M. Anwar, Deputy Director, GSP, Quetta. The fossil remains, collected so far, mainly comprise of the fore/hind limbs. More than fifteen hundred dinosaur fossil pieces have been found in the Pab Formation of Maastrichtian age (72-65 million years). With this discovery, Pakistan now stands amongst the few countries of the world from where a Dinosaur fauna have been reported and which have witnessed the global event of mass extinction around 65 million years ago. In this period hundreds of species of animals and plants were wiped out from the surface of the earth.

The dinosaurs of Pakistan are expected to generate a lot of interest in local and global geoscientific community, and may open several new avenues of research in Pakistan like paleo-faunal and paleogeographic inference, migration pathways of dinosaurs, location of land bridges in central and southeast Asia during the Cretaceous period.

The GSP has published an interim report (Information Release Series No.732) on this discovery and further research is continuing to find more dinosaur fossils for possible construction of a complete skeleton.



ARE HIPPOS ANCESTORS OF WHALES? GSP'S SCIENTIFIC ENDEAVOUR

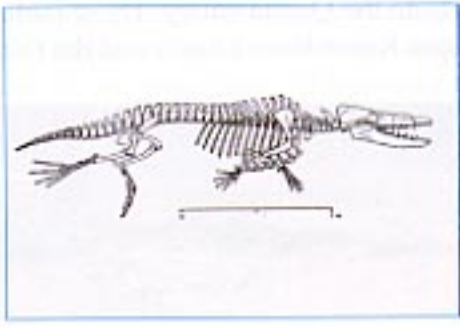
A team comprising researchers from the Geological Survey of Pakistan and the University of Michigan, USA has discovered partial skeletons of 47 million years old fossil whales in the eastern Balochistan. The fossils include partial skull, axial skeleton and virtually complete hands and feet. The fossils were collected from transitional beds at the top of Habib Rahi Formation and base of Domanda Formation, 25 km northwest of Rakhni, District Loralai, Balochistan.

The GSP and the University of Michigan at Ann Arbor, USA have a long term collaborative project on the Early Cenozoic Paleontology & Stratigraphy of the Sulaiman Range. Dr. Philip D. Gingerich, Director, Museum of Paleontology and Iyad S. Zalmout, Researcher, UM and M/S Munirul Haque, Intizar Hussain Khan and Sadiq Malkani, Assistant Directors, GSP, Quetta carried out field research during October, 2000. The newly discovered fossils of whale by Munirul Haq are important in augmenting the theories about which land mammals were the ancestors of whales, porpoises and dolphins.

Modern whales lack hind limbs retaining only vestiges of pelvic bone and hind limb elements embedded in the musculature of the body wall. The new whale species retain diagnostically artiodactyls characteristics, showing that cetacean has evolved from early artiodactyls. Discovery of the new whale fossils confirms that the whales were land mammals which adapted themselves to aquatic life, retaining many features of land mammals. These fossils suggest that the whales evolved from early ancestors of hippopotami, sheep and deer and also that hippos may be the closest living relatives of whales. The present discovery has produced high interest in local and global scientific community for opening up several new vistas of research for functional morphology, evolution and phylogeny of whales.

The latest issue of the Journal "SCIENCE" (Vol.293, September 21, 2001) carries its cover story on Pakistani whale fossil by Philip D. Gingerich, Munirul Haq, Iyad S. Zalmout, Intizer Hussain Khan and M. Sadiq Malkani (www.sciencemag.org). Dr. J.G.M. Thewissen, E.M.Williams, L.J.Rose and S.T.Hussain have also published their findings in the journal "NATURE" in its Vol. 413, September 20, 2001 (www.nature.com). The "Daily Telegraph" of UK and "National Geographic" magazine of USA also carried news on Pakistani whale fossils in their issues of September 20 and November, 2001 respectively.

The GSP has earlier issued an interim report on "Evolution of Whales" from early Artiodactyls: New Evidence form Pakistan as Information Release No. 751 by Munirul Haq and Imran Ahmed Khan.



EXPLORATION FOR HARDROCK AQUIFERS IN QUETTA VALLEY

Large subsurface reservoirs of good quality groundwater have been discovered by the GSP in the Jurassic rocks of Murdar Garh Range in Quetta Valley, Balochistan. The GSP's programme of hydrogeological and geophysical studies was carried out with the support, cooperation and collaboration of the Engineers 12 Corps of Pakistan Army and the Irrigation and Public Health Engineering Departments of the Government of Balochistan.

The success of this programme has averted the grave crisis that has been created due to a sharp depletion of alluvial aquifers in Quetta valley which have been the prime source of water supply to the provincial capital. By establishing a sound and sustainable alternate/additional water source, the people of Quetta have been relieved from the fears of Quetta becoming a ghost town as a result of large scale forced migration of population because of non-availability of drinking water.

More than 120 sites have been investigated and 30 sites recommended for test drilling after carrying out geological, geophysical and hydrogeological investigations. The hardrock aquifers are located within Chiltan Limestone. This formation is exposed in the hills surrounding Quetta and also form the basement of the Quetta Valley. The Chiltan Formation contains frequent beds with fractures, solution cavities and cavernous features which provide strong and enhanced frequent beds with fractures, solution cavities and transmission capacity of water flow. Subsurface detection of the confined saturated zones was done through electrical resistivity surveys, drilling and bore hole logging, pumping tests, water flow modeling, geochemical analysis, etc. Twenty seven test wells have already been completed. Success rate has been better than 90 percent.

Pumping tests at 10 wells have shown sustainable yields of 2,000-10,000 m^3 / day with a minimal draw down of 1 -3 meters. The planned 30 wells along the three flanks of Murdar Garh Range are expected to give water yield of more 30 million m3 per year which amounts to 60 percent of Quetta valley's normal water supply. The chemical analyses show that the quality of this water is in accordance with the international standards for potable water, as prescribed by the World Health Organization.

In order to give a further and more dependable boost to the newly discovered groundwater resources, the GSP also plans to investigate some major interesting geological structures outside the Quetta valley. These include the Zarghoon syncline, Sarakhula-Kach fault, Spin Karez-Hanna fault, and the fold plunge along the Takatu base.

BANKABLE FEASIBILITY STUDY OF THAR COAL DEPOSITS, SINDH

The Thar desert in the southeastern part of Sindh province, Pakistan hosts vast subsurface resources of lignitic coal. In order to develop these resources on a fast track basis, a high level task force has been constituted with the President of Pakistan as its Chairman and the Governor, Sindh and the Federal Minister for Petroleum & Natural Resources as Vice Chairmen.

The Thar coalfield is about 9,000 sq. km. with dimensions of 140 km. (north-south) and 65 km. (east-west). GSP/USGS delineated the coalfield by drilling 38 exploratory holes at a spacing of about 22 km. Subsequently, studies were carried out by GSP under a development scheme in four specific tracts/blocks covering an area of 356 sq. km. of Thar coalfield for systematic evaluation and appraisal of coal resources by drilling on approx.1 km grid.

By the June 2001 the coal resources of the Thar coalfield based on the exploratory drilling of 217 holes with a cumulative drilling of 51,076 metrage have been estimated at about 175.5 billion tonnes. Of these about 9 billion tonnes are categorized as proved reserves.

The thickest coal bed called the "Thar Coal Seam" is persistent over most of the area in the four investigated blocks. It is present between 150 and 203 metres depth. The maximum thickness of the seam is 22.81 metres. The cumulative coal thickness in the blocks varies between 7.15 and 36.00 metres. The thickness of overburden varies from 114 to over 200 metres and the sand dunes above the average ground level in the area increase it by another 30 metres. The quality of coal has been determined on the basis of chemical analyses of more than 2,000 samples.

The Thar coal deposit is a major energy resource, which has the potential to transform the energy equation of Pakistan, at a time when a continuing high level of energy demand can be foreseen in the long term. In addition, the development of this major indigenous energy resource would offer the prospect of employment and infrastructure development in one of the most under-developed and very remote area of Pakistan. The commitment of federal and provincial governments to a policy of encouraging private sector participation in the energy sector provides a framework for future development of this huge resource.

GSP is undertaking coal exploration and characterization studies in Thar coalfield to generate authentic and dependable technical data that can help in attracting foreign investment as well as to promote and facilitate the emergence of a competitive domestic private sector coal industry capable of developing large coal mines and utilize coal for power generation and fuel and feedstock in various industries. To further this cause in established economic terms, the GSP and the Sindh Coal Authority (SCA) have jointly prepared a PC-II Scheme for the Bankable Feasibility Study of Thar Coal Deposits. The study beginning July, 2002 will take about 18 months to complete and will cost about Rs.198.0 million. The project will be funded 80 percent through the Federal Public Sector Development Programme while the Government of Sindh will make 20 percent contribution.

The overall objectives of the proposed study will be achieved by employing reputable consultants through international bidding. The consultant will be required to prepare project-specific proposals for mining feasibility of Thar coalfield for mine-site power generation taking into account the technical, economic and environmental factors for mining and power generation.

CHEMICAL ANALYSES OF THAR COAL

S. No.	Area	As Received Values (%)					Heating Values (Btu/lb)				Volatile matter (%)
		Moisture	Ash	Volatile Matter	Fixed Carbon	Sulphur	As Received	Dry	Dry Ash Free	Mineral Matter Moisture Free	Dry Ash Free
1.	Block-I	44.07	6.18	33.04	22.00	0.92	6,398	10,461	11,605	6,841	60.00
2.	Block-II	49.01	5.18	26.50	19.35	1.05	5,780	11,353	12,613	6,101	57.72
3.	Block-III	45.41	6.14	28.51	19.56	1.12	5,875	10,880	11,789	6,268	59.76
4.	Block-IV	43.02	6.57	29.04	21.61	1.20	5,971	10,723	12,111	6,413	57.67

PRODUCTION & REVENUE RECEIPT FROM MINING

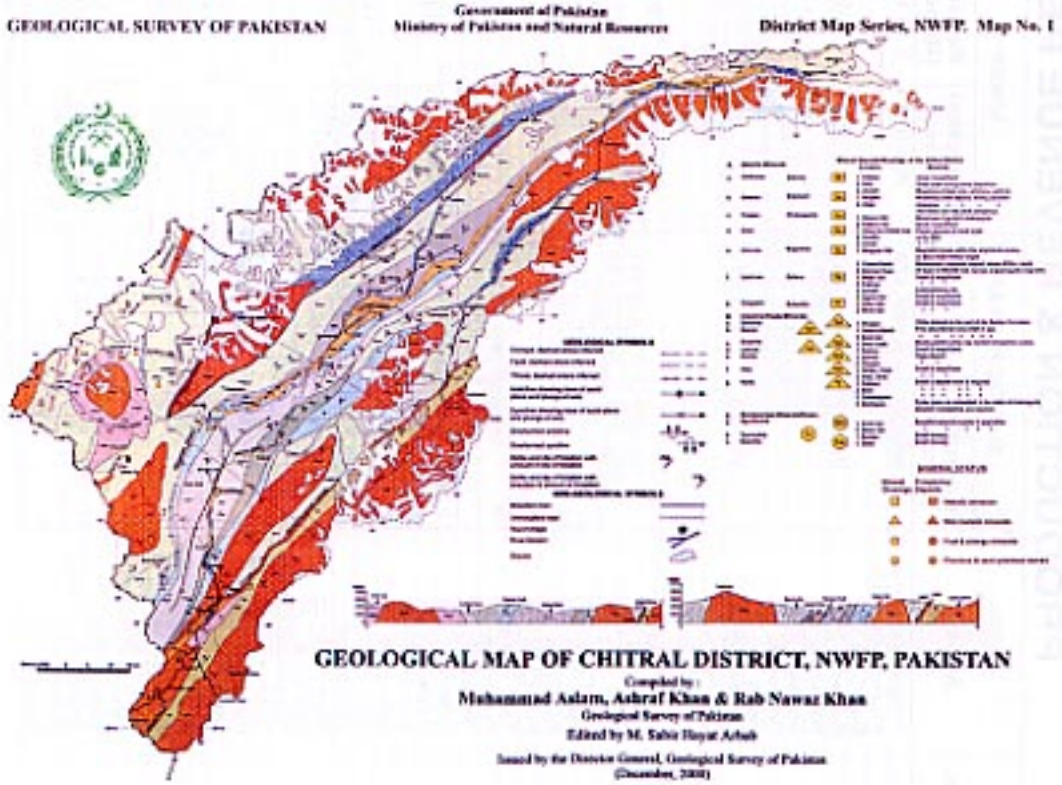
S. No.	Mineral	BALOCHISTAN		NWFP		PUNJAB		SINDH	
		Production (Tonnes)	Revenue (Rupees)	Production (Tonnes)	Revenue (Rupees)	Production (Tonnes)	Revenue (Rupees)	Production (Tonnes)	Revenue (Rupees)
1	Aragonite/Marble	68,132	5,683,478	260,674	5,213,480	2,236	20,100	2,226	384,946
2	Argillaceous clay					1,187,142	1795,958		
3	Ball Clay							905	4,000
4	Barytes	28,597	157,892	1,326	13,260				
5	Basalt		6,317						
6	Bauxite					5,015	22,440		
7	Bentonite			770	7,700	11,676	63,177	2,710	5,440
8	Brine					60,123	380,464		
9	Building Stone	17,249	201,610						
10	Calcite						300		
11	Celestite					345	2,450	616	14,325
12	Chalk							6,758	130,37
13	China Clay			47,815	478,150		200	20,095	398,396
14	Chromite	35,957	1,883,111	1,515					
15	Coal	1,578,919	30,277,128	59,092	1,477,300	365,605	6,562,633	1,164,827	78,803,238
16	Dolomite			2,004	12,024	18,307	36,150	85,525	3,667,334
17	Ebry						700		
18	Feldspar			20,365	395,476				
19	Fire Clay			1,040	4,680	93,355	427,650		
20	Flint Stone							200	13,058
21	Fuller,s earth			1,080	5,400	198,976	3,840	14,833	180,165
22	Granite	382		3,902	78,040			1,729	
23	Gravel							8,017	231,265
24	Gypsum			79,645	398,225	198,976	632,916		128,203
25	Iron ore					5,500	63,108		
26	Lake salt							16,304	180,384
27	Laterite			15,440	154,400			9,555	51,766
28	Limestone	217,849	1,571,420	2,771,563	13,857,815	4,644,318	25,860,550	2,719,808	30,984,418
29	Magnesite	270	1,100	3,157	47,355				
30	Millstone					1,174	10,400		
31	Nepheline syenite			40	600				
32	Ochres					3,112	12,364		
33	Pumice	2,011	46,648						
34	Quartz			216	1,728			946	
35	Red ochre			5,660	56,600				11,820
36	Red Oxide			6,630	66,300				
37	Rock Salt			124,483	1,244,830	836,035	7,512,119		
38	Sand/Bajri							15,150	78,642
39	Sea salt								1,332
40	Serpentine	4,004	17,200	545	5,420				
41	Shale/shale clay	855,509	9,194,750	252,084	2,520,840			586,713	1,055,359
42	Silica Sand			31,498	157,490	66,260	249,720	37,422	316,796
43	Soapstone			49,097					

The Production & Revenue figures are for the financial year 1997-98.
Data supplied by the provincial Directorates of Minerals Development, Quetta/Peshawar/Lahore/Karachi.

GSP PUBLISHES FIRST DISTRICT GEOLOGICAL MAP

The Geological Survey of Pakistan has initiated the preparation of district geological map. The first map of this series has been published for Chitral district on 1:3,75,000 scale. The map contains useful information on the exposed rock units and their tectonic frame work. All the major localities of metallic and industrial mineral and precious, semi precious stones are shown on this map. It also describes geo-chemical target areas and metallogenic zonation of Chitral district. Muhammad Aslam, Ashraf Khan and Rab Nawaz Khan have prepared this map while Hussain initiated the proposal of District Geological Map and Arbab M. Sabir Hayat Arbab have done its editing.

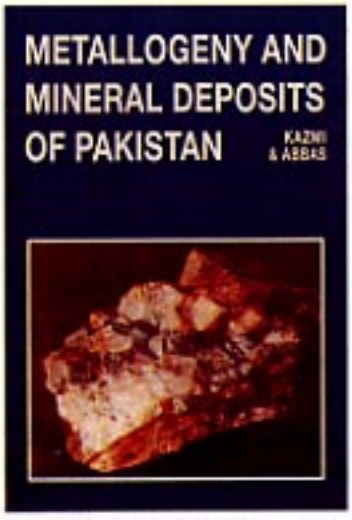
Some other District Geological Maps which are under preparation and planned to be published during 2002 are of districts of Kohat, Karak and Abbottabad in NWFP; Rawalpindi, Mianwali and Dera Ghazi Khan in Punjab; Karachi and Dadu in Sindh; Quetta and Zhob in Balochistan; and Mirpur in Azad Kashmir.



BOOK REVIEW

Metallogeny and Mineral Deposits of Pakistan
by Ali Hamza Kazmi and S. Ghazanfar Abbas
Printed by Graphic Publishers, Nazimabad, Karachi, Pakistan
Published by Orient Petroleum Inc., Diplomatic Enclave, G-5, Islamabad, Pakistan. 264 pp

A.H. Kazmi, former Director General, GSP and S. Ghazanfar Abbas, Director (Balochistan), GSP, Quetta have come up with a monumental work on economic geology of Pakistan which will fill a critical gap in present knowledge on the mineral resources of the country. The book is an invaluable addition to geological literature of Pakistan. Even though the title of the book is Metallogeny and Mineral Deposits of Pakistan, extensive coverage has been given to host rocks, ore forming processes, types of mineral deposits and metallogeny & plate tectonics.



Mineral deposits have been described in first two chapters under various heads such as those related to plate tectonics (gold, silver, platinum, iron, lead, zinc, manganese, radioactive minerals, etc), mineral fuels (coal, petroleum, natural gas), precious and semi precious stones, ceramic and industrial minerals.

The book gives a brief account of the mineral occurrences and various types of mineral deposits of Pakistan in the light of plate tectonics theory. Even a non-professional can benefit from the discussion as to what is metallogeny, what are ores, minerals and rocks, how they are formed, what are the different types of rocks and what kinds of minerals are associated with them and what are geological processes which from different kinds of mineral deposits. The third chapter on Plate Tectonics explains the plate tectonics theory, the structure of the earth and how it provides a mechanism for plate movement, different kinds of plate margins and how they form habitats for mineral deposits.

The fourth chapter presents an outline of the tectono-metallogenic zones of Pakistan, and the minerals, which characterize them. Chapters five to nine contain an account of metallic minerals, mineral fuel, precious stones, ceramic minerals, and fertilizers, and industrial minerals. The available mineral data is presented in a tabulated form on more than 200 metallic and 140 non-metallic minerals showings and deposits giving information concerning the name and location of the deposit, tectono-metallogenic setting and type of deposit, quality, grade and size.

The last and final chapter deals with the possibilities and prospects of exploration and development of minerals in Pakistan. It is followed by a comprehensive bibliography and index. This latest book provides the much needed concise and up-to-date information on mineral deposits of the country, to all those who are interested in mineral wealth of Pakistan such as students, researchers, economists, planners, prospectors, entrepreneurs as well as the general reader. It is hoped that this book will be well received by teachers and students of geology, mining and oil companies, and by a wide range of scholars and the geoscientists community at large.

Sri Lanka
GEOLOGICAL SURVEY AND MINES BUREAU

This article is based on the "Sri Lanka Minerals Yearbook 2002". Due to the limited length available in the newsletter, the Yearbook was excerpted and edited.

MINERAL RESOURCES OF SRI LANKA

1. Introduction

Sri Lanka, an island country with approximately 65 thousand square kilometers in area (and about 15 million people), is reasonably endowed with industrial mineral resources, but not with metallic nor energy resources. Hydrocarbon resources have yet to be found within our offshore Exclusive Economic Zone of Sri Lanka. The country is very well endowed with precious and semi-precious gemstones.

Industrial minerals include graphite, ilmenite, rutile, zircon, quartz, feldspar, clay, kaolin, apatite, silica sand, mica, calcite, and dolomite. All these minerals are mined in quarries or superficial pits. Two underground mines are for graphite and are located at Bogala and Kahatagaha.

Of the industrial minerals, graphite and mineral sands are our traditional export-oriented mineral commodities. Consequent to the expansion of mineral based industries during the past few decades, a substantial number of minerals are exploited today at an increased pace.

Occurrences of mineral resources are shown in Figure 1.

2. Mineral Sands

Exploitable beach-sand deposits are located at Pulmoddai, Induruwa, Beruwala (monazite, zircon and garnet), mouth of Kelani Ganga (ilmenite), north of Negombo (ilmenite), Kudremalai Point (ilmenite), Mannar south (ilmenite), Devinuwara (ilmenite and garnet) and Hambantota (garnet).

Mined ilmenite, rutile and zircon are exported in bulk. A small quantity of rutile is used by local industries.

Recently Renaissance Gold Field Corp of Australia found mineral sand reserves amounting to about 1.07 billion tons in northwestern coastal belt around Puttalam. The sand contains seven to eight percent heavy minerals mainly ilmenite.

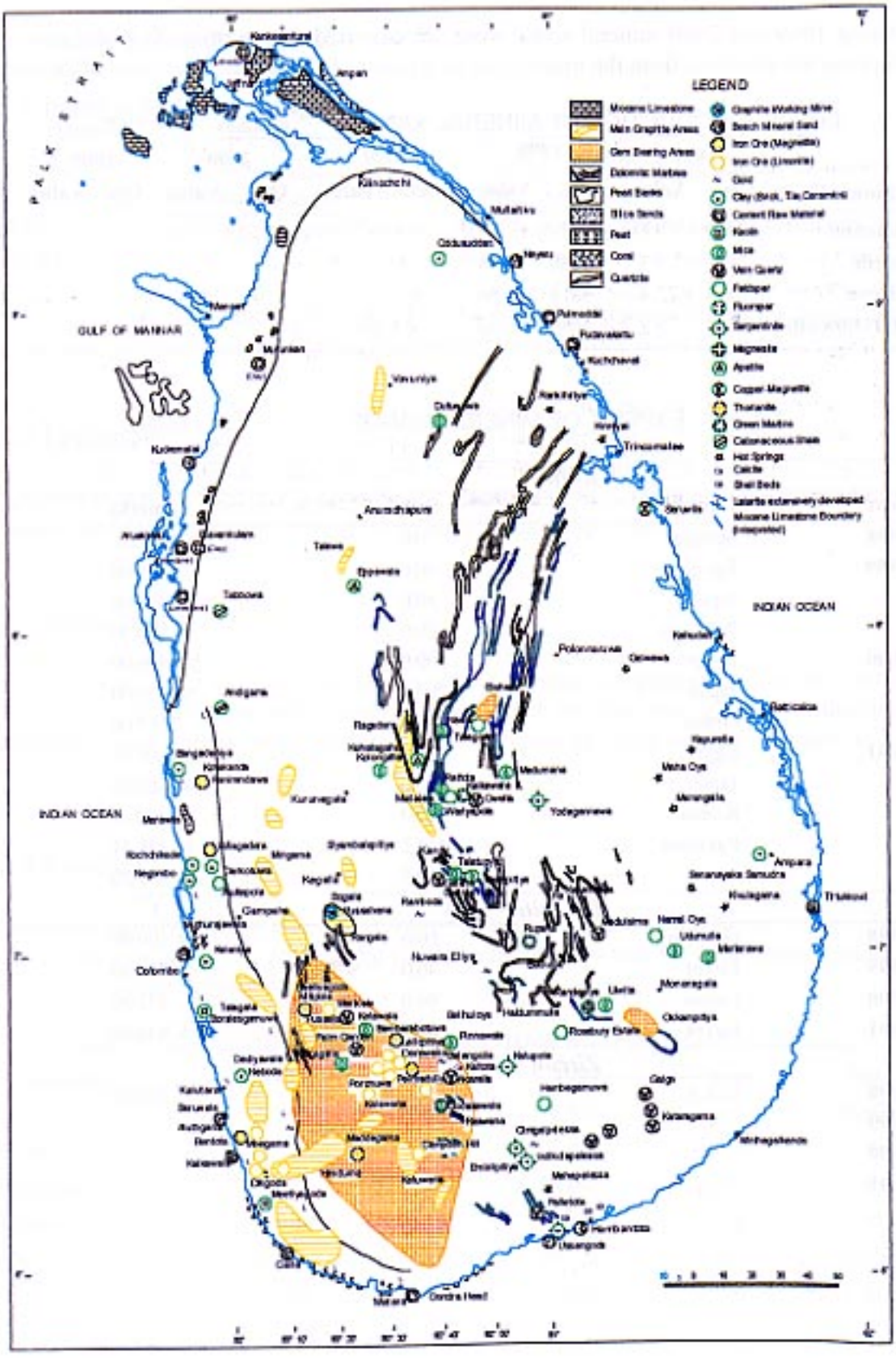


Figure 1 Mineral Resources Map of Sri Lanka

During 1999 and 2000 mineral sands were not exported due to prevailing obstacles to shipping the products from the mining site as a result of unfavorable security situations.

Table 1 PRODUCTION OF MINERAL SANDS (Tonnes, Rs. Millions)

	1997		1998		1999		2000		2001	
Commodity	**Qty.**	**Value**	**Qty.**	**Value**	**Qty.**	**Value**	**Qty.**	**Value**	**Qty.**	**Value**
Ilmenite	17969	7.1	34118	na	-	-	-	-	-	-
Rutile	2968	5.3	1930	na	-	-	-	-	-	-
Zircon	12454	22.4	8814	na	-	-	-	-	-	-
HiTiIlmenite	4564	8.2	3030	na	-	-	-	-	-	-

Table 2 EXPORT OF MINERAL SANDS (Tonnes)

	Rutile		
Year	**Country**	**Qty.**	**Value(S)**
1998	Senegal	20.0	na.
1999	Egypt	40.0	22 800.00
	Japan	80.0	40 400.00
	Pakistan	20.0	8 800.00
2000	Egypt	500.0	278 390.00
	Japan	200.0	91 770.00
	Oman	16.0	7 565.00
2001	Egypt	300.0	135 696.92
	Japan	100.0	48 880.00
	Kenya	20.0	19 200.00
	Pakistan	151.2	86 348.44
	U.K.	2 749.7	967 939.20
	Ilmenite		
1998	Germany	60.0	14 100.00
1999	Egypt	40.0	8 000.00
2000	Oman	04.0	572.00
2001	Egypt	43.2	5 896.80
	Zircon		
1998	U.S.A.	80	11 200.00
1999	-	-	-
2000	-	-	-
2001	-	-	-

3. Ceramic Raw Materials

3.1 Kaolin and Ball Clay

Annual kaolin production is sufficient to cater to the demand of local ceramic industry. Refined super-grade kaolin is used for high-grade porcelain ware intended for export. Different grade of kaolin is produced for rubber, plastic, earthenware, refractors and other products.

Kaolin and ball clay produced are used exclusively by domestic industries, and export of any raw or processed mineral used in the ceramic industry is not allowed.

3.2 Feldspar

Feldspar is mainly used in the ceramic and glass industry. There are several producers who supply feldspar mainly from Matale area, for domestic users.

3.3 Silica Sand

A very large silica sand deposit occurs in the Ampan-Vallipuram area in the Jaffina Peninsula. All of the silica sand is consumed by the two glass-manufacturing companies and ceramic-ware manufacturers. Export of silica sand in any form is not permitted.

3.4 Calcite

Calcite is mainly used in domestic ceramic industry. Most of the supply comes from the Balangoda area. At present the local requirement is met by the existing quarries, and export is not permitted.

Table 3 CONSUMPTION OF CERAMIC RAW MATERIALS (Tonnes)

Commodity	1997	1998	1999	2000	2001
Ball clay	22 043	24 478	26 678	27 525	24 846
Calcite	3 930	3 700	5 443	4 320	3 507
Feldspar	25 676	25 274	26 012	28 638	27 438
Kaolin	10 070	11 110	12 573	12 230	9 403
Silica sand	24 493	35 425	29 736	27 055	26 040
Vein quartz	2 160	2 382	2 818	3 795	2 955

4. Construction Materials

Construction materials produced in Sri Lanka include; Miocene limestone for cement, dimension stones mainly for buildings, crushed rocks, and inland corals and sea shells for lime production poultry feed.

4.1 Dimension Stone

Sri Lanka has large resources of rocks suitable for dimension stone, but dimension stone and polished slabs are still turned out in limited quantities. They come from open pits or hillside excavations of rock outcrops. Dimension stones are cut to specified shapes and sizes for use in buildings and other construction purposes. Significant portion of the production is exported.

Table 4 PRODUCTION OF DIMENSION STONE (Tonnes)

Year	1997	1998	1999	2000	2001
Qty.	2 600	2 264	3 219	1 408	2 281

Table 5 EXPORT OF DIMENSION STONES (Tonnes)

Year	Country	Qty.	Value($)
1998	Taiwan	260	23875
	Germany	1749	231907
	New Zealand	na	21192
	Australia	254	22517
1999	Australia	341	29814
	France	75	7500
	India	253	32075
	Italy	142	32351
	Japan	14	8648
	Switzerland	2394	339766
2000	Australia	180	14342
	Hongkong	90	39759
	Switzerland	736	88848
	Taiwan	275	2287
	Italy	88	25955
	Maldives	39	13304
	Germany	na	233
2001	Liechtenstein	1917	266126
	Japan	1	2600
	Taiwan	352	41277
	Maldives	11	16345

5. Fertilizer Materials

5.1 Dolomite

In Sri Lanka dolomite is mainly used for the manufacture of ceramic ware and lime and as fertilizer. With the rapid exhaustion of coral and shell deposits in the southern coastal area, dolomite is the only alternative raw material available for lime production. There are government restrictions on the export.

Table 6 CONSUMPTION OF DOLOMITE (Tonnes)

Industry	1997	1998	1999	2000	2001
Ceramic & Glass manufacturing	4 277	8 790	7 603	10 790	10 525
Fertilizer	13 146	21 619	12 350	31 940	39 143
Construction material (lime)	5 101	4 973	20 024	30 806	37 433
Other	329	21	2 644	1 736	7 059
Total	22 853	35 403	42 621	75 272	94 160

5.2 Apatite

In Sri Lanka apatite is powdered and used as fertilizer for long-term crops, such as tea, rubber and coconut. Recent studies by a foreign firm have been successful in identifying a method, which is commercially applicable for production of super phosphate. There are government restrictions on export of apatite.

Table 7 PRODUCTION OF APATITE (Tonnes)

Year	1997	1998	1999	2000	2001
Qty.	29 635	37 598	30 258	34 443	35 770

6. Other Industrial Minerals

6.1 Graphite

Graphite is one of the major industrial minerals produced in Sri Lanka and it has been exported for over 40 years. The best known areas for graphite are confined to the Central, Sabaragamuwa, Southern, Northwestern, and North Central provinces.

High-grade graphite is used for crucibles and lubricants and dust grade for foundry facings and polishing. Graphite is used in dry cells, as a refractory material in steel making, in electrical work and in a large number of other industries.

Although Sri Lanka has some of the world's best graphite with high carbon content

(99%), a negligible quantity is used domestically for pencil industry. Ninety nine percent of the production is exported.

Table 8 PRODUCTION OF GRAPHITE (Tonnes)

Year	1997	1998	1999	2000	2001
Qty.	5 400	5 910	4 592	5 902	6 585

Table 9 EXPORT OF GRAPHITE (Tonnes)

Country	1998		1999		2000		2001	
	Qty.	Value ($)	Qty.	Value ($)	Qty.	Value ($)	Qty.	Value ($)
Australia	106	377 000	150	95 540	171	76 664	36	23 565
Bangladesh	20	4 700	40	8 697	60	10 412	80	17 025
Germany	40	54 000	-	-	219	48 758	135	38 254
Greece	-	-	-	-	20	4 161	-	-
India	35	24 515	97	57 233	67	22 710	44.5	5 277
Japan	1 180	420 774	2 414	737 852	3 240	897 980	3 387	1 152 550
Korea	-	-	18	8 160	36	21 808	-	-
New Zealand	21	8 400	-	-	-	-	-	-
Pakistan	1 225	292 990	1 746	286 550	1 698	280 360	1 020	194 315
Philippines	0.5	2 418	0.5	2 418	0.5	692	0.96	1 704
Thailand	60	17 370	60	17 350	125	36 640	60	15 530
Turkey	-	-	-	-	-	-	45	12 400
U.K.	1 680	1 116 072	440	466 150	1 220	834 244	925	630 079
U.S.A.	780	890 925	526	622 665	195	223 317	168	202 478
China	-	-	-	-	-	-	20	30 000

6.2 Mica

Mica deposits are found in the Talagoda, Madumana, Pallekelle, Talau-oya, Badulla, Maskeliya, Madugoda, Udumulla, Maula, and other localities. The important commercial types are muscovite and phlogopite. Sheet mica is mainly used in electrical and electronic industries. Scrap and flake mica is processed into ground mica. Dry ground mica is used as filler in plastics, floor coverings and paints. Produced mica is all exported.

Table 10 PRODUCTION OF MICA (Tonnes)

Year	1997	1998	1999	2000	2001
Qty.	3 700	2 800	1 425	1 491	1 161

Table 11 EXPORT OF MICA (Tonnes)

Country	1998		1999		2000		2001	
	Qty.	Value ($)	Qty.	Value ($)	Qty.	Value ($)	Qty.	Value ($)
Belgium	776	341 715	80	28 140	80.4	25 551	60	18 090
China	-	-	-	-	1.8	170	-	-
France	20	7 000	40	14 080	20	4 836	-	-
Japan	1 635	522 370	730	243 730	1 096	281 772	1 026	359 360
Korea	350	116 700	575	201 780	212.5	63 955	35	15 600
Romania	-	-	-	-	0.35	270	-	-
Switzerland	3	1 140	-	-	80	20 424	40	10 300

7. Gemstones

Sri Lanka is well known for its precious and semiprecious colored gemstones and is one of the very important producers and exporters of the world. Some of the best-known gem-mining areas are Ratnapura, Elahera, Moneragala, Kamburupitiya, Okkampitiya, and Balangoda. The gemstones produced in Sri Lanka include sapphire, ruby, aquamarine, topaz, tourmaline, garnet, spinel and zircon.

Table 12 EXPORT OF GEMSTONES (thousand carats, Rs. Millions)

	1997		1998		1999		2000		2001	
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
Blue sapphire	79.5	714.5	95.2	1 150.7	155.4	1 600.8	173.7	2 693.2	na	na
Star sapphire	525.3	597.6	92.3	181.6	298.4	244.2	280.5	285.9	na	na
Ruby	3.0	96.0	6.4	55.4	11.3	70.7	15.8	104.2	na	na
Star ruby	11.5	90.6	7.5	33.5	11.6	25.0	5.4	40.7	na	na
Cat's eye	61.8	686.4	24.0	315.1	48.4	384.3	48.0	640.3	na	na
Others	16 469.5	1 409.0	12 081.5	1 161.6	12 428.9	1 256.1	6 126.3	1 977.6	na	na
Total Exports	17 180.6	3 594.1	12 366.9	2 897.9	12 954.0	3 581.1	6 649.7	5 742.0	na	5 177.7

Currency exchange rate – US$ 1 = 90 rupees (Rs) as of 31 December 2001.

8. Commodity Summaries

Table 13 PRODUCTION OF MINEARALS (Tonnes, unless otherwise specified)

MINERAL SANDS	1997	1998	1999	2000	2001
Ilmenite	17 969	34 118	nil	nil	nil
Rutile	2 968	1 930	nil	nil	nil
Zircon	12 451	8 814	nil	nil	nil
HI TI Ilmenite	4 564	3 030	nil	nil	nil
CERAMIC RAW MATERIALS					
Kaolin	20 126	11 110	12 573	12 230	9 403
Ball clay	15 750	24 478	26 678	27 525	24 846
Feldspar	25 676	25 274	26 012	28 638	27 438
Vein quartz	11 533	10 884	14 553	13 236	15 731
Silica sand	37 887	35 425	29 736	27 055	26 040
Calcite	3 930	3 700	5 443	4 320	3 507
CONSTRUCTION MATEIRALS					
Limestone	900 600	738 394	683 377	681 858	818 524
Dimension stone	2 600	2 264	3 219	1 408	2 281
Inland coral	6 037	5 938	4 332	5 263	1 348
Sea shells	5 084	5 875	11 834	2 979	4 186
FERTILIZER MATEIRALS					
Dolomite	22 853	35 403	42 621	75 272	94 160
Apatite	29 634	37 598	30 258	34 443	35 770
OTHER MINERALS					
Graphite	5 400	5 910	4 592	5 902	6 585
Mica	3 700	2 784	1 425	1 491	1 161
Salt	103 731	82 483	96 709	70 107	130 272
Gypsum	na	na	89	955	na
Gems(carats)	2 123 600	6 768 605	12 954 001	6 649 671	na

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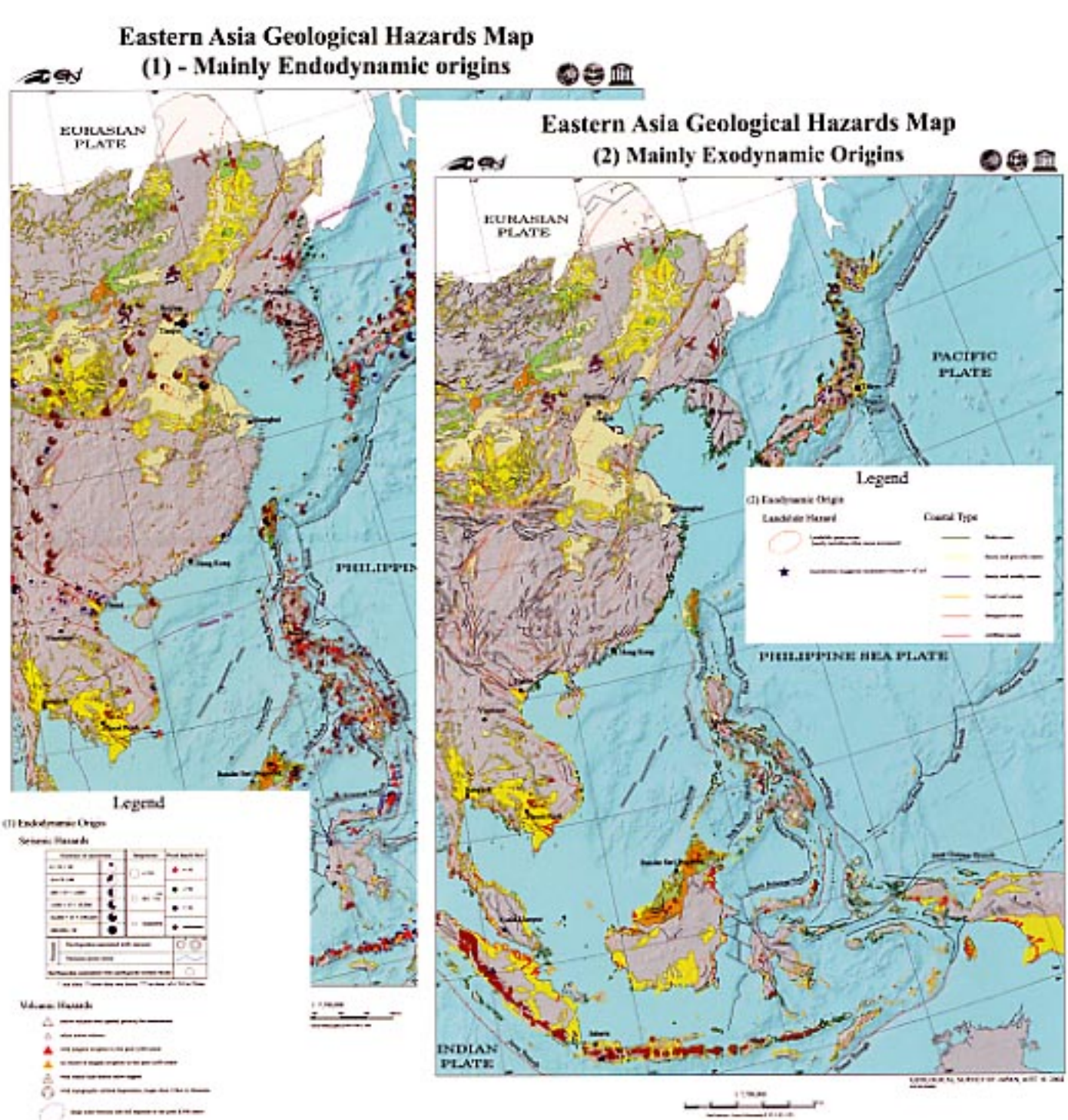

Eastern Asia Geological Hazards Map

The map is one of the results produced by the Eastern Asia Natural Hazards Mapping Project (EANHMP) proposed and promoted by the Geological Survey of Japan since 1994. It is a contribution to the International Decade for Natural Disaster Reduction (IDNDR) and UNESCO's objective regarding Natural Disaster Reduction activities and the IGCP-383 project. The EANHMP was implemented by national committees of the East and Southeast Asian countries and supported by international organizations. These organizations include the Coordinating Committee for Geoscience Programmes in East and Southeast Asia (CCOP) and Commission for the Geological Map of the World (CGMW). The map consists of two sheets on a scale of 1:7,700,000. The first sheet shows the geologic hazards of an endodynamic origin such as seismic hazard including tsunamis and volcanic hazards. The second sheet shows geologic hazards of an exodynamic origin partly induced by human activities such as landslides, coastal erosion/depositions and other similar processes. An explanatory pamphlet is attached. It was published in 2002 by the Geological Survey of Japan (GSJ), National Institute of Advanced Industrial Science and Technology (AIST). (UNESCO: United Nations Educational, Scientific and Cultural Organization, IGCP: International Geological Correlation Programme)

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