6. プロジェクト・ドキュメント（英文）

PROJECT DOCUMENT ON GEOLOGIC REMOTE SENSING PROJECT IN THE REPUBLIC OF TURKEY

JICA Turkey Office and General Directorate of Mineral Research and Exploration (MTA) signed the Record of Discussions and the Minutes of Meeting on July 4, 2002 for the implementation of the Geologic Remote Sensing Project.

The document attached hereto is the project document provided in the Minutes of Meeting mentioned above.

March 5, 2003
(Signed on the occasion of the first Joint Coordination Committee)

Mr. Yasushi INABA
Resident Representative
JICA Turkey Office
Japan International Cooperation Agency
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JAPAN – TURKEY

GEOLOGIC REMOTE SENSING PROJECT

Project Document

October, 2002

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Preface

I. PREFACE

Turkey is endowed with a geological environment capable of producing various mineral resources. For this reason, exhaustive surveys of its mineral deposits have been conducted mainly by the General Directorate of Mineral Research and Exploration Institute (MTA) established in 1935. According to MTA, nearly all outcrop deposits have already been exploited in regard to the country's non-ferrous metal resources, and that from here on, hidden mineral deposits must be explored based on wide-ranging geographical and topographical information and in reference to the origin of the deposits.

At the same time, MTA has acknowledged the need for the evaluation of water resources that are required for mining development, monitoring of the effects of metal refining on air and water, and access to wide-ranging and detailed geological and topographical information for oil exploration.

In order to address these issues, MTA established a Remote Sensing Unit in 1975 for analog imagery analysis. Since then, the unit has been strengthened through the donation of digital imagery processing system equipment from the UNDP in 1982 and through the enhancement of necessary facilities on its own budget, and was reorganized as the Remote Sensing Center (RSC) in 1994.

At present, however, the remote sensing technology and facilities of MTA are inadequate in terms of both technology and processing capability for the exploration of hidden mineral deposits that require a more extensive imagery analysis and complex data processing. There is much concern regarding the efficient implementation of exploration activities, as securing of resources in the mid- to long-term depends heavily on it. Furthermore, MTA conducts basic research for environmental preservation in the fields of natural disasters and mining, but in recent years it is using remote sensing technology even for surveys on active faults and monitoring of topographical changes, and the issue of updating its analytical technology in these areas is pressing.

Upon these backgrounds, the Turkish government elicited cooperation from the Japanese government in the form of a project-type technical cooperation (tentatively named the "digital imagery processing center" project) that aims to conduct topographical and geographical surveys in an efficient manner by installing advanced remote sensing technologies and relevant facilities.

In response to this request, the Japanese government conducted studies of Turkey's mining policies, as well as the present conditions and future issues of its mining sector, and verified the effectiveness of the "digital imagery processing center" project. It also dispatched a basic evaluation team to Turkey in April 2000 for the purpose of gathering such information as the organizational structure of MTA, the implementing agency, that is necessary for the formulation of a basic plan.

Furthermore, in order to confirm the significance of implementing the project, a short-term study team was dispatched in July 2001, in March and May 2002. From the results of their surveys, it was concluded that implementation of the said project will contribute to the technical upgrading of the mining sector, measures against natural disasters and environmental preservation, and furthermore to the economic development of Turkey. Subsequently, the drafting of a project document that summed up the fundamental concepts and specific plans for project implementation was begun. The R/D of this project was signed on July 4th, 2002 and the project started on August 1st, 2002.

Chapter II

Background of project implementation

II. BACKGROUND OF PROJECT IMPLEMENTATION

A. Social Conditions of the Country Concerned

Blessed by a natural environment endowed with fertile land and abundant rainfall, agriculture was the main industry in Turkey until the 1950s, but in the 1960s, the government pushed forward an aggressive industrialization policy. On account of this policy, the Turkish economy grew relatively steadily with a central focus on its manufacturing industries (including the mining sector). In recent years, the manufacturing industries as a whole account for nearly 25% of gross domestic product (GDP) (Figure II -1).

However, the budget deficit brought about by the economic development of public investment businesses and the delay in rationalizing the public sector, had become a serious problem. Also, with technical innovations coming to a standstill due to the fixation of high inflation and high interest rates weighing heavily on public investments, efforts to lower the dependency on imports failed, and trade deficits subsequently expanded. The government vainly adopted a policy that would cover these deficits with tourism revenues, but overseas borrowings and accumulated debts only increased.

Under these circumstances, the government announced the Seventh Five-Year Development Plan in May 1995. The plan anticipated an industrialized and information-intensive society for the 21st century, and defined the five years concerned as time for preparing a framework that can respond to such a society. Specifically, it included policies to lower the salaries of public officials, actively continue the privatization of major national companies, and to raise the eligibility age for receiving pension. Among them, the privatization policy of national companies, which aimed to reduce the government's budget deficit that is the source of inflation, has been in implementation since 1984. Of the national companies specified for privatization, approximately 70%, or 107 companies, were privatized by February 1998. In these ways, the Seventh Five-Year Development Plan provided measures for economic structural adjustment and stabilization plans, but in addition to the economic slump experienced since 1998, the earthquake disaster of 1999 also adversely affected the stagnant economy, so that high inflations continued and accumulated deficits showed an increasing trend (Figure II -2).

Figure II -1: Turkey's GDP breakdown by industry in recent years (unit: 1 billion lira)

	1994	1995	1996	1997	1998
Agriculture	598,169	1,218,178	2,489,774	4,170,001	8,947,885
Manufacturing	1,019,767	2,042,395	3,716,528	7,293,186	11,958,801
Construction	263,720	426,215	857,762	1,743,240	3,057,577
Trade	760,919	1,587,691	3,022,315	5,985,402	10,352,369
Transportation and Communications	514,110	981,070	1,941,547	4,018,613	7,181,691
Finance	115,011	322,590	732,340	1,474,426	3,191,373
Real Estate	127,918	249,170	442,955	850,332	1,670,981
Public Services	142,795	287,000	554,080	1,067,451	1,939,228
Government Services	344,530	619,785	1,238,527	2,579,910	4,782,332
GDP Total	3,868,429	7,762,456	14,772,110	28,835,883	51,625,143

Figure II -2: Recent inflation rates and overseas borrowings in Turkey

	1996	1997	1998	1999	2000
Consumer price inflation (%)	80.4	85.7	84.6	65.1	54.9
Total overseas borrowings (unit: $US 1 billion)	79.6	84.8	97.2	101.8	114.3*

Note: Numbers with asterisks (*) are EIU estimates
Source: Country Report July 2001 Turkey (The Economist Intelligence Unit)

B. Present State of Turkey's Mining Sector

1. History of mining in Turkey

Mining in Turkey can be traced back to ancient prehistoric times. More specifically, refined copper was found from the ruins of an architecture built several thousand years ago in the Anatolia region, and it has been confirmed that coins were made from copper in those ancient times.

Modern mining began with the productions of boron in the Bandirma mine in 1815 and chromium in the Bursa-Harmancik mine in 1848.

Turkey became a republic in 1923, and the first president, President Ataturk, defined mining as the country's key industry, and enacted a law concerning the rights of oil exploration and development in 1926. Mining activities rapidly accelerated soon after that, with the establishment of the General Directorate of Mineral Research and Exploration (MTA), a government-linked organization for implementing geological surveys and mineral explorations, in 1935, and Etibank, a government-affiliated company specializing in the development of resources.

In 1954, the functions of MTA's oil mining section were transferred to the newly-established Turkish Petroleum Corporation (TPAO), and a new mining law was enacted. Yet, as the mining sector at the time was not considered as important as it is today, the implementation of mineral exploration and mine development was basically restricted to government agencies.

Later, in 1985, the mining law was revised as part of the government's policy of privatizing its national companies, and private companies were allowed to participate in the exploration and development of mines. The government also allowed foreign businesses to obtain exploration and development rights as well, and approved the advancement of foreign companies into the mining sector. These two changes thus led to the further development of Turkey's mining sector. In the meantime, the Ministry of Energy and Natural Resources was established in 1963, and was given jurisdiction over energy and natural resources, thereafter handling the drafting of mining policies and the administration of mining rights through the General Directorate of Mineral Works, which is one of its subordinate state enterprises.

2. Positioning of the mining sector in Turkey

As mentioned above, the mining sector has a long history in Turkey, but it does not have a large impact on the entire national economy. Its share of GNP has been in the 1 – 2 % range for the past sixty years, as shown in Figure II -3. However, this only accounts for raw minerals, and mining products with added value are calculated into the manufacturing sector. If mining products are included as part of the mining sector, the General Directorate of Mineral Works estimates the mining sector to make up 4 – 5% of total GNP in recent years.

Figure II -3: Trends in the share of the mining sector in Turkey's GNP (unit: %)

1940	1950	1960	1970	1980	1985	1990	1995	1998	1999
1.35	1.46	2.09	1.34	1.59	1.74	1.81	1.44	1.04	1.14

Source: State Statistics Institute and hearings of General Directorate of Mineral Works

3. Overview of major mineral resources

a. Reserves

Geologically-speaking, Turkey belongs to the Tethys Sea convergent zone (Turkey-Caucasus area), which forms a mineral district endowed with various mineral resources due to the development of its complex geological composition since the Paleozoic era (see Figure II -7).

Turkey's major reserves of mineral resources consist of the world's largest reserve of boron, third largest of soda ash, and fourth largest of barite in regard to industrial raw minerals, and fourth largest reserve of magnesium (magnesite) and seventh largest of chromium in reference to metallic minerals. (Source: Metal Mining Agency of Japan, Report of the FY 2000 Overseas Satellite Imagery Analysis Survey)

Moreover, according to MTA materials, the percentage of Turkey's share of the world's mineral reserves has been reported with a focus on major industrial raw minerals (Figure II -4).

Figure II -4: Turkey's share of the world's mineral reserves (unit: %)

Boron	Pearlite	Barite	Strontium	Cyanite	Sodium sulfide	Mercury	Tripolite	Lignite	Magnesite
51	8.7	7.1	7.1	3.4	3	3	2.9	2.2	1.5

Source: Mining Organization of Turkey and MTA 1999 (Third World training text)

b. Production volume

Beginning with chromium, boron, magnesite, lignite, and steel are among the major mineral productions in Turkey. The production of magnesite has increased approximately three-fold in the past ten years (Figure II -5).

Figure II -5: Trends in production volume of Turkey's major minerals (unit: 1,000 mt)

	1965	1970	1975	1980	1985	1990	1995	1996
Chromium	585	773	952	551	877	1,204	2,080	1,279
Boron	196	524	964	1,334	1,543	2,062	1,768	2,400
Magnesite	86	300	457	826	1,137	845	1,928	2,341

Source: Mining Sector in Turkey (General Directorate of Mineral Works)

c. Volume and amount of exports and imports

According to statistics on Turkey's total mineral exports and imports (Figure II -9 and 10), the ratio of total imports of industrial raw minerals and metallic minerals to total exports examined by fiscal year amounted to an import surplus of approximately 70 – 80% for each fiscal year in the three years from 1996 to 1998.

The most conspicuous factor causing the import surplus is the import of hard coal and iron ore, with their combined imports accounting for approximately 72 – 75% of all imports each fiscal year.

Regarding Turkey's domestic reserves of hard coal and iron ore (1995 estimates), it possessed 743,300 thousand tons of hard coal and 119,161 thousand tons of iron ore (see Figure II-7), and domestic production volume (FY 1996) was 3,581 thousand tons for hard coal and 6,279 thousand tons for iron ore (see Figure II-8).

Import volume, on the other hand, was 7,855 thousand tons (1996), 9,606 thousand tons (1997), and 8,450 thousand tons (1998) for hard coal, and 2,999 thousand tons (1996), 2,950 thousand tons (1997), and 3,821 thousand tons (1998) for iron ore (see Figure II-12). Judging from the domestic reserves of these minerals, there still seems to be potential to increase the national production rate.

d. Major minerals

(1) Industrial raw minerals

(i) Boron

Turkey has the world's largest boron reserve, claiming 51% (1.8 billion tons) of the world's reserves of boron (Figure II-4 and 7). At 1.56 million tons (refined volume, 1998), its production volume is second only to the USA, and claims 25% (1998, $124 million) of all mineral exports (Figure II-9).

Major mines are located in Kirka, Emet, and Bigadic, all of which are operated under the monopoly of Eti Holding.

(ii) Others

Turkey's production of pearlite, magnesite, and feldspar, etc. make up approximately 10% of the world's production (Figure II-6), establishing Turkey as a major producer of industrial raw mineral resources. Marble accounts for the second largest export ($105 million, 1998) of minerals following boron (Figure II-9).

Figure II-6: Turkey's share in the world's mineral production volume as of 1997 (unit: %)

Boron	Pearlite	Magnesite	Feldspar	Chromite	Lignite	Bentonite	Barite	Graphite
48	11.82	10.67	7.92	6.87	5.20	4.31	2.38	2.18

Source: Mining Organization of Turkey and MTA 1999 (Third World training text)

(2) Metallic minerals

(i) Chromium

Turkey is known as an exporter of chromium used for steel. In fiscal 1997, export volume totaled 510,000 tons, total exports $57 million, and production volume 1.64 million tons, accounting for 7% of the world's total (Figure II-6).

Major deposits are found in the Guleman-Elazig, Kopdag-Erzincan, and Koycegiz-Fethiye-Mugla regions. Ferrochromium (secondary raw material for steel, processed product of chromium) is produced solely by Eti Holding, whose plants in Elazig and Sark have a production capability of 150,000 tons for high-carbon ferrochromium and 10,000 tons for low-carbon ferrochromium.

(ii) Copper

Turkey's copper reserve is small compared to the world, but the region along the Black Sea has high mining potential for Kuroko-type ores, and is currently under exploration by INCO and Dowa Mining. Besides the Murgul mine, another major copper mine is the Kure mine of Eti Holding, which produces about 300,000 tons of refined copper yearly.

In addition to the Samsun smelting plant, there are eight smelting and refining plants in Turkey, but all with a low rate of operation. As opposed to a combined production capacity of 188,000 tons, actual performance in 1998 was a mere 109,000 tons. Because of the shortage of copper ores, there is much concern regarding exploration and development issues.

(iii) Lead and zinc

The production capacity of the Cinkur refinery, privatized in 1996, is small in scale at 350,000 tons of electrolytic zinc, 6,000 tons of lead, and 125 tons of cadmium. However, as with copper, there is a serious lack of lead and zinc ores, causing the refineries to depend on imports.

(iv) Aluminum

Seydisehir mine and refinery operated by Eti Holding are the only production facilities of aluminum. They are capable of producing 540,000 tons of bauxite, 200,000 tons of alumina, and 60,000 tons of aluminum (1998), but are not capable of producing excess for exports.

Figure II -7 Turkey's Mineral Reserves (Estimated in 1995)
Source: The Mineral Industry in Turkey 1997 (Text made for the Third Country Training by MTA)

	Reserves (mt)	Reserves
Metallic Minerals	Proved + Probable	Grade - Quality
Antimony	106,306	Metallic Sb
Bauxtie	87,375,000	42-60% Al_2O_3
Chromite	28,500,000	20-50% Cr
Copper	2,279,210	Metallic Cu
Gold	112.8	Metallic Au
Iron	119,161,000	55% Fe
Lead	860,387	Pb content
Manganese	4,500,000	35% Mn
Mercury	3,820	Metallic Hg
Silver	6,062	Metallic Ag
Tungsten	36,719	Metallic W
Zinc	2,294,479	Metallic Zn
Industrial Minerals		
Alunite	4,000,000	7.54% K_2O
Asbestos	29,646,379	In variable fibre length, fibre content over 4%
Barite	35,001,304	71-99% $BaSO_4$
Bentonite	236,315,642	Drilling mud additive, molding sand binder, bleaching earth
Boron Minerals	1,805,709,953	24.4-35% B_2O_3
Celestile	665,072	Over 72% $SrSO_4$
Clay (ceramics & refractory)	349,819,000	Ceramics + refractory
Diatomite	44,224,029	Good quality
Dolomite	15,887,160,000	Over 15% MgO
Emery	3,725,082	Over 50% Al_2O_3
Feldspar	239,305,500	Albite and orthoclase
Fluorite	2,538,000	40-80% CaF
Graphite	90,000	1-17% C
Kaolin	89,063,770	15-37% Al_2O_3
Kyanite	3,840,000	21-52% Al_2O_3
Magnesite	111,368,020	41-48% MgO
Meerschaum	1,483,000 (box)	Good + medium quality
Perlite	136,087,368	Expansion ratio over 5%
Phosphate	70,500,000	19% P_2O_3
Pumice (m^3)	1,472,964,776	Good quality
Pyrophylite	6,644,000	Ceramics + refractory + cement quality
Qyartz sand	911,000,000	Over 90% SIO_2
Quartzite	1,847,082,433	Over 90% SIO_2
Rock Salt	5,773,708,017	Over 88.5% Nacl (200 million tons of lake water reserve
Seplolite	13,676,727	Sepolite content over 50%
Sodium Sulphate	16,536,000	81% Na_2SO_4 (13 million tons of lake water reserve included)
Sulphur	626,000	32% S
Talc	283,531	Good quality
Trona	233,317,680	Over 56% trona
Zeolite	17,931,375	Clinoptilite + heulandite
Fuel Mineral		
Hard Coal (Tons)	743,300,000	
Lignite (Tons)	7,964,900,000	
Oil (Tons)	958,000,000	
Neural Gas (m^3)	16,700,000,000	

Figure II -8 Mineral Production in Turkey

Source: Mining Sector in Turkey (General Directorate of Mineral Works)

Years	Production	Hard coal	Lignite	Iron ore	Chromium	Copper	Boron	Magnesite
1965	T	7,019	6,350	1,545	585	817	196	86
	G	7,007	4,641	872	270	817	81	-
	P	12	1,709	673	315	-	115	86
1970	T	7,608	8,773	2,949	773	835	524	300
	G	7,598	6,881	1,672	278	822	242	79
	P	10	1,892	1,277	495	13	282	221
1975	T	8,361	11,856	2,359	952	2,205	964	457
	G	8,361	8,732	1,333	278	2,189	652	21
	P	-	3,124	1,062	674	16	312	436
1980	T	6,599	16,998	2,579	551	1,593	1,334	826
	G	6,599	15,593	2,314	206	1,590	1,334	109
	P	-	1,405	265	345	3	-	717
1985	T	7,260	39,438	3,955	877	2,228	1,543	1,137
	G	7,260	34,039	2,746	233	2,228	1,543	135
	P	-	5,399	1,249	644	-	-	1,002
1990	T	5,628	46,892	4,924	1,204	4,018	2,062	845
	G	5,628	39,781	4,293	242	4,018	2,062	228
	P	-	7,111	631	962	-	-	616
1994	T	4,210	55,038	5,773	1,270	3,346	2,087	1,365
	G	4,210	49,415	5,225	253	3,346	2,087	423
	P	-	5,622	547	1,016	-	-	942
1995	T	3,377	56,031	4,931	2,080	2,927	1,768	1,928
	G	3,377	51,184	3,997	323	2,927	1,768	363
	P	-	4,846	933	1,756			1,564
1996	T	3,581	57,532	6,279	1,279	3,528	2,400	2,341
	G	3,581	52,920	5,250	341	3,528	2,400	1,491
	P	-	4,611	1,029	937	-	-	850

T=Total, G=Government, P=Private ($\times 10^3$ ton)

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Figure II -9 :Amount of mineral exports in Turkey

Source: Mining sector in Turkey (General Directorate of Mineral Works)

EXPORT ×1000$			
Industrial Minerals	1996	1997	1998
Borax productions	141.020,00	136.124,00	123.841,00
Sinter magnesite	26.350,00	35.266,00	31.683,00
Calcined magnesite	4.019,00	2.415,00	3.330,00
Raw magnesite	2.917,00	1.359,00	2.138,00
Pumice	10.796,00	8.073,00	8.517,00
Barite	8.079,00	8.743,00	8.163,00
Plate marble	2.153,00	3.602,00	5.068,00
Block marble	7.593,00	11.029,00	12.096,00
Marble production	79.142,00	94.305,00	104.990,00
Perlite	4.212,00	3.942,00	3.874,00
Celestine	3.405,00	3.228,00	1.981,00
Kaolin and clay	5.150,00	3.878,00	5.592,00
Bentonite	2.431,00	2.790,00	4.133,00
Feldspar	15.933,00	2.0692,00	24.500,00
Salt	692,00	981,00	864,00
Hard coal	-	-	-
Lignite	-	-	-
Other	18.444,00	18.752,00	19.516,00
Total	332.363,00	355.149,00	360.286,00
Metals and concentrates			
Chromic concentrates	59.124,00	57.495,00	45.638,00
Copper and concentrates	28.740,00	49.732,00	33.916,00
Zinc and concentrates	21.907,00	31.138,00	22.487,00
Aluminium and concentrates	357,00	35,00	64,00
Raw chromite	960,00	3.467,00	3.382,00
Other	23.730,00	18.874,00	19.793,00
TOTAL	134.818,00	160.741,00	125.280,00
GENERAL TOTAL	467.181,00	515.890,00	485.566,00

Figure II -10 :Amount of mineral imports in Turkey

Source: Mining sector in Turkey (General Directorate of Mineral Works)

IMPORT ×1000$			
Industrial Minerals	1996	1997	1998
Borax productions	-	-	-
Sinter magnesite	2.670,00	1.216,00	987,00
Calcined magnesite	155,00	231,00	124,00
Raw magnesite	1,00	280,00	-
Pumice	36,00	43,00	16,00
Barite	214,00	306,00	434,00
Plate marble	8,00	71,00	96,00
Block marble	1,00	4,00	36,00
Marble production	13.395,00	20.425,00	34.871,00
Perlite	14,00	17,00	32,00
Celestine	0,00	56,00	-
Kaolin and clay	13.090,00	15.346,00	18.653,00
Bentonite	385,00	97,00	191,00
Feldspar	814,00	1.798,00	1.841,00
Salt	735,00	1.462,00	3.362,00
Hard coal	521.558,00	555.259,00	458.839,00
Lignite	56.609,00	3.022,00	1.216,00
Other	100.014,00	139.303,00	127.684,00
Total	707.296,00	738.946,00	648,382,00
Metals and concentrates			
Chromic concentrates	166,00	166,00	104,00
Copper and concentrates	4.310,00	18.685,00	2.283,00
Zinc and concentrates	8.681,00	13.448,00	18.942,00
Aluminum and concentrates	4.527,00	4.146,00	44.550,00
Raw chromite	647,00	37,00	4.767,00
Iron ore	115.000,00	106.000,00	141.000,00
Other	6.148,00	11.036,00	9.486,00
TOTAL	139.479,00	153.518,00	181.132,00
GENERAL TOTAL	846.775,00	892.465,00	829.514,00

Figure Ⅱ-10 :Amount of mineral imports in Turkey
Source: Mining sector in Turkey (General Directorate of Mineral Works)

IMPORT ×1000$			
Industrial Minerals	1996	1997	1998
Borax productions	-	-	-
Sinter magnesite	2.670,00	1.216,00	987,00
Calcined magnesite	155,00	231,00	124,00
Raw magnesite	1,00	280,00	-
Pumice	36,00	43,00	16,00
Barite	214,00	306,00	434,00
Plate marble	8,00	71,00	96,00
Block marble	1,00	4,00	36,00
Marble production	13.395,00	20.425,00	34.871,00
Perlite	14,00	17,00	32,00
Celestine	0,00	56,00	-
Kaolin and clay	13.090,00	15.346,00	18.653,00
Bentonite	385,00	97,00	191,00
Feldspar	814,00	1.798,00	1.841,00
Salt	735,00	1.462,00	3.362,00
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Raw chromite	647,00	37,00	4.767,00
Iron ore	115.000,00	106.000,00	141.000,00
Other	6.148,00	11.036,00	9.486,00
TOTAL	139.479,00	153.518,00	181.132,00
GENERAL TOTAL	846.775,00	892.465,00	829.514,00

Figure II -11 :Quantity of mineral exports in Turkey

Source: Mining sector in Turkey (General Directorate of Mineral Works)

EXPORT ton			
Industrial Minerals	1996	1997	1998
Borax productions	735.878	731.719	655.517
Sinter magnesite	96.607	156.435	147.090
Calcined magnesite	22.388	17.561	24.433
Raw magnesite	52.876	27.115	39.135
Pumice	145.880	88.066	94.966
Barite	124.887	125.411	123.957
Plate marble	15.828	23.018	21.474
Block marble	48.646	79.738	91.861
Marble production	169.927	206.183	234.191
Perlite	161.526	178.054	141.897
Celestine	49.350	46.110	29.570
Kaolin and clay	188.666	158.642	185.431
Bentonite	48.528	68.178	90.182
Feldspar	770.171	950.140	1.283.090
Salt	10.377	13.116	17.427
Hard coal	-	-	-
Lignite	-	-	-
Metals and concentrates			
Chromic concentrates	519.299	518.554	495.136
Copper and concentrates	111.435	180.669	154.840
Zinc and concentrates	107.672	108.186	101.840
Aluminum and concentrates	21.000	110	226
Raw chromite	8.398	35.350	42.516

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Figure II -12 : Quantity of mineral imports in Turkey
Source: Mining sector in Turkey (General Directorate of Mineral Works)

IMPORT ton			
Industrial Minerals	1996	1997	1998
Borax productions	-	-	-
Sinter magnesite	1.052	4.016	3.526
Calcined magnesite	175	352	157
Raw magnesite	1	178	-
Pumice	5	9	3
Barite	401	642	2.069
Plate marble	24	462	191
Block marble	3	35	485
Marble production	17.250	24.259	41.406
Perlite	15	26	43
Celestine	-	60	-
Kaolin and clay	83.690	113.432	139.326
Bentonite	1.932	154	206
Feldspar	10.108	7.546	18.035
Salt	3.511	4.660	7.569
Hard coal	7.855.087	9.606.114	8.450.734
Lignite	951.862	62.115	22.580
Metals and concentrates			
Chromic concentrates	686	672	435
Copper and concentrates	735	35.952	8.219
Zinc and concentrates	31.613	68.120	83.377
Aluminum and concentrates	34.874	25.680	24.844
Raw chromite	4.517	150	19.062
Iron ore	2.999.000	2.950.000	3.821.000

Chapter III

Organizational Framework of Development Issues

III. ORGANIZATIONAL FRAMEWORK OF DEVELOPMENT ISSUES

A. Legal System

1. Mining industry regulations

According to the Turkish constitution, natural resources belong to the country, and the right to search for and develop resources is assigned to the state. Mining industry regulations and other related laws have been established in keeping with this basic principle.

The laws and regulations related to mining include mining industry laws, petroleum laws, salt regulations, and quarry regulations. Among these, the Mining Law was enacted in 1958. Revisions to the law are still being made.

The Mining Law specifies the issues of resource search and development in Turkey, other than for petroleum, natural gas, salt and rock quarries. The target minerals are classified into 4 categories; energy minerals (coal, radioactive minerals), metallic minerals (iron, copper, lead, zinc, gold, silver, etc.), construction and industrial minerals (clay, marble, boron, etc.), and precious stones/gemstones. Mining activities in Turkey are regulated by the Mining Law 3213, under the jurisdiction of the Ministry of Energy and Natural Resources (MENR). Presently, the Ministry of Energy and Natural Resources is making preparations to revise the Mining Law.

2. Mining industry rights and royalties

When mining activities are conducted in Turkey under this Mining Law, it is necessary to obtain mining rights. There are 2 types of mining rights, a prospecting license (AR) and an exploitation license (OIR or IR).

The prospecting license is granted on a first-come-first-served basis, and is valid for 24 months. In principle, the area of exploration is not limited, except for marble (2.5 km^2) and mining in lakes and marshes (20 km^2). Every 8 months a report must be submitted to the MENR. For the transition to development, a period of 3 years is allowed for development or trial operations.

The exploitation licenses are divided into 2 types, the pre-exploitation license (OIR) and the exploitation license (IR). The OIR are granted in cases when promising areas are identified through exploration activities. If a prospecting project is conducted while the OIR is in effect, an IR is granted. The license period from the IR can be anywhere from 10 to 60 years, but the operations must be started within 6 months after the IR is obtained. Five (5)% of the annual net profits from the mining development must be paid to the national treasury as royalties. Further, the Mining Law stipulates that 5% must be paid to the Mining Fund. However, this Mining Fund was eliminated.

(The Mining Fund was established under the General Directorate of Mining Fund of the Ministry of Energy and Natural Resources, as a fund to subsidize search, investment, production and exportation for the mining industry. This fund was built up through payments of 5% of the annual net profits from the state-run and private enterprises in the mining field. However, on February 22, 2001 this scheme was abolished as a result of EU demands. Under the Mining Fund, there are 5 types of credit, including mining research and development credit, export credit, investment credit, mining credit, and stock.)

MTA activities are conducted in accordance with the Mining Law 3213. The MTA is entitled to be a holder of AR or OIR, but cannot be granted an IR. Therefore, when the MTA completes search activities, the AR and OIR are sold off to private enterprises or to state-run companies in order to realize a profit.

B. Mining and Geology related agencies

1. Government agencies

a. Ministry of Energy and Natural Resources : MENR

The government agencies are set up under the Prime Minister's Office, consisting of 17 ministries and 18 ministers of state.

Mining industry issues are under the jurisdiction of the Ministry of Energy and Natural Resources. This Ministry was separated from the Ministry of Industry and established as a separate entity in 1963. The General Directorate of Mineral Research and Exploration (MTA) was also under the supervision of the MENR, but is presently set up as an agency under the immediate control of the ministers of state.

MENR is composed of 14 bureaus. Mining industry policy, regulation and licensing (exploration, development, and operation) is under the jurisdiction of one of these bureaus, called the General Directorate of Mineral Works.

b. Under secretariat of State Planning Organization : SPO

The Under-secretariat of the State Planning Organization is an agency associated with the Prime Minister's Office. The SPO determines the budget allocations to the various agencies, including the MTA, and devises the national development plan (every 5 years). In addition, the SPO also acts as the contact for receiving assistance from abroad. The SPO comprehensively bears the responsibility for implementing policy, and for giving approval of the planning and operation of policy overall. The SPO does not directly supervise each agencies.

For the parts that are related to the MTA, there are negotiations between the SPO and MTA regarding budget decisions, and budget allocations are made through the approval of the operation plans.

For the SPO, the revenue from the resource exploration that is the activity of the MTA is recognized as being important from the perspective of overcoming economic crises, and is considered to foster the export industries of the future. The SPO places a priority on exploration for precious metals (gold) and for key industrial materials such as iron ore.

c. General Directorate of Mineral Research and Exploration : MTA

This is a national geological survey and resource exploration agency established in 1935 by law 2804 for the purpose of promoting the development of resources; and is the agency implementing this project. This agency is discussed in detail in section C.

2. Government-run enterprises (public corporations)

State-run enterprises related to the mining industry include TDCL for iron and steel, TKI (lignite) and TTK (bitumen) for coal, and the two companies of Eti Holding Inc. (formerly Etibank) and KBI (Black Sea Copper Works) handling metals other than iron. Eti Holding Inc. and KBI are both currently in the process of being converted to private companies.

Outlines of Eti Holding Inc. and KBI are given below.

a. Eti Holding Inc.

Etibank was established in 1935, and is the largest state-run mining company in Turkey. In 1998, it was separated into Eti Holding Inc., handling the mining operations, and Etibank, handling the financial operations.

In accordance with the privatization plan, 4 of the 7 subsidiary companies (related to copper, silver, chromium, and natural soda) in Eti Holding Inc. were privatized in 2000. However, since boron and aluminum (bauxite) are key mineral products, these are a monopoly under the same company. Each year, the scale of operations contracts, and there are presently 3 or 4 geologists.

The exploration projects conducted by Eti Holding Inc. are often performed jointly with the MTA or a private company. The Cayeli copper mine that began operation in 1994 was the first joint operation in Turkey for the mining division. The breakdown of the investment is Eti Holding 45%, Inmet Mining (Canada) 49%, and GAMA Co. 6%. The MTA is conducting joint venture (J/V) exploration for lead, zinc and gold ore in the north eastern area of Anatolia. The expense of prospecting is about $300,000 for each site, and the MTA is covering the expenses for the mine development with their own fund.

In addition to the documents and map information from the MTA, other project data is provided, and exploration, feasibility studies (F/S), etc. are conducted based on these information.

b. KBI (Black Sea Copper Works)

KBI was established as a subsidiary of the copper division of Etibank in 1968. In 1993, it was split off and became independent. In May 2001 a bid was placed on the Kure mine owned by Eti Holding Inc. and plans have been made to privatize the operation.

KBI operates the Murgul copper mine (Damar ore deposit, and Cakmakkaya ore deposit). The annual quantity of concentrates produced at this copper mine is about 75,000 t. The entire amount is transported to the Samsun smelting works where blister copper and sulfuric acid are produced (annual processing capacity 180,000 t, blister copper production capacity 35,000 t, purity 99.3%). The lacking raw materials relative to the production capacity of the Samsun smelter are purchased from the Cayeli copper mine, which is a J/V of Eti Holding Inc. and private enterprise. The amount of confirmed remaining ore in the Murgul mine is about 5,000,000 t (grade 0.6%Cu), and it is expected that operations will be terminated within 1 to 2 years.

INCO/Dowa mining operations are continuing to prospect in the region along the eastern coast of the Black Sea. If a developable ore deposit is discovered, there is a plan for a joint venture between KBI and INCO. At present, there is no cooperative relationship with MTA.

c. Private sector companies

The major private mining companies are Demir Export, Park Holding, and Dardanel (J/V with France). In recent years, operations have been developing not only domestically, but also in Central Asia, the Caucasus, and Eastern Europe.

However, the private enterprises active in Turkey are mainly involved in development, and there are few companies conducting exploration activities. The results of the hearing from the Park Teknik company indicate that they are the only private company conducting exploration in Turkey.

Accordingly, the research and exploration activities for mineral resources in Turkey are primarily conducted by the MTA. The MTA performs 80% of the research and exploration activities, with 10% handled by universities and 10% conducted by private enterprise.

For the previously-mentioned Eti Holding Inc., the divisions for copper, silver, chromium, natural soda, as well as lead and zinc have already been privatized, so development is being conducted with a private company base.

Foreign-capitalized firms (Cominco–Canada, Eurogold–Canada・Australia, Gencor–South Africa, etc.) are gaining ground in the area of gold mining.

d. Agencies associated with geological remote sensing

Besides the MTA, organizations making use of remote sensing technology for the field of geology include the Middle East Technical University (METU), which offers remote sensing / GIS courses (Geodesic and Geographic Information Technologies: GGIT, masters course).

GGIT was established 2 or 3 years ago under the Department of Civil Engineering. Currently, there are about 40 students and 3 staff members. This is a multi-disciplinary program, with students from a variety of backgrounds, including civil engineering, agriculture, urban planning, as well as geology and resource engineering. There are 5 students specializing in resource exploration, one each from the MTA Geological Research department RS and GIS Division, and Turkish Petroleum Enterprises, with the remaining students belonging to private companies. The RS section of METU has 4 computers for 12 students working with LANDSAT, IRS and SPOT images.

The relationship to the MTA is that MTA staff members are accepted into the masters courses for GGIT and geological science. For the GGIT, requests are received from other agencies, and training courses and engineering are performed. When the MTA conducts a training program, instructors may be dispatched from GGIT.

METU students are required to take positions as interns during the summer of their second and third years. The MTA accepts METU students in this role. In the summer of 2000, there were 6 interns in RS and GIS Division.

In addition to those mentioned above, there are related agencies (government, research organizations/universities, private enterprise) conducting activities utilizing general remote sensing technology. The figure Ⅲ-1 lists some of the agencies.

These agencies use the remote sensing technology for a variety of applications, including agriculture, the environment, earthquakes, and oceanography. The results of the image analyses obtained from the MTA remote sensing center can be applied to fields like these in the future. From the perspective of widely disseminating the results of this project, seminars could be held, and trainees could be accepted from these related organizations.

Figure III-1: Agencies related to remote sensing in Turkey

Agency / Organization	Field
Anadolu University, Research Institute of Satellite and Space Sciences	Earth Sciences, Remote Sensing
Cukurova University, Faculty of Agriculture, ADANA	Agriculture and Soil Mapping
Gazi University, Department of City Planning, ANKARA	City Planning
General Directorate of Eastern Black Sea Forestry	Forestry
General Directorate of Mineral Research and Exploration, Division of Remote Sensing and Geographic Information Systems, ANKARA	Earth Science
General Directorate of Rural Affairs, Research Institute of Soil and Fertilizer	Soil Mapping
Hacettepe University, Application and Research Center of International, Karst and Water Resources, ANKARA	Water Resources Hydrogeology
Hacettepe University, Department of Geological Engineering, ANKARA	Earth Sciences
Institute of State Statistics Divisions of Data Systems, ANKARA	Agricultural Statistics
Istanbul University, Institute of Marine, Sciences and Geography, ISTANBUL	General Geography
Istanbul Technical University, Department of Photogrammetry, Division of Remote Sensing, ISTANBUL	Digital Photogrammetry and Land Use
Mediterranean University, Faculty of Agriculture, ANKARA	Soil Mapping and Land use
Middle East Technical University, Department of Geological Engineering, ANKARA	Geology
Ministry of Agriculture, General Directorate of Agricultural Reform, Directory of URFA Region, URFA	Farmland Planning
Ministry of Agriculture, General Directorate of Agricultural Researches, ANKARA	Agricultural Research
Ministry of Environment	Environmental Research
Ministry of Public Works, General Directorate of Disaster Affairs, Department of Earthquake Research, ANKARA	Earthquake Research
Middle East Technical University, Department of Civil Engineering, Water Resources Lab.	Water Resources
Tubitak, Marmara Research Center, Department of Aero Space	Remote Sensing
Tubitak, Marmara Research Center, Department of Earth Sciences	Earth Sciences
University of Ankara, Faculty of Agriculture Department of Landscape Architects, ANKARA	Landscape, Architect and City Planning
University of Ankara, Faculty of Sciences, Department of Geological Engineering, ANKARA	Geology
University of Dokuz Eylul, Institute of Marine and Science and Geography, IZMIR	Marine Sciences
Uludag University, Department of Agricultural Structures and Irrigation, BURSA	Agricultural
Yildiz Technical University, Department of Geodesy and Photogrammetry, ISTANBUL	Soil Mapping and Land Use

C. MTA Current Status and Issues

1. Current Status

The MTA (General Directorate of Mineral Research and Exploration) is a government-run geological survey and resource exploration organization that was established in 1935 by law 2804 for the purpose of promoting the development of national natural resources. It is the largest organization in Turkey in the field of geology in terms of both facilities and personnel. In the past, it was part of the Ministry of Energy and Natural Resources (MENR), but is currently operating as an agency directly connected to the Prime Minister's Office, under the jurisdiction of the ministers of state.

The MTA headquarters are located in the capital, Ankara, and has 16 departments operating under the direction of a president and vice presidents (4 people). At one time, there were also 13 local branches. As a result of the enhanced authority of MTA headquarters and the effort to streamline the organization, restructuring and consolidation are being made. In July 2001, one of the local branches was closed, with another 5 local branches eliminated in April 2002. Further consolidation and down-sizing are planned in the future.

As of March 2002, the MTA had approximately 3,800 employees (2,115 at headquarters, 1,666 in the local branches), and an estimated budget of 91.75 trillion Turkish lira (TL).

2. Operating Details

a. Outline

The main operations of the MTA are as follows:

—Exploration and search of promising regions for exploration of mineral resources

—Documentation of the geology of ore deposits and conducting laboratory tests

—Performing economic evaluations of ore deposits

—Human resources development in the field of geology and mining

In addition to departments conducting various types of surveys, such as drilling, geophysical exploration, and geological surveys in order to implement exploration, there are also departments set up to provide support for development, including feasibility studies (F/S) and financing.

In addition to these activities, the MTA also has a role as a research organization, and is responsible for maintaining the fundamental public maps of Turkey. With regard to the geological maps, already a series of 1:100,000 scale map has covered all national territories, and currently a work on a more detailed 1:25,000 scale digital map is in progress. Furthermore, other types of maps on a wide range of topics, such as a map of all mines in Turkey, are created and published. The MTA also possesses a variety of facilities and equipment to support these investigation and research. They own a special geological survey vessel for fault surveys in Anatolia, Three ICP units (inductively coupled high-frequency plasma emission photo spectrometers), as well as various types of analytic devices.

The survey, research and exploration projects conducted by the MTA can be classified into 2 categories, those planned and executed by the MTA itself, and those performed at the request of another agency (government organization, state-run company, or private enterprise).

For the former type of survey and research projects, authorization from the SPO is required. The survey results from the project are summarized in reports and provided to the relevant agencies either at no charge or for a nominal fee.

For the latter type, requests have been handled from government-owned companies including Eti Holding Inc., TDCL (Iron Steel Enterprises), TTK (Hard Coal Enterprises) and KBI. For projects conducted at the request of private enterprises, a special agreement is made, and there are typically about 5 such projects a year. Basically, these projects are conducted at no charge (including up to the pre-F/S).

b. Basic Research on Environmental Conservation and Natural Disasters

For the fields of environmental conservation and natural disaster, the MTA acts as an advisor to the government on the geological aspects. In addition to creating and maintaining a wide variety of maps, such as fault distribution maps, the MTA receives requests from other government agencies and state-run companies to conduct surveys and research.

At present, there is work underway on a request from the Ministry of the Environment for a survey to select sites for a nuclear power plant, as well as on a request from Eti Holding Inc. to conduct monitoring for the soil cover planting on strip mines.

There are also surveys being conducted on landslides and surveys to select sites for urban and industrial areas.

c. International Exchange and Acceptance of Trainees

The MTA makes efforts to participate in international exchanges related to geological technology, especially with various countries in Central Asia, northern Africa, the Caucasus, and the Balkans, through joint research, construction of geological information databases, and bringing in trainees. Turkey has technological superiority over the neighboring nations in the field of geology, as well as historically deep ties with these neighbors. From now on, these international exchanges regarding geology are likely to continue.

In this way, the MTA is more than just an exploration agency responsible for resource development in Turkey. This agency is also a comprehensive organization taking the lead in basic research and technological cooperation in the field of geology with the neighboring nations.

3. Issues

The Turkish economy is not yet in a good condition, including the recent rapid growth in financial deficits. Turkey is proceeding with a 3 year economic recovery program that was designed in partnership with the IMF. The Turkish government is also faced with demands to correct various issues, in order to achieve the targets specified for admission to the EU.

Under these circumstances, for the mining resources field, although development has proceeded in the past under a concept of relatively "big government", there are forces at work to restructure and downsize the various government organizations. For the mining industry sector, it has already been decided that the state-run companies handling development and production, such as Eti Holding Inc. and KBI (Black Sea Copper Works), will be privatized, and there is a gradual transition and contraction trend. Furthermore, as mentioned previously, on February 22, 2001 it was decided to abolish the Mining Fund system that has acted as a mutual aid mechanism to promote mineral resources development.

For the MTA as well, as part of the strengthening of headquarters and streamlining the organization, in July 2001 one of the 13 local branches was eliminated, with another 5 local branches closed in April 2002. There are still plans to continue to consolidate and down-sizing in the future. The number of employees has also decreased by about 700 in the last few years, although most of this was the result of natural attrition (people reaching retirement age). There are no plans to reduce the workforce, and 40 new employees were hired in 2001, and an additional 35 new hires are planned for 2002. In fact, there are many outside groups asking the MTA to hire their personnel so that they can learn the latest technology. Internally, the MTA is revising the assignment of personnel in order to strengthen the geological research department that focuses on exploration of ore deposits. They are also investigating changes in the drilling department, where the cost of diamond drilling hole have become high as US$250 per meter.

An issue related to the implementation of the exploration activities of the MTA is the restriction on the freedom to choose the survey areas. Under the current Turkish Mining Law, the MTA is required to obtain exploration licenses with their own money before conducting exploration operations, in the same way as private enterprises and individuals. Accordingly, when selecting a target survey region, the MTA must avoid the mining areas of others, preventing effective exploration and development of the country based on the true resource potential. Revisions to the Mining Law are underway to address this issue, and the MENR General Directorate of Mineral Works, which authorizes mining claims, is actively conducting investigations.

In addition, for the 8th National Development Plan effective exploration activities are proposed based on high-level technology. It is anticipated that the MTA will be the agency implementing these activities. The reason there is this kind of participation from the public sector is said to be the fact that the private sector in Turkey does not have sufficient exploration capacity or technology. However, there is a demand to raise the technological level of the recipient private enterprises and universities through widespread awareness and application of advanced technology.

D. Organization Systems and Operations of the Geological Research Department and the Mining Research and Exploration Department

1. Geological Research department

The counterpart for this The Japan-Turkey Geologic Remote Sensing Project is the Geological Research Department. As shown in figure III-2 of the organizational chart, this department is composed of 6 divisions, an Editorial Board, and a general affairs office.

There is a coordinator acting as the head of each division, which is composed of several units. Each unit is managed by a Unit Manager. Within each division in addition to the units, there are also some positions that are not shown on the official organization charts.

The following are a summary of the duties of the 6 divisions and the Editorial Board:

a. R/D, Planning & Evaluation Division

Planning, monitoring and evaluation of the Geological Research Department

b. Geological Research Division

Creation of detailed geological maps and regional maps

c. Natural Hazards Research Division

Research of active faults and natural disaster: Research on the active faults in northern Anatolia has been conducted for the past 10 years (following an especially large earthquake). The results are planned to be published as a 1:25,000 scale map. In the future, it is planned to study the active faults in eastern and western Anatolia. There are currently also engineering geology studies being conducted (soil utilization, landslides, flooding, etc.).

d. Marine Research Division

Areas at risk of earthquake in the Sea of Marmara are being studied. The Geological Survey of Japan, Tokyo University, the University of Tsukuba, and Kochi University are also participating. They currently own one survey vessel and have planes to acquire another one in the near future.

e. Remote Sensing and GIS Division

(Described later in section E. "Current Status and Issues of the Remote Sensing and GIS Division")

f. External Relations and International Projects Division

This is the group that acts as the contact point for the outside for the entire MTA, including the Geological Research Department. The procedures for cooperative projects with other countries and third-party research are handled here.

2. Mineral Research and Exploration Department

a. Outline

This department conducts the explorations for all mineral resources other than petroleum and energy. The total budget is 150 million dollars. (Support comes from this department's project budget when there are requests for studies from other departments and for physical exploration).

There are 160 staff members, of which about 100 are technical staff, including engineers (mostly geologists), technicians, and map technicians, while the remaining 60 people are office and administrative personnel.

b. Operations

The projects conducted by this department are classified into 2 types; metallic resources and industrial materials. At present, there are 30 projects being implemented. Of these, 60% ~65% are related to metallic resources.

The principle projects among those related to metallic resources are the projects connected with iron, for which there is a strong demand. However, Turkey has a suitable geological structure for gold, so there are also projects related to gold. In addition, there is also exploration being conducted for titanium so that the amount of titanium that is imported can be reduced.

With regard to the industrial materials projects, explorations are being conducted to find the raw materials for the extensive ceramics and glass industries that operate in Turkey.

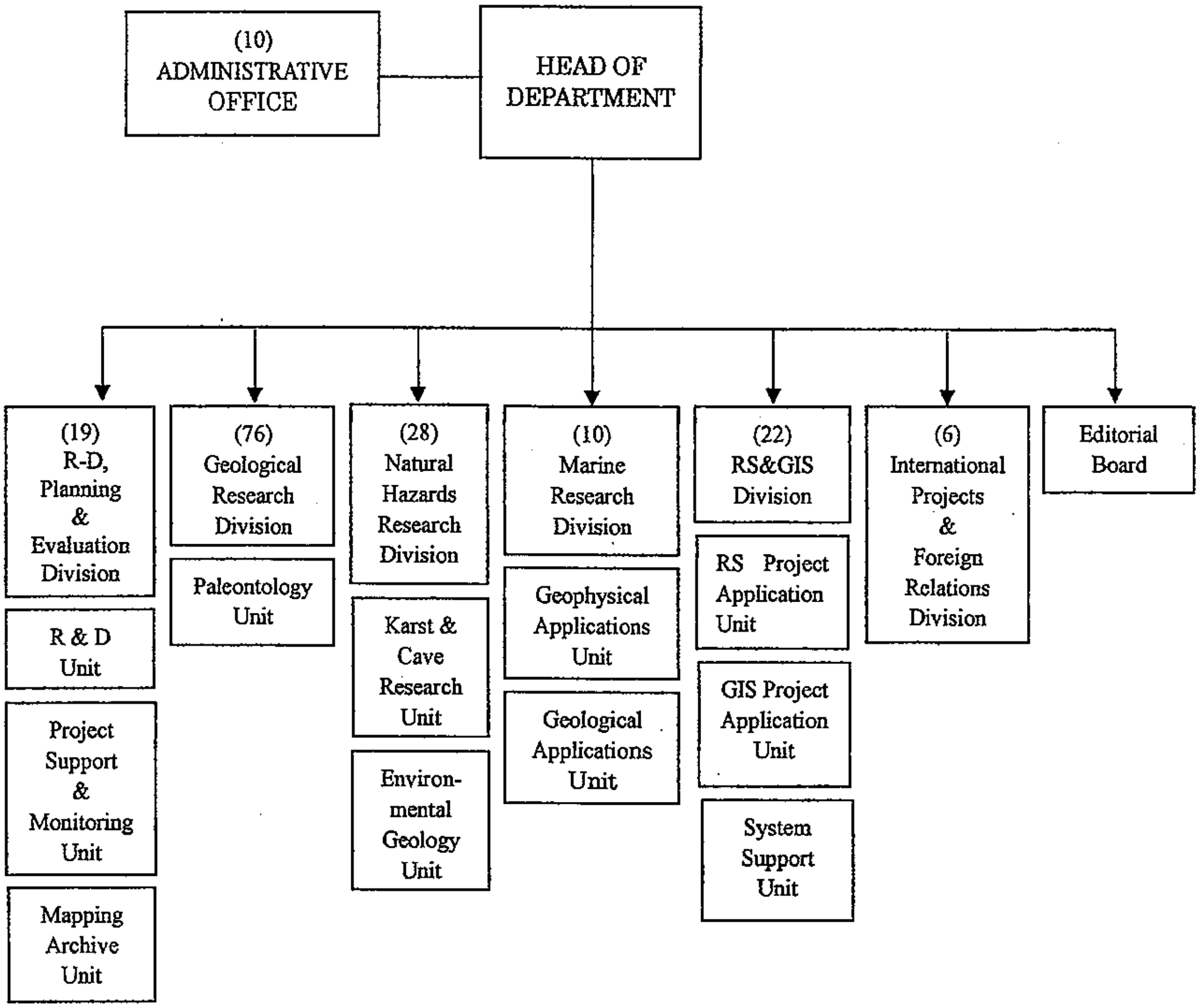
Furthermore, there are also explorations being performed abroad. The first of these projects abroad was started 3 years ago in Mongolia with field surveys performed targeting precious metals (gold) and copper. There are also studies underway for places such as the Sudan and Central Asia (including Azerbaijan).

The connection to the Geological Research Department is basically only at the initial stages of project activity, but there are currently some merged projects for both departments being conducted in the northeastern areas of Anatolia.

c. Exploration Results

When there are promising ore deposits discovered within Turkey, a tender is held and the company that will perform the development is selected. If this company so desires, the Feasibility Study Department can conduct a Pre-F/S.

Figure Ⅲ-2: Geological Research Department



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E. Current Status and Issues of the Remote Sensing and GIS Division

1. Current Status

a. Organization and history

Geological analysis using remote sensing was started at the MTA by the Remote Sensing Unit established in 1975 as part of the Geological Research Department. At that time, there were still no resource exploration satellites, so the analysis was performed using optical equipment purchased to interpret the aerial photographs from UNDP. However, the MTA received these materials and equipment from the UNDP without any specific transfer of analysis technology, and the techniques were learned and built-up independently. Later, computers and resource satellite data became widely available. In 1994 the MTA made a major increase in the facilities and personnel of the Remote Sensing Unit, and established the Remote Sensing Center (RSC) with its own separate budget. Further, in December 2000, the RSC merged with the Geological Data Base Unit and the Geological Data Base Unit to form the Division of Remote Sensing and Geographical Information System (RS and GIS).

The current RS and GIS Division is composed of the Remote Sensing (RS) Laboratory, which mainly works on processing and analyzing LANDSAT data from the USA, the GIS Laboratory, which is converting existing geological data into GIS data, and the Geological Database (DB) Laboratory. The figure Ⅲ-3 shows the organization chart and personnel.

The figure Ⅲ-4 shows the current equipment of the RS Laboratory. Among the hardware owned by the RS Laboratory, both UNIX and Windows NT are used on the image analysis systems. However, since the UNIX machines have not been updated since 1994, expect for memory and HDD upgrades, the performance seems to be somewhat outdated. In addition, the large-format line printer is not capable of producing the current standard level of print quality. For the software, although ERDAS Imagine is being used, it does not appear to have been upgraded since 1994.

There are currently 11 staff members in the RS Laboratory, 2 having Ph.D.s. Almost all of the senior staff members have long experience with field study, and later became involved in the analysis for remote sensing. Accordingly, practical themes are established based on the wealth of experience with field work. In comparison, there are 2 new graduates among the employees. One is enrolled as a graduate student (Middle East Technical University), and is aware of the latest topics and issues on precise evaluation of high-spatial resolution data.

b. Implemented projects and technology level

The research projects conducted by the MTA include projects performed with the MTA's own budget, and projects that have been assigned to the MTA by outside agencies. The entire MTA has a total of 108 research projects. Of these, the RS Laboratory is participating in the 8 projects shown in the figure Ⅲ-5. The use of remote sensing technology in the research projects in recent years breaks down to about 60% for resource development related projects, and 20% for each of environment-related and hazard-related projects. In addition to these projects, the products shown in the figure Ⅲ-6 are also created and sold upon request from outside departments.

c. Examples of Analysis

Some examples of the most recent analysis projects handled by the RS Laboratory are described below.

(1) Basin Project

This is a joint project between the Mineral Research and Exploration Dept. and RS being conducted in the southern portion of Trabzon in the northwest area of Turkey to find metallic ore deposits. The study area is approximately 80,000 km^2, and the targets are the potential areas in the densely forested coastal areas along the Black Sea near Trabzon for lead and zinc deposits, and regions further inland with more sparse vegetation for gold and copper deposits. For the former, LANDSAT data is used to clarify the distribution of especially the circular structures. The areas in the neighborhood of what appear to be marine domes or calderas are presumed to be originating points for mineral deposits. For the latter, basic analysis is being conducted to extract alteration clay zones in the areas around the ore deposits.

(2) Biga Peninsula Project

This is a project for Laboratory. This project is related to the mapping of the regional strata in order to search for ore deposits in the Biga peninsula (480,000 km^2) in the north western area of Turkey. Since this area is about 60% ~ 70% covered by vegetation it is not possible to effectively use the usual method of ratio calculations. Therefore, PCA analysis on LANDSAT data is performed and images are generated using PCA factors with very little contribution of vegetation cover. The results of this analysis yield a diagram that explains the distribution of alteration zones and indicated newly recognized alteration areas which were unknown before this analysis.

(3) Anatolia fault analysis

This is a joint project with another division of the Geological Research Department (Natural Hazards Research Div.). Thermal infrared LANDSAT is used to estimate concealed faults in areas partially covered with vegetation.

Typically, there are zones of comparatively high water content formed along faults. It is known that distinctive low-temperature zones are formed in these areas as a result of heat loss caused by the vaporization of the water. This analysis maps the distribution of latent fault areas showing these low temperature bands, and identifies these areas as potential earthquake prone regions.

(4) Evaluation of turbidity / Study of coastline changes

This is a joint project with other divisions in the Geological Research Department (Natural Hazards Research Div. and Marine Research Div.). Using LANDSAT data from after the massive earthquake in Turkey in 1998, the changes in turbidity along the Sea of Marmara and the changes in the coastline before and after the earthquake are being compared.

(5) Monitoring the effects of open pit mining

On the request of the Eti Holding Inc. LANDSAT data is being used to monitor the progress of soil-covering plantings at the Eskisehir boron mine. Specifically, false color is generated from the data obtained at several time periods, and the vegetation areas are extracted. This is overlaid on the topographical maps to monitor changes.

Based on the analysis examples described above, the fundamentals of the geological remote sensing of the MTA are extremely solid. A thorough geological interpretation is being made of the photographs for the structural analysis maps for the project described in (1). For the projects described in (2), (3), and (4), creative ways are being devised to resolve problems. Project (3) is demonstrating that a method that was considered to only be effective in arid regions can be applied even in semi-vegetated areas.

The RS Laboratory has basically acquired their remote sensing analysis technology and techniques independently, although there has been considerable reference to Japanese technology. The MTA has worked with Japan's ERSDAC (Earth Remote Sensing Data Analysis Center; http://www.ersdac.or.jp/) in joint research operations related to remote sensing.

The joint research projects with ERSDAC were started in 1992. Over a 3 year period explorations for ore deposits in the western portion of Anatolia were performed. Subsequently, from 1995 ~ 1998 the western portion of Anatolia were explored for geothermal resources, and from 1998~2001 there were explorations for ore deposits in the eastern portion of Anatolia. More than half of the image analysis was performed by Japan for the joint research with ERSDAC. After obtaining the analysis results, the Japanese mission was dispatched to Turkey for about 10 days to discuss the field surveys and laboratory studies with the MTA personnel. The project through ERSDAC did not have technology transfer as a goal, but the remote sensing technology on the Japan side was relied upon. Four members of the RS Lab staff have visited Japan 2 ~ 4 times at the invitation of ERSDAC.

A three hour seminar was held during the 2nd preparatory study (July 2001) for the Geologic Remote Sensing Project. The technology for alteration zone mapping is particular interest to the MTA. At this seminar, analysis examples of the alteration zone were presented for the cases of using various types of multi-hyper-spectral data from (1) LANDSAT, (2) JERS-1 OPS, (3) ASTER, and (4) AVIRIS, and discussions were held with 8 engineers from the RS Lab. The seminar made it clear that although there was sufficient understanding of the technology for LANDSAT, which they have been using, the grasp of some portions related to SAR and ASTER was limited, and AVIRIS was a completely new topic.

The GIS Laboratory at MTA has 6 engineers, while the DB Laboratory has 3. These engineers are working primarily on the data I/O to construct GIS data sets, Arc Info programming, and archival. There is a separate building within the MTA for large-scale data storage and the various types of digital data and the derived products are centrally managed using a LAN. The hardware includes both UNIX and Windows-NT systems, just like the RS Lab. For software, there are two licensed copies of Arc Info, as well as licenses for several users for Arc View and Map View.

The work related to creation of geological scale maps by the GIS Lab includes the creation of a 1:25,000 scale map and digitizing the existing 1:100,000 maps through a joint project with the Geological Research Department. The work on the 1:25,000 scale maps began in 1995, and about 4,000 of the required 5,549 sheets have been completed. For this scale map project, the Geological Research Department is performing the editing, while the GIS Lab is responsible for the I/O. In addition, the DB Lab is handling the conversion into a GIS data set for all the other geochemical and geophysical data owned by the MTA.

d. Training Efforts and Technical Level

The MTA fills a role as a training organization. In addition to MTA personnel and engineers in Turkey, the RS and GIS Division also conducts training on RS and GS for government personnel from other countries. At present, about 30 people a year receive training for a month or less. The number of participants from abroad is limited. In 2001, there were 3 engineers attending from Sudan. The training is mainly about software operation, accounting for 80% or more of the time. Other topics include data I/O, geometric compensation, various types of stretch, false color generation, and geological interpretation of photographs. On the other hand, there are only 2 days set aside for lectures on the fundamentals, so the curriculum is slightly biased with regard to obtaining an adequate understanding of the basics. The course content is primarily practical in focus in order to develop personnel who can immediately apply their new knowledge after the short period of training.

The MTA has indicated that they would like to expand this kind of training in the future. In addition to increasing the number of trainees, they would like to set up an application course that would require several months to complete.

2. Issues

A common issue for the various divisions in the MTA, including the RS and GIS Division is the advancement of exploration technology and techniques applicable to deeply situated metal ore deposits that are the target of exploration. Nearly all of the metal ore deposits with outcrops situating very near surface in Turkey up until 1985 were explored and developed. For this reason, a conversion from conventional exploration methods that focus on surface drilling, etc. aiming at surface deposits is inevitable. At present, in order to search for hidden ore deposits, a wide-ranging surface survey based on ore deposits origination theories is required. Since resource exploration based on theories of ore genesis requires wide-ranging geological evaluations of various geological data, it is important to further raise the level of the remote sensing technology, and extract valuable geological information with even greater efficiency and precision.

In order to deal with the situations described above, the MTA must address issues related to both personnel and equipment, as well as introduce and implement an even higher level of RS analysis.

From the personnel perspective, except for the joint research with ERSDAC, the RS and GIS Division has few opportunities to have contact with the latest technology while geological analysis capabilities for satellite sensing of resources over the past 10 years have progressed remarkably. The MTA must catch up, especially in analysis technology and techniques.

With regard to equipment, it is particularly important to upgrade the computer hardware. At the time the RS and GIS Division was established, the MTA obtained EWS, PCs and printers. These have become outdated, and are affecting the ability of the MTA to perform effectively. Further, since the factors of resolution and color reproducibility are important in determining the quality of the output from the large-format printers, the printers must also be upgraded. In addition, in order to implement even more advanced remote sensing analysis, there is also a need for field investigations using outdoor measurement devices like spectrometers. However, the MTA does not yet have any experience with the handling or application of this type of measurement equipment, so this is likely to be a technology that must be learned in the future.

Figure III-3: Organization Chart and Personnel of RS and GIS Division

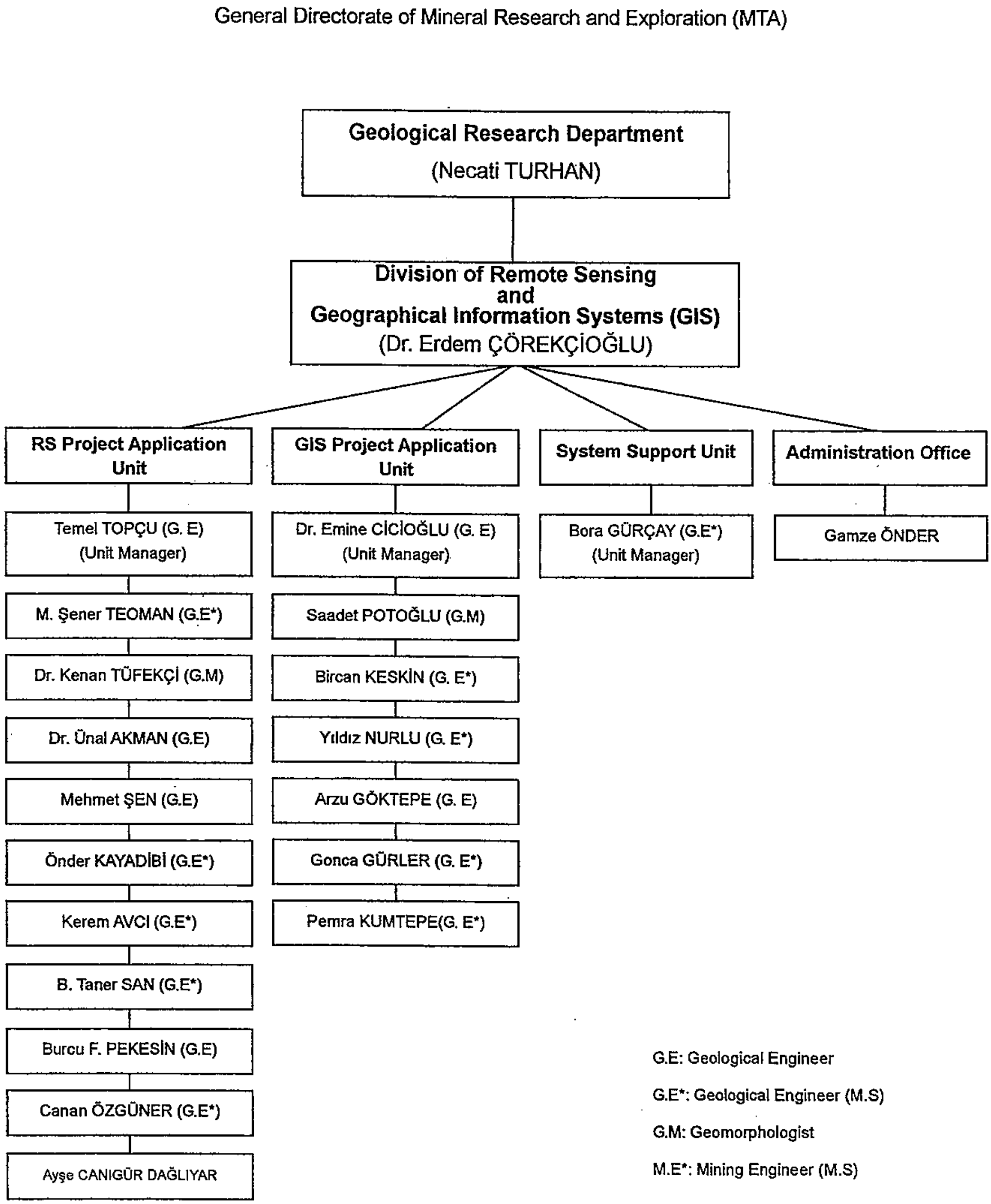


Figure Ⅲ-4: Current Equipment of the RS and GIS

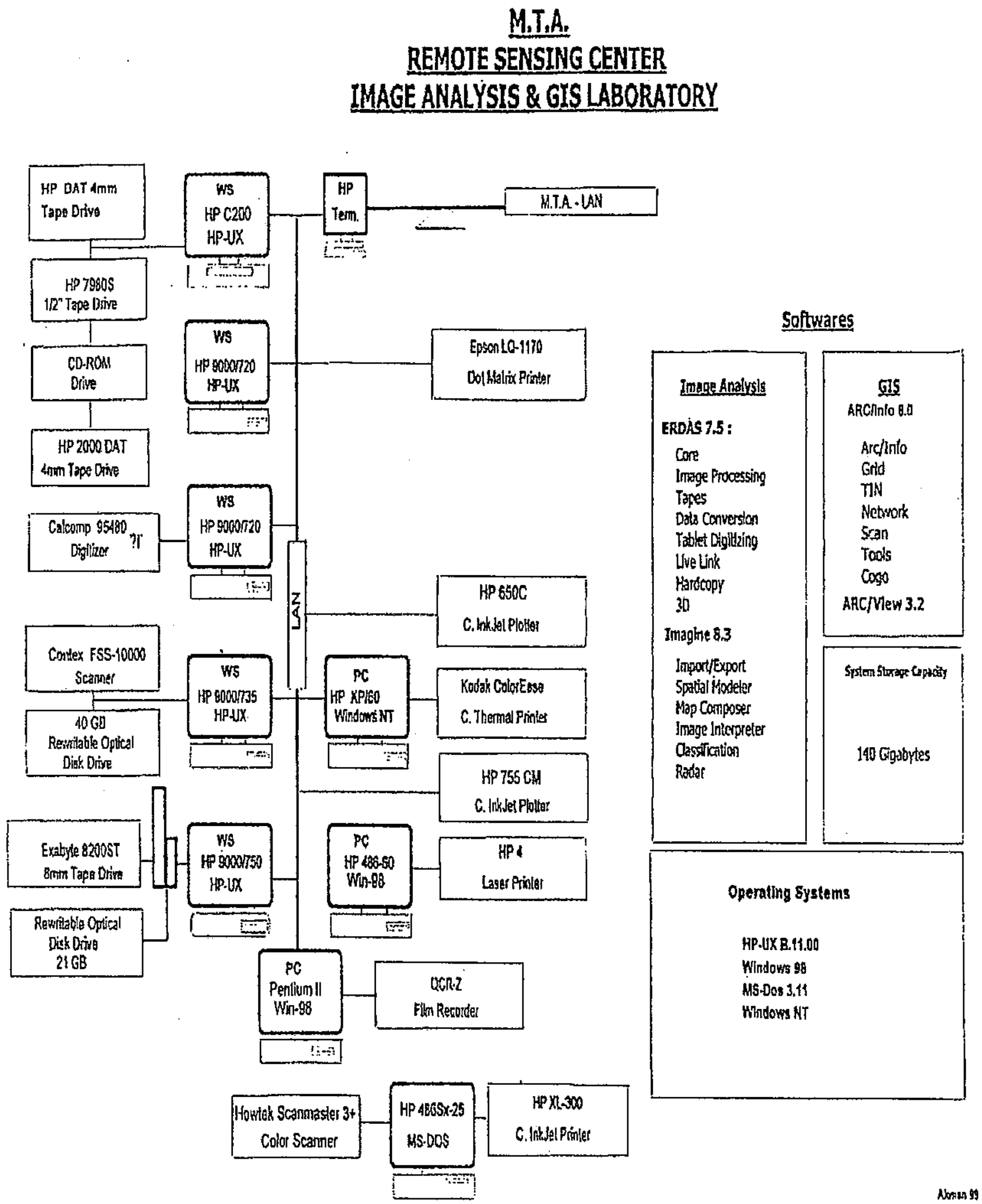


Figure Ⅲ-5: Projects supported by Remote Sensing Laboratory Unit for 2001

Project Belongs to MTA Department	No.	Project Name	Project Code	Project Area (k ㎡)	Explanation
Mineral Research and Exploration Dept.	1	Polymetal exploration in Eskisehir fault zone (Ankara-Eskisehir-Afyon), middle Anadolia	13B2	5100	
	2	Polymetal and industrial raw material investigations in Bitlis Massive (Bitlis-Siirt-Batman), Eastern part of Turkey	13B7	5000	
	3	Investigations ore deposits which are related asidic magmatisim (all of Turkey)	16AD	7000	
	4	Investigations ore deposits which are related ophiolitic rocks (includes various parts of Turkey)	13A4	5000	
Geological Research Dept.	5	Mine geology mapping and mineral investigations in Eastern Black sea region (Giresun-Trabzon-Rize-Ordu-Gumushane-Artvin)	14A1	2400	The Joint Project Geological Research & Mineral Research and Exploration Dept.
	6	Mine geology mapping and mineral investigations in Bolkar Mountains (Konya-Nigde-Adana, Icel), Southeastern part of Turkey	14A3	6150	
	7	Using LANDSAT-TM satellite digital image and remote sensing techniques, extract hydrothermal alteration areas in semi vegetation covered areas, Northwestern Anatolia (Balikesir-Canakkale)	16A6	1800	Plot project of Remote Sensing Lab. Unit
Mineral Analysises and Technology Dept.	8	The investigations of site selection for disposal of dangerous waste material, (middle part of Turkey)	16AP	40	

Note: Additionally, during the year, from inside or outside of MTA, "RS laboratory Unit" shall receive some short term work demands (such as; satellite images and their lineament maps). These would also be added to schedule, when received.

Figure Ⅲ-6: The Price List of Processed Satellite Images

KIND OF PRODUCT	DIMENSION Pixel/k ㎡	PRICE (US$)	EXPLANATION
Linear stretched single band satellite digital image (magnetic media 1.44 FD, CCT, DDS, EXABYTE)	1024×1024 (pixel) or 1000(k ㎡)	30	Customer have to provide magnetic media
Single band satellite digital image (Georectified)	1024×1024 (pixel) or 1000(k ㎡)	45	Customer have to provide magnetic media
Georectified colored satellite image in photographic paper	A3, A4	50	
Georectified satellite image print out, printed in special paper	A 0	100	
Georectified satellite image print out, printed in special paper	A3; A4	50	
Georectified satellite image print out, printed in high gloss photographic paper	A0	120	
Colored satellite image print out and its lineament map in translucent paper (Georectified)	A0	200	
Colored satellite image print out and its lineament map in polyester film (Georectified)	A0	250	
Colored satellite print out and its lineament map in translucent paper (Georectified)	A3, A4	150	
Copy print outs of satellite images such as second or third print outs	According to their dimensions, discount will be made by 50% of price of the first copy		
Digitizing (in raster format) of colored documents (magnetic media: CCT, DDS, EXABYTE)	A3, A4	30	Customer have to provide magnetic media
Digitizing (in raster format) of black and white documents	A0	50	Customer have to provide magnetic media

F. Existing and Planned Operations

1. Cooperation with JICA

a. Individual Specialists

Eighteen individual specialists, from various fields including geology, ore deposits, geothermal energy, and faults have been dispatched.

b. Cooperative Basic Study on Resource Development

As described below, 6 projects on cooperative basic study for resource development have been conducted since 1973. In addition to contributing to the accumulation of geological and ore deposit data, 3 of the projects (Tunceli-Kopdag area, Gümüşhane area, and Çanakkale area) led to the identification of ore deposits. Development was started in 1985 for the Ezan mine in the Tunceli-Kopdag region for chromium, but the mine was closed before 2002.

1973～1975 Eastern region resource development study
1977～1980 Tunceli-Kopdag region resource development study
1984～1986 Gumushane region resource development study
1987 follow-up study
1988～1990 Çanakkale region resource development study
1991 follow-up study
1992～1994 Kure region resource development study
1995～1997 Espiye region resource development study

In 2002, Turkey submitted a request for new cooperative basic study for resource development. One of the target areas for the requested survey is along the Black Sea coast (Hopa region) similar to Japan's black ore deposits (copper, zinc, etc. is expected and copper and zinc mines are known). The other proposed area is in the mid-west portion of Turkey (Eskisehir district) characterized by large fault zones, and porphyry deposits (copper, molybdenum) are expected.

c. Third Country Training Program (TCTP)

Between 1996 and 2000, the MTA conducted Third Country Training for "Exploration and Evaluation of Underground Resources", and 2 individual specialists were dispatched from Japan. Phase 2 will be conducted from 2001 ~ 2005. Training courses on remote sensing are planned in the first, fourth and fifth years. Details are provided in (1-6-4) "Technical Transfers to Other Countries".

2. International Organizations and other Donors

The MTA Geological Research Department received a single-user digital image analysis system from the UNDP in 1982.

There has been no other technical cooperation with international organizations or other countries. It is expected that the technical level of the remote sensing staff of the Geological Research Department will improve through participation in the JICA research courses conducted by

Japan, study abroad with the Netherlands ITC, and through joint projects with other mining-related organizations.

3. Joint Research Projects

a. Joint Research with the Earth Remote Sensing Data Analysis Center

Between 1992 and 2000, joint research projects have been conducted by Japan's Earth Remote Sensing Data Analysis Center (ERSDAC) with the RS and GIS Division as their main counterpart. For these projects mineral resource exploration and geothermal exploration were conducted using remote sensing technology. For these projects, the purpose was to conduct research and development on the application of remote sensing technology to the development of underground resources in regions selected as areas of promising mineral resources. Joint research was conducted on underground resource exploration using satellite data, and emphasis was placed on the topological analysis using DEM data in particular.

(1) Research on application of satellite data for the Izmir region (1992—1994)

Based on various research results, it has been shown that the satellite data in October acquired at the condition of 40 degrees or less solar elevation in the target region is useful. In addition, a new method was devised to detect alteration zone in areas covered with vegetation.

(2) Research on application of remote sensing for underground resource exploration for the Antalya region (1995—1997)

Clarifies the potential characteristics of geothermal resources in the target region, and suggested geothermal exploration indicators from the topological features that accompany active faults. It also became possible to extract topological features formed by structural movement accompanying vertical displacements from the DTM data created from JERS-1.

(3) Research on topological analysis methods for identifying geological structures related to mineralization in the Trabzon region (1998—2000)

Topology and structure analysis tools from the DTM created from ASTER were developed, and could be estimated by these tools minute structural movements and stage of development. These tools can be applied to other areas with vegetation as well as arid regions.

b. Projects with Other Countries

The Geological Research Division of the Geological Research Department is conducting the following mapping projects in cooperation with other countries.

—Handling the areas of Turkish territory for the project of 1 1:5,000,000 geological atlas of Europe (headquartered in Germany)
—Cooperation with Israel to produce a 1:400,000 scale map of the entire Middle East
—4 joint projects with CNRS of France
—2 joint projects with the Netherlands
—1 joint project with Georgia

—1 joint project with Azerbaijan

—A joint project with Georgia and Azerbaijan targeting the entire Caucasian region

—Mongolian exploration project (started 3~4 years ago, the first exploration project in a foreign country)

—(Being planned) Creation of an earth science data bank of Central Asia and Azerbaijan (in cooperation with RS and GIS)

—(Being planned) Creation of a mineral resource inventory for Turkmenistan (in cooperation with TIKA)

4. Technical Transfers to Other Countries

a. Third Country Training

Between 1996 and 2000, the MTA conducted Third Country Training for "Exploration and Evaluation of Underground Resources". The target countries were Turkey's neighbors in Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan), the Balkans (Bosnia-Herzegovina), and Caucasia (Azerbaijan). Each year 25 trainees were accepted for training. For this project, Japan also sent about 2 specialists in average each year as instructors.

The Turkish government in their foreign policy places a high priority on relations with their neighbors, including those in Central Asia. Cooperation in the field of mining and the foreign policy efforts are unified through this Third Country Training. The Third Country Training is conducted through the MTA, which is extremely significant in terms of disseminating the results of the cooperation between Japan and the MTA over the past 30 years.

With regard to the above-mentioned Third Country Training (Phase 1), Turkey has requested that it be continued in and after 2001. Based on the results of the evaluation survey conducted in December 2000 for 3 of the target countries for the Third Country Training in Central Asia (Kazakhstan, Uzbekistan and Kyrgyzstan), the evaluations by the returning trainees were ranked at high, and strong expectations of continuing training were expressed. Upon receiving these excellent evaluations, Japan and Turkey confirmed the implementation of Phase 2, and began conducting Phase 2 over a 5 year period extending until 2005.

For Phase 2, in order to accommodate diversified needs of the trainees, the training will proceed by setting the themes for each year. The training themes for each year are shown below.

—Year 1 (FY 2001): Introduction to Remote Sensing and GIS

—Year 2 (FY 2002): Metallic Minerals

—Year 3 (FY 2003): Introduction to Industrial Minerals

—Year 4 and 5 (FY 2004 and 2005): Remote Sensing and GIS

For Phase 2, it is planned to offer remote sensing training in the first year, as well as in the 4th and 5th years. For year 4 and year 5, since these will correspond to the latter half of the term of the project, it is expected to be even more effective for making full use of the technology transfer results of this project from the perspective of widely disseminating the results to the neighboring countries.

b. Others

In addition to the Third Country Training as a training project, through an agreement with the GRAS Institute of Sudan, starting in late January 2001 2 Sudanese geologists and 1 computer scientist were accepted as trainees in the MTA RS and GIS Division for a period of about 1 month.

Chapter IV

Project Strategies

IV. PROJECT STRATEGIES

A. Background

Turkey's exploration of metallic resources is at the stage in which the development of outcrop deposits that leave traces on the earth has been completed for the most part, and the exploration of blind deposits that reveal no indications on the ground surface is being pursued. To this end, MTA has established a Remote Sensing Center (RSC) with the objective of further expanding widespread explorations within the country. MTA introduced remote sensing technologies in the 1970s, and has already mastered the fundamental technologies. However, the application of these technologies to the exploration of resources requires a more sophisticated analytical system, data analyzing technology, and practical experience of these systems and technologies in mineral explorations, as well as a multi-band database that contains abundant information on resources. In light of this, MTA is currently calling for the introduction of advanced remote sensing technologies that can respond to the needs of resources exploration.

Moreover, as remote sensing data provides information relevant to many different fields, high expectations are placed on MTA's RSC for remote sensing in fields related to geology, such as the environment and natural disasters.

With these points as background, the Geologic Remote Sensing Project is to be implemented for the transfer of advanced remote sensing technologies that can be put to practical use for resources exploration, especially of metallic minerals, and in fields related to the environment and disasters.

B. Main Goals

Specifically, it aims for RSC's acquisition of technologies for extracting areas with high potential for reserves from among a wide range of targeted regions using remote sensing data. Specifically, satellite data with features relevant to resources exploration, such as ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) and PALSAR (Phased Array L-band SAR), will be used. The development of these technologies is expected to enable Turkey to singly achieve the following three main goals upon completion of the project.

- —To invigorate resources exploration activities in Turkey so that the mining sector plays an active role in supporting the Turkish economy as one of the major components of the country's industries.
- —To acquire application technologies for monitoring environmental and geological disasters using ASTER and PALSAR data. By doing so, an information collecting function that can contribute to the country's environmental and disaster prevention policies will be put in place, as an information center for environmental and disaster issues related to geology.
- —To raise the level of RSC so that it becomes a central organization that can disseminate the effectiveness of remote sensing as a resource exploration and land conservation technology to Central Asia and other surrounding regions, by installing the above-mentioned technologies for resources exploration and fields related to the environment and disasters.

C. Strategies In Order To Achieve The Goals

1. Importance of Field Survey

In order to achieve these goals, empirical technologies will be acquired through the comprehension of fundamental technologies with the assistance of JICA experts, on-the-job training of system utilization, and furthermore by case studies that include field surveys. Because there are both vegetated regions and non-vegetated regions in Turkey, the methods for utilizing remote sensing technologies also differ according to region. This project aims to enhance the effectiveness of remote sensing by implementing case studies taking such regional characteristics into consideration.

2. Cooperation with Other Department

Potential regions extracted by remote sensing data analysis will then be explored in order to verify achievement of the technology transfer. For verification, the cooperation of other sections, such as the exploration section that specializes in such tasks, is necessary. By doing so, remote sensing will be acknowledged as an important process in exploration, and at the same time, the examination of the results of various trials and errors can help to improve the precision of narrowing down exploration regions. Consequently, the creation of an internal cooperative system as a center co-owned by MTA is the key to success in terms of both technology and the project itself.

3. Importance of Monitor Disaster

Regarding the environment and disasters, the acquirement of application technologies will be sought in reference to earthquakes, landslides, ground subsidence, floods, etc. Because the knowledge required in this field differs from resources exploration, counterparts should be divided into specialized fields and technology transfers conducted in a concentrated fashion. Along with the selection of themes, fundamental technology transfers by short-term experts and training based on case studies will be implemented. Training regions should remain the same as much as possible, so that observations can be made to detect the changes of disaster elements in process of time. In other words, an attempt to monitor disasters using remote sensing is extremely important.

4. Promotion of SAR Data Utilization

In addition, SAR data utilization skills will be actively pursued. Since the use of SAR data is still uncommon, training will focus on the features of SAR imagery, basics of deciphering and interpreting SAR imagery, techniques for analyzing information of time-lapse changes, and other techniques that make full use of SAR characteristics. SAR interferometry (hereafter referred to as InSAR) is an application technology currently under development. As it can precisely measure ground displacement, it can be applied to surveys of crustal deformations due to earthquakes, slope movements caused by landslides, and amount and distribution of ground subsidence. In addition, InSAR will in the future enable high-precision measurement of crustal deformations over time, thereby contributing to the prediction and prevention of earthquakes and volcanic disasters. Basic

InSAR technology is an important aspect of this project, and is expected to soon become a major technology for regional monitoring by remote sensing. Counterparts will study this technology using JERS-1 SAR data, as it has been reported to produce good results, while receiving training from short-term experts who have practical experience in processing such data.

5. Publication and Other Activities

As for the results of the project, the technologies acquired by each of the counterparts will be compiled into a report, and published as a collection of MTA technologies or publicized via website.

The counterparts will prepare their own texts and serve as lecturers of relevant technical courses and instructors for on-site training in data processing for Third Country Training Program (TCTP). Through explanations given in these lectures, technologies transferred in this project can be confirmed. Project experts will provide technological support to the counterparts in TCTP. In regard to RSC, Turkey must actively promote the dissemination of information, receive trainees, and conduct seminars and such from during the project, in order to ensure that RSC can attain self-development capabilities as a diffusion center for remote sensing that encompasses its surrounding regions upon completion of the project.

Chapter V

Master Plan

V. MASTER PLAN

A. Project Purpose*

* An objective that is expected to be achieved by the end of the project as a result of the project implementation.

This project consists of mineral resources exploration (sub-project A) and analysis of environmental and natural hazard (sub-project B). The project aims for the following three points by utilizing the advanced satellite data which is made by MTA/RSC as a result of the project activities:

- Promotion of the investment in mineral resources developments
- Contribution to the revision of policies or regulations related to the environment and natural hazard by the Turkish government
- Dissemination of the utilization technology of the advanced satellite data to the neighboring countries and central Asia

While the technical details and processes for this project are common between A and B at basic stages of both sub-projects, differences appear in application stages. For this reason, the project is divided into two sub-projects.

1. Sub-project A (project purpose)

MTA/RSC is able to utilize advanced remote sensor data such as ASTER and/or PALSAR data for geological analysis aiming at mineral resources exploration.

2. Subproject B (project purpose)

MTA/RSC is able to utilize the advanced remote sensor data such as ASTER and/or PALSAR data for environment and natural hazard analysis.

In the sub-project A, over the proposed case study areas, the analytic capability required to conduct the actual mineral explorations will be transferred by generating theme diagrams based on the geological structure and the variations in rocks mainly using the ASTER data and carrying out ground-truth. With regard to the analysis related to the mineral explorations, the aim of MTA/RSC is in-depth understanding of the process enabling transfer to other countries through the Third Country Training Program.

In the sub-project B, methods of vegetation evaluation surveys based on multi-polarized waves as the environmental analysis and for methods for natural disasters such as ground subsidence, active faults, and landslides, with the application of interferometry technology. The aim is to understand the usefulness of the technology for the survey field. This is an introductory phase in order to resolve problems (-based on fundamental analysis methods-), and actual application analysis techniques will be an issue for MTA/RSC itself as a practice phase.

B. Overall Goals

The effect of a development project expected to be attained (after the project ends) as a result of the Project Purpose.

1. Sub-project A (overall goal)

—MTA/RSC is able to extract promising areas utilizing advanced remote sensor data, such as ASTER (and/or PALSAR).

—Basic data with analytical results utilizing advanced remote sensor data are supplied to mining sector.

—Technical expertise focusing on analysis of the remote sensor data for mineral resources exploration is transferred to other institutes and third countries through training courses.

2. Sub-project B (overall goal)

—Accumulation and utilization of the advanced remote sensor data such as ASTER and/or PALSAR data for environmental conservation and disaster prevention are expanded and enhanced at the MTA/RSC.

— Technical expertise focusing on analysis of the advanced remote sensor data for environmental conservation and disaster prevention is transferred to other institutes and third countries through training courses.

For sub-project A, the technology related to the resource satellite data analysis for the proposed case study areas will be transferred, but the overall goal for MTA/RSC is to cultivate the overall practical capability for mineral exploration, including identifying further possible areas in Turkey where remote sensing can be utilized, selecting the regions that seem to have potentials for future development, and carrying out a comprehensive analysis taking the specific geological condition and mineral deposits circumstances of Turkey into consideration.

In order to achieve the overall goal for MTA/RSC, in addition to the technology transfers for the project, it is crucial to continue the placement of the necessary personnel and budgetary measures through MTA/RSC. MTA/RSC is making every possible effort to perform these measures.

These points can be considered important assumptions* for achieving the overall goals.

* These must be satisfied in order for the project to succeed, but cannot be controlled by the project itself, and are uncertain situations that may or may not occur.

C. Super Goal

Effects that are intended to be attained in the future through the achievement of the overall goals.

1. Subproject A (super goal)

Investment in mineral resources developments is promoted.

2. Subproject B (super goal)

Achievements realized by the MTA/RSC concerning utilization of the advanced remote sensing technology contribute to the revision of the environment and natural disaster policies or regulations by the Turkish government.

The significance of this project in mid to long term is the promotion of investment in mining of Turkey through the accumulation of basic data by MTA/RSC on the potential of mineral resources. In addition, the environmental and hazard analysis results are appropriately reflected in the policies for these fields. However, in order to actually stimulate investment in the mining industry, not only the technology transfer, it is also necessary to deal with a variety of conditions, such as trends in international metals prices, the stability of the investment environment to Turkish mining industry and other related factors. For the environment and natural hazard countermeasures, an important assumption is that the current basic policy of the Turkish government will not change.

D. Outputs *

* Several objectives that must be realized in order to achieve the project purposes.

1. Sub-project A and B (outputs)

—The project operation unit (RSC) is established. (Both A and B)

—Equipment and advanced satellite data are introduced and maintained properly (Both A and B).

—Image processing of ASTER data for mineral resources exploration can be carried out by the C/P personnel (A).

—Case studies of mineral resources exploration utilizing ASTER data are accumulated (A).

For the case studies, areas of which information of the geology and mineral deposits already have been well provided by existing conventional methods will be the subject of ground-truth and analysis related to mineral resource detection using ASTER data, in an effort to improve and enhance the efficiency of analysis using remote sensing. Accumulating this kind of case studies will contribute to the development of the ability to carry out various activities to detect exploration targets.

—Spatial analysis by GIS can be carried out by the C/P personnel. (A)

—Analysis for natural hazard area using the SAR and ASTER data can be carried out by the C/P personnel (B).

—Environmental analysis using remote sensor data can be carried out by the C/P personnel (B).

—MTA/RSC can provide necessary technical support to implement training courses (Both A and B).

The current plans for the technical support for the training programs include technical support from JICA for the Third Country Training Program (Underground Resource· Development & Evaluation II/ 2001 - 2005), and training courses conducted by MTA itself. Since it is planned to conduct the advanced remote sensing training in the fourth (2004) and fifth year (2005) of the Third Country Training Program, the Japanese experts will provide indirect and limited support in the fields related to the technology transfer and topics for this project paying attention to the initiative of MTA. This training provide a good opportunity for MTA/RSC to verify whether the technology transferred through the project is well-established and growing. Furthermore, it will be an opportunity to display the value of the technology transfers and results to the outside.

The support from JICA for the training courses conducted by MTA itself will remain at the extent of advice of technical matter to the C/P, within the range that does not interfere with the original task of the technology transfer.

2. Fields of technical transfer

For both sub-project A and B, there should be technology transfers for the following fields and items.

a. Familiarization Training for New Hardware and Software

—Network and hardware installation

—Software familiarization /remote sensing, GIS, others

—Spectrometer hands-on training

b. Optical Sensor Data Analysis for Natural Resource Exploration with ASTER Data

—Introduction to effective use of ASTER data from previous studies

—VNIR (visible near infrared) and SWIR (short wavelength infrared) analysis

- Conversion method from raw data (radiance at sensor) to apparent reflectance
- Construction and management of spectral library
- Method of mineral alteration mapping
- Ground-truth
- Evaluation of vegetation effect to the performance of lithological mapping

—Thermal-infrared (TIR) analysis

- Concept of TIR analysis
- Image processing of TIR data
- Methodology for lithological mapping with respect to silica content
- Ground-truth
- Evaluation of vegetation effect to mapping quality

—Regional DEM processing based on ASTER stereo mode

c. Microwave Sensor Data Analysis for Natural Hazard with JERS-1 SAR and PALSAR Data

—Introduction to effective use of JERS-1 SAR and PALSAR data

—Data handling and basic image processing of SAR data*

*standard products prepared by ERSDAC

—Interferometry detecting subtle surface changes

- Concept of interferometry
- Process of interferogram
- Analysis of ground surface movement

—Verification by ASTER images and ground-truth

d. Environmental Analysis

—Vegetation: SAR image processing for monitoring of vegetation at local to regional scale

e. GIS-based Integrated Spatial Analysis

—Mineral potential mapping with GIS

—Hazard area mapping

f. Support to Technical Training Program to the Third Countries

—Preparation of materials for the Technical Training Program to the Third Countries

—Seminar and/or workshop

—Field excursion

3. Activities

Activity	Details
1-1 Allocate staff as planned	Refer to section 4: "Outputs" regarding the Japanese experts. The implementing agency will allocate 4 full-time counterparts and 9 part-time counterparts to conduct the project activities
1-2 Make plan of operation	Make an Annual Plan of Operation, and draw up detailed individual action plans according to the APO.
1-3 Make budgetary plan	Make a budgetary plan for each year to conform to the APO
1-4 Make and implement monitoring plan	After the commencement of the project, both sides discuss the monitoring methods and contents. The monitoring will be conducted every 6 months after the project starts.
1-5 Operate the Joint Coordinating Committee	The Joint Coordinating Committee meeting should be carried out once a year or more in order to manage overall project operation, evaluate activities, and work out the APO, etc.

2-1 Procure and install necessary equipment	Complete the procurement and installation of the materials and equipment required for the project within 3 months upon starting the project.
2-2 Operate and maintain equipment properly	Implement construction of a digital image processing system with the materials and the equipment which is planned to be obtained in the first year. After the installation of the equipment, transfer the operation and management technology while supervising development of the system. Also transfer the technology to operate the installed software. Transfer the technology on supply and management of consumables as well as maintenance of the system at the stage of regular operation. Create equipment usage, maintenance and management tables for the existing equipment and the supplied equipment, and build a foundation for the system to perform proper management
3-1 Introduce application of ASTER data	The implementing agency (MTA) purchases ASTER data for the proposed case study areas via the Internet. Through the techniques for searching and ordering ASTER data, transfer the technology related to unique characteristics of ASTER data and data utilization.
3-2 Introduce processing of VNIR and SWIR data	Training on multi-band math techniques for ASTER VNIR and SWIR, alteration mapping satellite image photo-geology analysis and mosaic processing.
3-3 Analyze TIR data	Transfer technology on lithological mapping based on silica content, TIR image processing, and basic concepts of thermal infrared data analysis
3-4 Generate regional DEM processing ASTER stereo mode data	In addition to training on topological mapping, generate digital elevation models from the ASTER data, and learn the techniques to analyze geology and geological structures with photo interpretation methods.
3-5 Transfer technology on effective application of ASTER data	Transfer technology on interpretation of 3-D views using ASTER stereo-pair images, and on alteration mineral mapping using multi-band analysis.
3-6 Carry out data acquisition of spectrometer and construction of spectral databases.	Technology transfer for operation techniques of spectrometer such as data measurement, calibration and recording the results in a spectral database.

4-1	Collect data of the proposed areas and input data	Collect existing data on the 3 proposed case study areas, and digitize and input the data .
4-2	Analyze data of the proposed areas	Analyze the satellite data for the 3 proposed case study areas (VNIR, SWIR and TIR)
4-3	Select the promising areas	Combine the analytic results from the existing data and the satellite data for the 3 proposed case study areas using GIS, and analyze to select and identify promising areas (area of about 1000 ㎢)
4-4	Carry out ground-truth	Perform a ground-truth checking for the promising areas selected in the 3 proposed case study areas and investigate the promising areas. Firstly, make a plan for the ground-truth and perform a field survey and analysis (including chemical analysis of samples); then summarize the results.
5-1	Transfer technology of integrated spatial analysis integrating various geologic data	For exploration of mineral deposits, it is necessary to select promising areas for mineral deposits using a variety of data from a wide range of regions. Therefore, transfer the technology to create standards for selecting promising areas for each type of mineral deposits (exploration guidelines). As training on the fundamentals and concepts of GIS, study the basic operations of GIS (projection setting, data retrieval, shape generation, attribute table manipulation, etc.) Also study the fundamentals of potential mapping using GIS.
5-2	Transfer technology how to select exploration areas utilizing GIS	Use existing data and study selecting of promising areas using GIS with potential mapping.
5-3	Carry out resources area evaluation utilizing GIS	In addition to creating the data on the actual analysis target areas (proposed case study areas), conduct case studies (data processing) to identify promising areas with a potential mapping for exploration. Then, also implement field survey (ground-truth) for the selected areas.
6-1	Introduce basic knowledge of utilization of satellite data for disasters monitoring	Perform analysis of JERS-1 and ASTER data for examples of past natural disasters both inside and outside Turkey.
6-2	Transfer technology how to extract possible hazard areas utilizing ASTER and/or SAR image	Analyze ASTER and SAR data for the proposed case study areas (targets: flood, landslide, earthquake, ocean pollution, forest fires, etc.), and perform hazardous area mapping.
6-3	Transfer technology how to extract area of ground surface movement utilizing InSAR data	Transfer technology on InSAR data processing, and identify ground surface movements from InSAR data.
6-4	Verify InSAR results by ASTER image and ground-truth	Conduct ground-truth including using ASTER images for the selected ground surface movement results.

7-1 Transfer technique how to select environmental indicator such as vegetation index	Conduct environmental analysis with ASTER data using indicators such as vegetation and ocean water quality.
7-2 Introduce remote sensing technology applicable to environmental problems in Turkey	Implement analysis of variation extraction using multi-temporal ASTER and SAR data (targets: deforestation, ocean pollution, coastal alluvial fans, etc.)
7-3 Strengthen capability of designing environmental survey plan	Training on the effective utilization of satellite images (monitoring, etc.) for making environmental study plans.
8-1 Make technical support program for TCTP	MTA will carry out a training course on advanced remote sensing fields associated with the technology transfers for this project in conjunction with the JICA scheme for the Third Country Training Program (Underground Resource Development & Evaluation Phase 2 / 2001 – 2005). The corresponding training courses are planned to be separated into two rounds in 2004 and 2005. Provide support to create these training program courses.
8-2 Prepare textbooks for TCTP	The counterparts will make the texts and study materials for the training courses described above with the technical support of Japanese experts.
8-3 Support seminars and/or workshops for TCTP	Technical support for seminars and workshops for the training courses mentioned above will be provided by the counterparts and the Japanese experts.
8-4 Support field excursions for TCTP	Technical support for field excursions for the training courses mentioned above will be provided by the counterparts and the Japanese experts.
8-5 Carry out training courses (other than TCTP)	The training courses conducted solely by MTA/RSC will be held for outside groups based on the technology for advanced remote sensing that is gained through this project. MTA/RSC will be the primary implementing entity, so the involvement of the Japanese experts will be in the form of technical advice.

4. Inputs

a. Inputs by the Japanese side

(1) Dispatch of experts

(a) Long-term experts

Experts covering the four fields listed below will be dispatched for a period of four years.

(i) Chief Advisor

—Supervision of the entire project tasks

—Arrangement of plans required to put co-operation activities into operation

—Budget management

—Equipment management

—Reinforcement of the communication and liaison system with the Japanese side, etc.

(ii) Project Coordinator

—Assistance to the Chief Advisor

—Monitoring of the progress status of the entire management of the project

—Promotion of problem solving in project implementation

—Budget management

—Equipment management

—Liaison and coordination, etc.

(iii) Expert on Digital Image Processing

—Introduction of the digital image processing system

—Guidance on the operation of the digital image processing system

—Training of the abilities of management (selection, acquisition, processing, save, distribution, etc.) of satellite data and data sets created

—Guide on techniques for using advanced satellite data

(iv) Expert on Geological Remote Sensing

—Explanation of ASTER data characteristics

—Confirmation of the validity of ASTER data through analysis of ASTER for regions with existing prepared data and on-site surveys (as required)

—Guidance of the methods for using ASTER data in order to improve efficiency of creation of geological diagrams and mineral formation and adding additional information

(b) Short-term experts

Among the fields of technology transfer described in the section 2 "Field of Technical Transfer" of the D "Outputs", additional experts will be dispatched for short periods for those portions which are difficult for the long-term experts to handle, such as especially differentiated or advanced technologies, and the environment and hazard analysis fields. The dispatch plan will be discussed each year jointly between Japan and Turkey, but at the present time and also tentatively, the fields below are expected to be handled with short-term experts.

TIR analysis

DEM processing with SAR data

Interferometry with SAR data

Environmental and natural hazard analysis

GIS-based integrated spatial analysis

Photo-geology

(2) Training of C/P in Japan

Japanese side will conduct C/P training in Japan for about 2 people each year for a period between 2 to 3 weeks to about 2 months (differs depending on the training content). This training will be given for the purpose of transferring understanding of the technical content and activities of the ASTER researchers and users engaged in image processing, resource development-related work, environmental analysis and disaster research. In addition, the goal is to encourage trainees to promote the use of ASTER data after returning home as a result of their study of research examples. Additionally, it is being considered to participate in the ASTER Science Team Meeting held every year between late May and early June.

Here are some possible organizations that may receive the C/P trainees:

(a) General remote sensing training

—RESTEC (about 1 month)

—ERSDAC (1 day)

—Research Institute of Science and Technology, Tokai University (about 1 week)

(b) Specialized geological remote sensing training

—International Cooperation Office and the Geological Remote Sensing Laboratory, Geological Survey of Japan (1 ~ 2 weeks)

—Faculty of Earth and Planetary Science, Graduate School of Science, Nagoya University (about 1 week)

(c) Application to mineral resources and case study

—MMAJ and 6 resource development consultant firms (about 1 week)

—MMAJ Kosaka Technology Research Center (2-3 days)

(d) Application to environment and hazard analysis

—Production Engineering Institute, Tokyo University (2-3 days)

—National Institute of Environmental Studies (2-3 days)

—Environmental Remote Sensing Research Center, Chiba University (2-3 days)

—National Institute for Disaster Prevention

—Tokyo University,

—Nagoya University, etc.

(3) Equipment

The equipment that is planned to be supplied mainly consists of the followings (the individual items and the specifications are as described in the List of Equipment).

(a) Digital image processing system

As a minimal configuration of digital image processing system, that can be afford to process the ASTER and SAR data in order to output geological maps and various theme diagrams at MTA/RSC during the implementation of this project, Japan will supply computers, software and various peripherals.

(b) Field survey equipment

Basically, the field survey equipment that is currently owned by MTA will be used. Japan will supply the following equipment, which is specifically required to conduct ground-truth for the satellite data.

(c) Spectrometer

By ensuring detailed observations and measurements of the reflectance spectra (visible near-infrared and short wavelength infrared regions) of ground surface and rock samples using a spectrometer, the meaning of the color tones in the ASTER images (color composite) and the image data calculations can be investigated. Based on spectrum measurements in the field, the image interpretation results, such as the geological feature distribution, are confirmed.

b. Input by the Turkish side

(1) Personnel allocation

The Turkish side will allocate the following personnel for this project.

Project role	Position/affiliation in MTA	Remarks
Project Director	General Director of MTA	Oversee the entire project
Deputy Project Director	Head of Department, Geological Research Department	Assist Project Director
Project Manager	Coordinator of RS and GIS Division	Project operations management
Coordinator	RS Center-Project Application Unit Manager	Manage promotion of technical fields
Full-time counterparts	MTA RSC technical counterparts	2 for each of the long-term experts (digital image processing and geological remote sensing), for a total of 4 people
Part-time counterparts	MTA RSC technical counterparts	9 people (60% ~70% of their time is dedicated to project tasks)

(2) Facilities

MTA will arrange the building facilities for implementing the project. A 2-story building that was previously a printing center on the MTA grounds will be renovated and opened as the Remote Sensing Center. Offices will be prepared for the Japanese expert team, including the Chief Advisor, Project Coordinator, and the technical experts, as well as office equipment, Internet connections and a LAN environment.

(3) Budgetary allocation

MTA now allows for a budget as specified on the next page for the implementation of this project.

(Unit: US dollars)

Items of expenditures	Fiscal Year				
	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
ASTER satellite image purchase costs (all proposed case study areas/ 3 areas for mineral resource exploration and 1 area for environmental / natural hazard study)	21,000	21,000	7,500	7,500	-
Spectrometer maintenance	-	2,500	2,500	2,500	2,500
Field survey costs (plane tickets, travel expenses)	2,000	4,000	4,400	5,000	5,000
Field survey allowances (per diem, lodging)	30,000	60,000	60,100	60,200	30,000
Other expenses	-	10,000	12,000	13,000	13,500
Expenses for sample chemical analysis	10,000	20,000	21,000	22,000	22,000
Assistant expenses	5,000	7,000	8,000	9,000	2,000
Expenses for meeting, workshop	1,000	1,000	2,000	2,500	3,000
Consumables (ink, paper, CDs, etc.)	3,000	4,000	5,000	5,500	4,000
Computer maintenance costs (hardware, software upgrades)	-	10,000	10,000	10,000	10,000
Total (US dollars)	72,000	139,500	132,500	137,200	92,000

The basis for the amounts is as follows.

(a) ASTER satellite image purchase costs

The Japanese side has calculated that there are a total of 140 scenes for the 4 proposed case study areas (3 areas for mineral resource exploration and 1 area for environmental / hazard study). Since 3 types of images (Level 1A to create DEM, Level 1B for VNIR and SWIR spatial analysis, and Level 2B for TIR spatial analysis) are required for 1 scene, this makes the total number of 420 images. At a cost of US$100 for each image, the total cost of purchasing the images is US$42,000. The cost of purchasing the images for the 4 target survey regions is divided across the first and second year of the project, with half in fiscal 2002 and the other half in fiscal 2003. The amounts listed for fiscal year 2004 and 2005 are for the MTA plan to purchase images covering all of Turkey, for the areas outside the 4 target survey regions.

(b) Spectrometer maintenance costs

This equipment requires certification (verification of measurement accuracy) maintenance once a year. These amounts are for this maintenance.

(c) Field survey costs

For each survey it is assumed that the survey group will consist of 4 people, including (a) Japanese expert(s).

(d) Consumables

Includes the consumable items associated with the equipment that will be provided.

(4) Equipment and Materials

The use of materials and equipment currently owned by MTA and MTA/RSC will be shared with this project. Besides these, the vehicles and survey tools (hammers, GPS, etc.) needed for the field surveys, as well as the office equipment and audio-visual equipment needed for the seminars and workshops will be provided.

5. Prior obligations and requirements

In addition to faithful handling the details described in the section 4 "Inputs", the Turkish side will make every effort to satisfy the requirements noted for "Sustainability" described in the chapter VI.

Chapter VI

Comprehensive Validity of Project Implementation

VI. COMPREHENSIVE VALIDITY OF PROJECT IMPLEMENTATION

A. Validity*

*The following are confirmed: whether the project purpose and overall goal (super goal) meet the needs of the target group, whether they meet the needs of Turkey, whether the project conforms to the aid policy, etc. of Turkey and Japan and whether the project is appropriate as a public work.

1. Public Interest of the Project

The extraction of promising areas for underground resources development (Sub-project A), which is a super goal of this project, aims to promote investment in a way that the government plays the role of the extraction to reduce the risk that private companies assume. In other words, this realizes the sharing of role in which the public sector covers the socially necessary part that the private sector cannot bear due to the requirement for large investment and the high risk of entry. Therefore, the project can be considered to bring public interest. In addition, the preparation and provision of data (for example, geological maps) on environment/disaster measure systems (Sub-project B) means the provision of basic information required to establish and implement environmental control and disaster prevention system, etc. by the government. Thus, the project activities will bring social benefits.

2. Conformity to the Aid Policy of Japan

In the "Plan for Country-specific Implementation of Programs for Republic of Turkey" prepared by JICA, the following are set as key aid fields after policy consultations with Turkey: (1) human resources development, (2) environmental problems, (3) the correction of gaps between regions, (4) support for South-South cooperation and (5) rehabilitation after earthquake damage and the strengthening of disaster prevention systems. This project is positioned as part of human resources development.

Regarding (1) human resources development, it is desired to develop persons who will play a role in economic development corresponding to industrial advances. The content of technology transferred to C/P personnel under this project is cutting-edge exploration technology in the mining sector. Therefore, the project is positioned as part of human resources development of technicians who contribute to promoting economic and social development (industrial development).

Regarding (2) environmental problems, problems such as the decrease of forest, soil discharge, the degeneration of urban environment and the pollution of surrounding ocean areas are considered especially important. This project is expected to contribute to solving these problems through the provision of the results of satellite data analysis, which are obtained by "environment and natural hazard analysis" under the project. For (5) rehabilitation after earthquake damage and the strengthening of disaster prevention systems, the project is also expected to make contribution through the provision of satellite data on topographic information.

The field of (3) the correction of gaps between regions is to correct the wide economic gap in Turkey between the western area where commerce and industry are developing remarkably and the eastern area and southeastern Anatolia, which are mountainous areas that have been left behind in terms of economic development. It also aims to develop regional industries for the purpose of decelerating population drain to the western area and eliminating gaps in income levels. The target exploration areas for "underground resources development" under this project include eastern Anatolia, and industrial development in the region through underground resources development is expected.

In terms of (4) support for South-South cooperation, Turkey has already been offering active cooperation with neighboring developing countries including the Central Asian countries that gained their independence from former Soviet Union. In the mining field, Turkey has been implementing the Technical Training Program to the Third Countries (TCTP) on underground resources development and evaluation (Phase 1: 1996–2000/ Phase 2: 2001–2005) by appointing the MTA as an implementing agency. A training course on remote sensing technology was also held in 2001. The course is also scheduled to be held in 2004 and 2005, and this project will provide support to the TCTP as a part of the activities.

3. Conformity to the National Development Plan

The problems contained in the mining sector in Turkey so far have been the high cost for exploration and the inefficient development, production and consumption of domestic resources. As for the main body for policy-making and execution, the authorities of many related ministries and agencies had been tangled.

In order to solve these problems, the Eighth National Development Plan (2001–2005) issued in 2001 sets the main purpose as the efficient development and production of bountiful underground resources by introducing mineral resources exploration technology utilizing advanced technology while promoting the unification of the policy of mining sectors and execution thereof, the organizational reform of related agencies and the review of the Mining Law. In particular, since it has been pointed out that the MTA, the implementing agency of this project, has a high cost structure, the Plan aims to strengthen the structure of the Headquarters by closing local branch offices and to reform it into an organizational structure with high exploration technology, adopting advanced technology.

This project is to transfer exploration technology utilizing advanced remote sensing that focuses on increasing the efficiency of exploration (reduction of exploration costs, improvement in the precision of exploration and shortening of the period of time for exploration). Therefore, the project conforms to the National Development Plan of the Turkish Government.

4. Preparation of a Participatory Plan

Activities related to remote sensing technology started when the MTA valued the importance of the technology, independently recognized the necessity of introducing it, established a remote sensing division in 1975 and started interpreting analog images.

After that, the MTA has been strengthening the said division by receiving equipment for a digital image processing system from UNDP in 1982 and reinforcing installations at its own expense. As mentioned above, the MTA is strongly eager to introduce advanced remote sensing technology through this project, so it has been actively participating in consultation with Japan not only in planning this project (basic study, first and second short-term studies) but also in making activity plans during the project period as well as in relation to the future MTA after the end of the project.

5. Superiority of Technology of Japan

A sensor for the resource exploration satellite, ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer), which will be used for this project, was developed by the Ministry of International Trade and Industry :MITI (present Ministry of Economy, Trade and Industry :METI) as a satellite sensor for the ASTER Project under the EOS (Earth Observing System) Project promoted by NASA. Under the ASTER project, Japan and the United States jointly aimed to contribute to solving environmental and resources problems by observing time-series changes of global environment from space. ASTER was fitted to TERRA, a polar platform that was launched in December 1999.

ASTER was designed and developed as a successor to JERS-1 (Japanese Earth Resources Satellite-1) of MITI, which was launched in 1992 for the purpose of resource exploration. ASTER is characterized by that it consists of three sensors, a visible and near-infrared radiometer (VNIR; with 3 bands; used for resource exploration, national land survey, vegetation, environmental protection, disaster prevention, etc. with 15-meter ground resolution), a short wave infrared radiometer (SWIR; with 6 bands; used for resource exploration with the discrimination of rocks and minerals, monitoring of environment such as vegetation, observation of volcanic activities, etc. with 30-meter ground resolution precision) and a thermal infrared radiometer (TIR; with 5 bands; used for discrimination of minerals, observation of temperature of ground surface and sea surface, etc. with 90-meter ground resolution). This constitution is to observe the surface of the earth at the wavelength region from visible to thermal infrared. Accordingly, ASTER has outstandingly high spectral resolution while keeping higher ground resolution than that of LANDSAT-TM. ASTER also provides stereoscopic vision that is far more advanced than that of JERS-1.

PALSAR (Phased Array type L-band Synthetic Aperture Radar), which will be used in the latter half of the project, is a sensor to be fitted to the Advanced Land Observing Satellite (ALOS) that will be launched by the National Space Development Agency of Japan (NASDA) in summer 2003. It will make it possible to observe the earth regardless of weather or time (day or night). Since PALSAR brings satellite images with new information by advanced observation technology, it is expected to make a large contribution to not only resource exploration but also to the understanding of global environment changes and disaster situations.

All of these sensors were developed in Japan ahead of other countries, and have already achieved a certain reputation through the accumulation of many successful results. Therefore, the technical level of Japan can be considered to be ahead of global standards in the field in question.

B. Effectiveness*

*Whether the target group will certainly receive benefits by the implementation of project plans is verified. The effectiveness is verified by verifying the logicality of plans in PDM, the level of purposes set and important assumptions to achieve the project purpose.

1. Logicality of the Plan

The basic relation from activities to outputs, project purpose, overall goal and super goal under this project is shown in Figure VI-1 and VI-2 on page 58 and 59.

Figure VI-1: Basic relation from Activities to Super Goal

(Sub-project A: Mineral Resources Exploration)

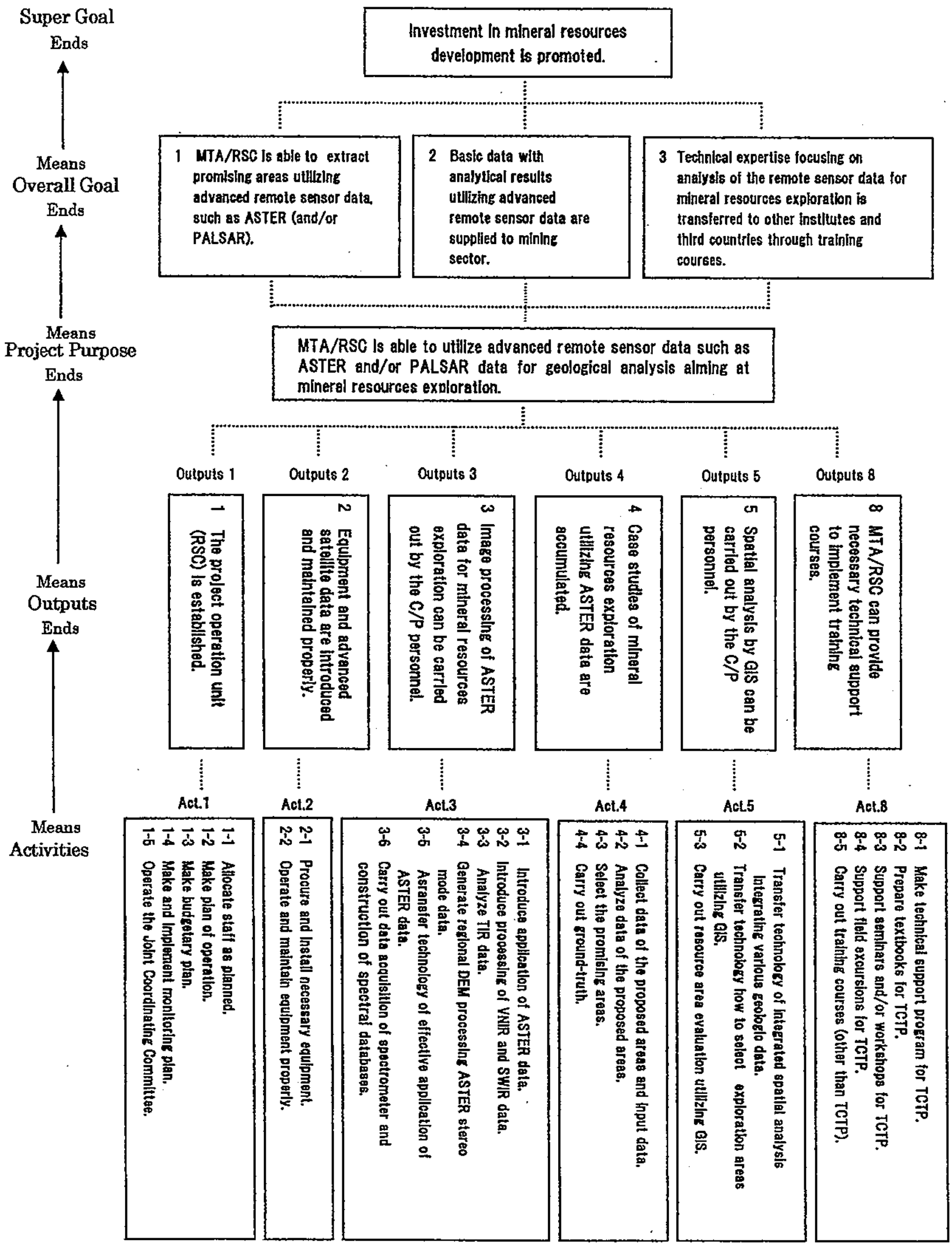
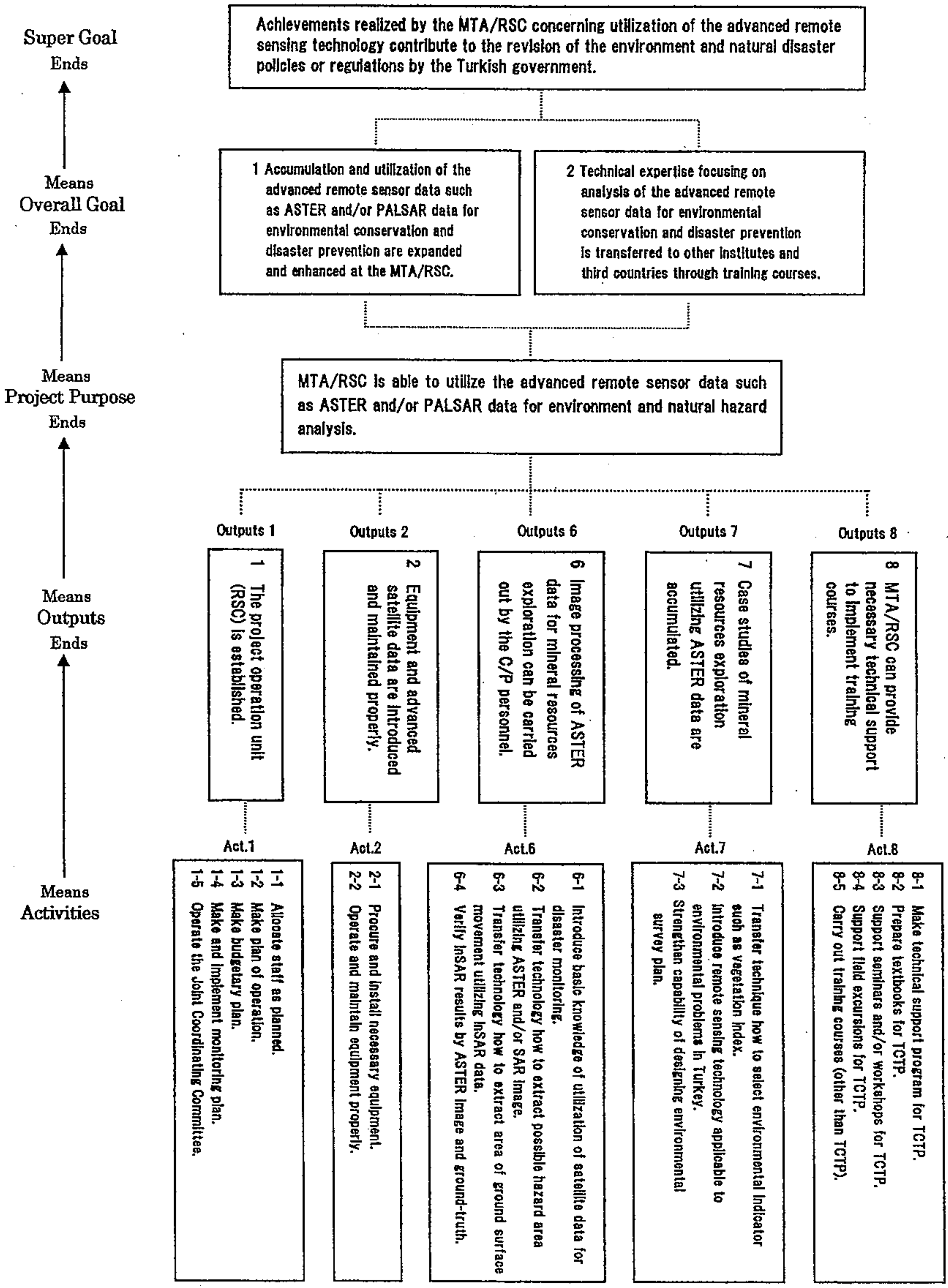


Figure VI-2 : Basic relation from Activities to Super Goal

(Sub-project B: Analysis of Environmental and Natural Hazard)



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2. Level of Purpose Set

The following are verified: whether the project purpose is made clearer by an indicator; whether the project purpose is achievable; and whether the achievement thereof really can be considered to be a result of the project implementation if achieved.

The project purposes and indicators of Sub-projects A and B are as follows.

(A)Project Purpose MTA/RSC is able to utilize advanced remote sensor data such as ASTER and/or PALSAR data for geological analysis aiming at mineral resources exploration.	→	**(A) Objective Verifiable Indicators** Analysis of the semi-detailed survey (1000 km^2) areas extracted from three (3) proposed case study areas is completed by the trained C/P personnel before the termination of the project.
(B)Project Purpose MTA/RSC is able to utilize the advanced remote sensor data such as ASTER and/or PALSAR data for environment and natural hazard analysis.	→	**(B) Objective Verifiable Indicators** By 2006: Trained C/P personnel extract the priority areas and start the analysis of the advanced remote sensor data for environmental conservation and disaster prevention.

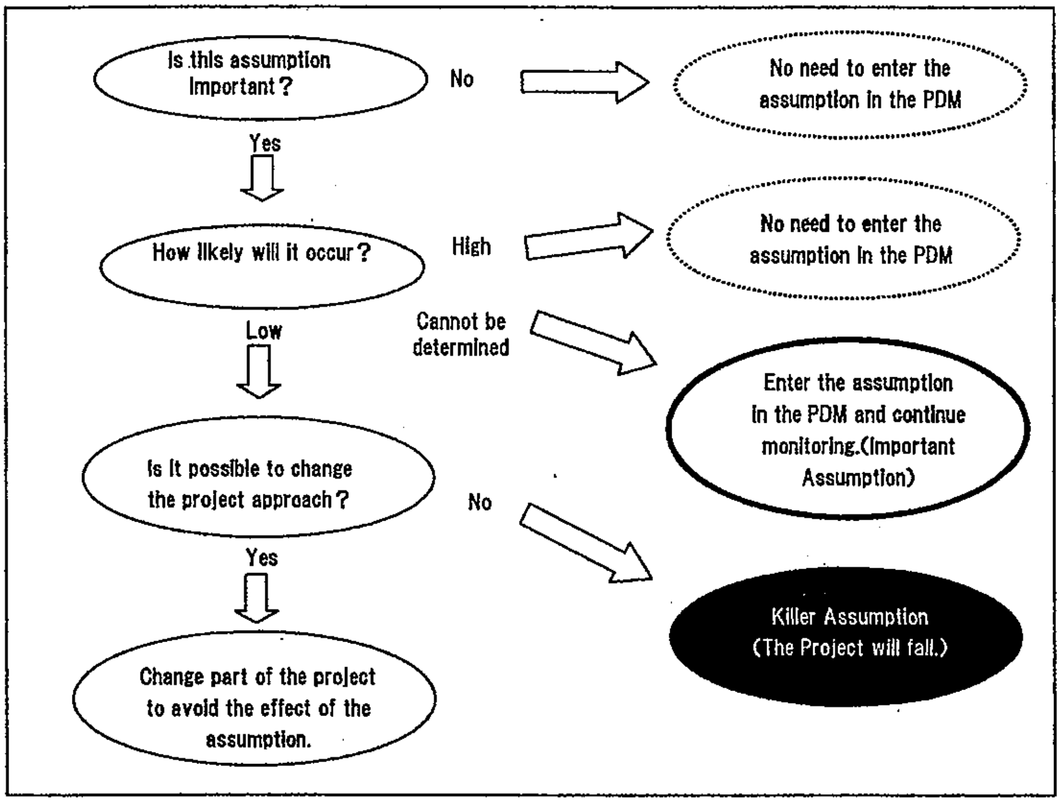
There are four case study areas in Sub-projects A and B (3 areas for A and 1 area for B), and the number of satellite images to be analyzed for A and B is 420* scenes in total. The transfer of technology for such computer image analysis is directly linked to the project activities. In addition, the analysis results are verified by field survey. These activities are quantitatively achievable, and thus can be completed within the project period. The project purpose will be realized through these.

*This is the approximate number of scenes presented by Japan at the second short-term survey to prepare the MTA's budget draft concerning the purchase of satellite data. The number of scenes for the entire area was calculated based on the area of the case study and the area that can be included in the image of one scene. The entire case study area can be covered by 140 scenes, but three types [level 1A, level 1B and level 2B] of image are necessary for one scene, so 420 scenes are necessary in total.

3. Verification of Important Assumptions to Achieve the Project Purpose

For the verification of important assumptions at the activity and output levels, whether the important assumptions are killer assumptions (important assumptions that will kill the project) is verified.

(DETECTING "KILLER ASSUMPTIONS")



Sub-projects A and B have common important assumptions set as follows.

—Important assumptions at the activity level

- C/P personnel continue to work.
- Equipment is provided and allocated without delay.

—Important assumptions at the output level

- Project budget is allocated as planned.
- Trained C/P personnel continue to work.

These important assumptions are necessary for project operation, and the possibility that they will occur is neutral. Therefore, they can be verified as appropriate important assumptions.

C. Efficiency*

*Whether the project has been planned to achieve greatest outputs by effectively utilizing the resources that can be inputted into the project is verified.

1. Cost Effectiveness/Results

a. Appropriateness of Inputs by Japan

(1) Quantitative Appropriateness of Input of Experts

Regarding the details of project activities, the two-person system consisting of a chief advisor and an operation coordinator is taken for the operational management field of the project. For the technology transfer field, the two-person system is taken for both data image processing such as ASTER and operations such as field survey, sample analysis and textbook preparation, so four long-term experts are resident in the field. Moreover, short-term experts are in charge of technology transfer in six fields, and it is planned that about 3–4 of such experts will conduct activities per year for an average of 3–4 weeks. By the look of the details of annual operation plan (PO), the input can be considered quantitatively appropriate.

(2) Appropriateness of Acceptance of Trainees

The number of C/P personnel related to this project on the Turkish side is a total of four full-time personnel and a total of nine part-time personnel in the technical field, but the number of trainees accepted for training in Japan annually is around two (eight for four years).

Therefore, all C/P personnel cannot be accepted for training in Japan, so full-time C/P personnel are accepted as priority. For part-time C/P personnel, the training will be carried out taking the content of their operations and the necessity of the training into consideration. Since there is group training for remote sensing, the possibility of their participation therein is also considered. We believe that quantitatively appropriate training can be provided through these.

(3) Qualitative and Quantitative Appropriateness of Input of Provided Equipment

Regarding main equipment, peripheral equipment for analyzing satellite data, such as computer hardware, software and printers, are limited to those which are as general-purpose as possible so as to enable arrangement and procurement (maintenance, purchase of spare parts, upgrading of software, etc.) on the spot even after the end of the project. Therefore, the quality of input has been sufficiently considered. Regarding equipment provided, the number of desktop computers to be provided was set as nine in total. Since the number of allocated C/P personnel is four full-time personnel and nine part-time personnel (ratio of engagement: 60–70%), it was decided to provide one computer for each of the four full-time C/P personnel and five computers for the nine part-time C/P personnel in consideration of the figure obtained by multiplying the number of C/P personnel by the ratio of engagement. In addition, the number of licenses for software was decided, taking price and the priority of full-time C/P personnel into consideration.

These inputs can be considered to be matching the expected outputs (minimum unit of input without which outputs cannot be expected).

b. Input by Turkey

(1) Input for Facilities and Installations

There are facilities and installations with functions that are indispensable to implement the project, such as a working room for experts, an image analysis room, a library/reference room, a training room and a common room, as well as LAN and an Internet environment.

(2) Allocation of C/P Personnel

C/P personnel who are in charge of operational management of the project and those who directly receive technology transfer are allocated as follows.

—Project Operational Management

- Project Director (General Director of MTA) 1 person
- Deputy Project Director (Head of Geological Research Department) 1 person
- Project Manager (Coordinator of RS and GIS Division) 1 person
- Project Coordinator (RS Project Application Unit Manager) 1 person

—C/P Personnel Who Receive Technical Transfer

- Full-time C/P personnel for image digital processing 2 persons
  (Geological Engineer, Project Application Unit)
- Full-time C/P personnel for geological remote sensing 2 persons
  (Unit Manager, System Support Unit 1 person)
  (Geological Engineer, Project Application Unit 1 person)
- Technical C/P personnel (part-time) 9 persons
  (Geological Engineer, Project Application Unit 6 persons)
  (Geomorphologist, Project Application Unit 1 person)
  (System Engineer, System Administration Unit 2 persons)

(3) Local Cost

A budgetary plan for appropriate expense items and the budget amount thereof for project implementation has been prepared (See list about the budgetary measures of Turkey in 4. "Input", Chapter V).

2. Cost Effectiveness

Regarding the cost effectiveness of mineral resources exploration activities by advanced remote sensing that utilizes ASTER satellite data, the expected cost reduction is as follows if simply compared to that by a conventional optical sensor.

a. Narrowing Down of Alteration Zone by a Conventional Optical Sensor

A conventional LANDSAT sensor has only two bands in the short-wavelength infrared region where alteration minerals are distinguishable. Therefore, although the existence of alteration minerals can be identified, the type thereof cannot be specified.

b. In the Case of Using ASTER Optical Sensor

ASTER sensor measures simultaneously nine bands ranging from visible to short-wavelength infrared, and the number of possibly distinguishable alternation minerals is considered to be seven or more. By utilizing this distinction ability, it becomes possible to group the alternation zones obtained by conventional satellite image in more detail. It is assumed that the use of ASTER triples the distinction ability compared with the conventional method. Hereby, the alternation zone, which indicates locations that show signs of orebodies, is narrowed down to one-third the size of the expanse obtained by the conventional method (assuming that the area of each alternation zone around the orebody is the same). Therefore, the costs for the field research required to confirm signs of orebodies can be reduced to one-third. So, the project can be considered highly cost-effective.

ASTER data → Possible to distinguish alteration minerals three times more effectively than the conventional method

↓

Narrowing down of alteration zone → Possible to narrow the expanse down to one-third

↓

Costs for ground survey at the site→ One-third

This refers to mainly mineral resources exploration (Sub-project A). Under this project, environmental and natural hazard analysis (Sub-project B) is implemented at the same time, so the range of data utilization expands.

D. Impact*

*"Impact" means the longer-term, indirect effects and repercussion effects that are brought about by implementing the project. In the PDM, the overall goal (the super goal in this project) expresses long-term effects, and the probability of achievement of the super goal is primarily verified. In addition, what social and economic impacts are expected as a result of project implementation is also verified.

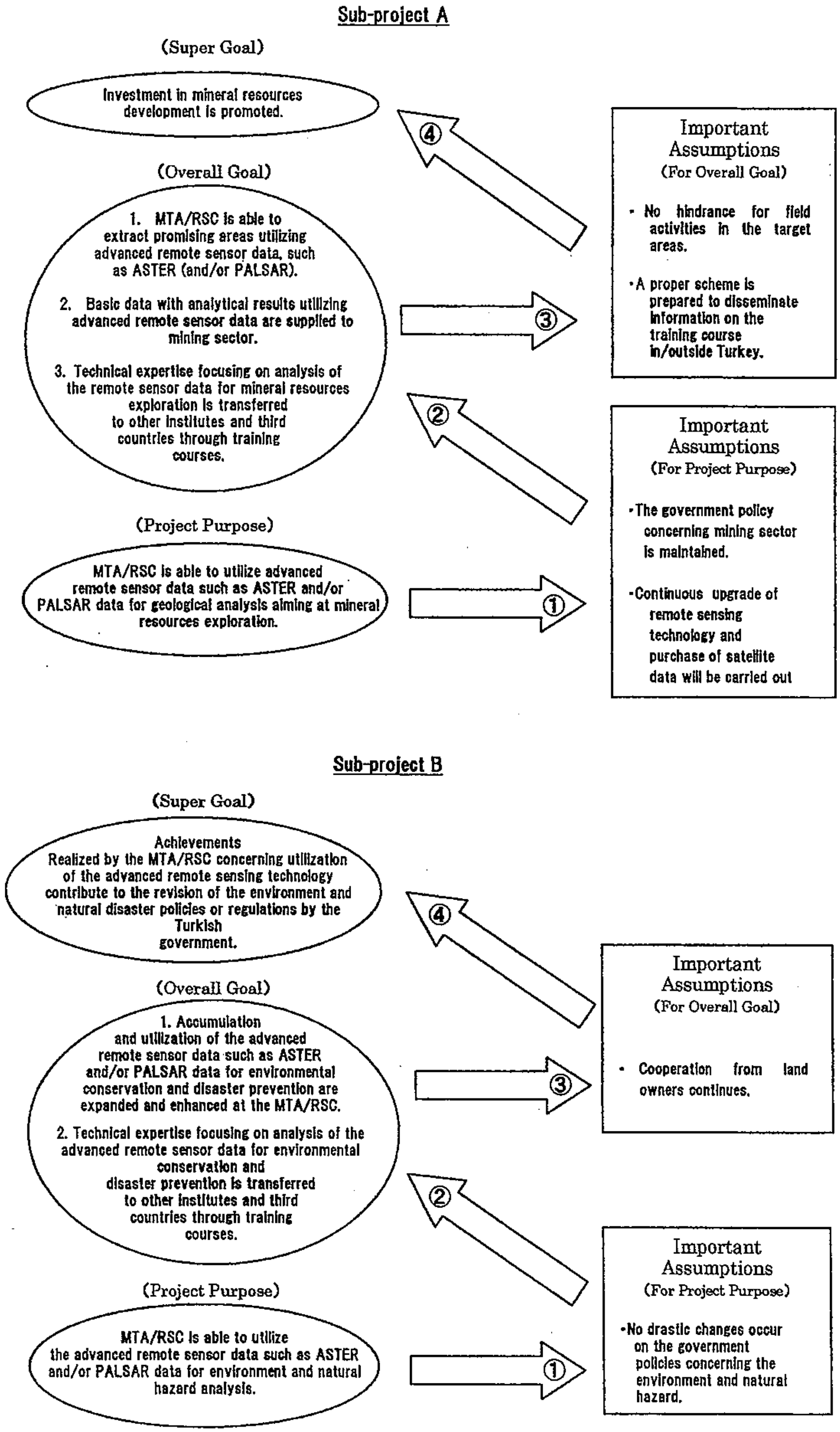
1. Probability of Achievement of the Super Goal

In order to verify the probability of achievement of the super goal, there needs to be, in PDM, an established theoretical flow in the relations between the project purpose and each goal at upper level as well as in the relations among important assumptions thereof.

a. Theoretical flow from the project purpose to the super goal

The theoretical flows of the sub-projects in the PDM of this project are shown in Figure VI-3 below.

Figure VI-3: Theoretical Flow from Project Purpose to Super Goal



If the project purpose is achieved (arrowhead ①) and important assumptions for the project purpose are satisfied, the overall goal is achieved (arrowhead ②). In the same way, if the overall goal is achieved (arrowhead ③) and important assumptions for the overall goal are satisfied, the super goal is achieved (arrowhead ④).

A theoretical flow is recognized in the said Sub-project A and Sub-project B, and it can be said that the super goal set is the result brought by the achievement of the project purpose. Therefore, the probability of achievement of the super goal depends on whether the important assumptions occur, and it is derived from the verification of b.(1) and (2) below that the possibility of achievement of the super goal is high.

b. Verification of the Possibility that the Important Assumptions Occur

(1) Important Assumptions for Project Purpose

The possibility that the important assumption for the project purpose under both sub-projects occurs is contingent on the government policy concerning mining sector being maintained as it is. The Eighth National Development Plan is for the period between 2001 and 2005, and this project ends in 2006. Therefore, if the policy is not drastically changed in the Ninth National Development Plan, the important assumption will not be changed.

The Eighth National Development Plan refers to the organizational reform of the MTA, and clearly calls for increasing the efficiency of exploration activities by introducing latest technology. It is quite unlikely that the policy will be modified to a negative one in the Ninth National Development Plan, so the important assumption for the project purpose will probably be achieved.

(2) Important Assumptions for the Overall Goal

For Sub-project A, the important assumptions are "no hindrance for field activities in the target areas" and "preparation of a proper scheme to disseminate information on the training course." Moreover, for Sub-project B, the important assumption is "cooperation from land owners."

As for hindrances to field activities in the target areas for Sub-project A, the obstruction of the survey and security problems are assumed. Awareness of environmental problems is recently growing sufficiently in Turkey, and these problems can be avoided by considering policies for sufficient advance information disclosure and sustainable development at the time when a promising area for mineral deposit is tentatively determined. Regarding security problems, there is no area that requires special attention within the target areas of exploration implemented under the project.

Moreover, the preparation of a proper scheme to disseminate information is nothing more than the timely dissemination of needed information on training to more domestic and foreign institutes related to the mining field, etc. The MTA will disseminate information, but since the dissemination will be conducted away from RSC, which is the main body of the project, it is considered to be an important assumption. It is important that the information is disseminated effectively, and there will probably not be much difficulty encountered in the creation of a system therefor.

In terms of cooperation from land owners for Sub-project B, since the project also brings benefits to local residents, such as environmental conservation and disaster prevention, it is reasonable to assume that cooperation from land owners will continue.

2. Impact Brought by the Implementation of the Project

a. Policy Impact

The implementation of this project enables an overview of potential resources throughout Turkey. Because of this, it becomes possible to consider the details of geological conditions nationwide, and the obtained data will become important as basic data for Turkey to manage underground resources by itself and decide a mining policy.

Moreover, advanced remote sensing technology, which is adopted in relation to environmental conservation, disaster prevention, etc., is not utilized in Turkey at all. Since the MTA is an agency that gives advice on policy, etc., it is requested to accumulate the latest information. A geological information database will first be established, and this will have impact on disaster prediction information such as that about earthquakes and landslides. It is clear that these will have great impact on the basis of the central government's policy-making.

b. Institutional Impact

Regarding the impact on the establishment of systems for environmental conservation, disaster prevention, etc., the establishment thereof is taken into consideration in the super goal of Sub-project B. Specifically, the review of regulations for measures against landslides, active faults and floods, and the standards for disaster prevention techniques is possible. Moreover, remote sensing is considered to be useful for disaster prevention, environmental monitoring and analysis, and, studies in the field are also proceeding in Japan. If studies in this field also proceed under this project through the preparation of geological maps focusing on the case study areas and disaster prevention and environmental monitoring are conducted by remote sensing in the future, it will become possible to obtain information on natural disaster efficiently and effectively and this is expected to lead to the improvement of safety in city planning and infrastructure building. In addition, environmental monitoring may be used for standards for mining pollution prevention, etc.

c. Social Impact

It is generally thought that if mining development is realized, approximately 10 thousand people will receive direct and/or indirect benefits per mine. There is a problem of the wide economic gap (gap in income levels of about 10 times) between the western area where commerce and industry are developing remarkably and the eastern area and southeastern Anatolia, mountainous areas that have been left behind in terms of economic development. Therefore, there is a high expectation for correction of the gap between the regions through social infrastructure building such as reducing the unemployment rate, improving income and infrastructure building including roads, electricity and gas, if exploration activities in the area including southeastern Anatolia under this project result in mining developments.

The impact on environmental conservation and disaster prevention measures is also as mentioned in b. above for this item.

d. Technical Impact

An assumed impact of technology transfer under this project is the preparation of new types of geological maps such as the alteration minerals classification map and silica content-based sectional map, which could not be prepared by the techniques of MTA/RSC up to now. Another assumed impact is that by using said silica content-based sectional map and other satellite data (for example, DEM), the time required to prepare geological maps, etc. can be dramatically shortened and the precision of the maps is improved remarkably.

Moreover, by acquiring these techniques and providing training for domestic and foreign researchers, etc., the technology is expected to be disseminated to neighboring countries. The MTA has been playing a role as a central research institute in the mineral resources development field in Turkey, and the MTA/RSC is expected to become a central agency for remote sensing in the Middle East, Central Asia, etc. in the future.

The MTA has already started the TCTP (Underground Resources Development and Evaluation Phase II: 2001–2005), and training on advanced remote sensing is also scheduled to be conducted in the fourth and fifth year of the training. The target countries are Kazakhstan, Uzbekistan, the Kirghiz Republic, Georgia, Macedonia, Moldova, Syria, etc., and the project implementation will have large technical impact on neighboring countries including these.

e. Economic Impact

Geological information, which is high-precision and contributes directly to mining development, is expected to be promptly prepared after the transfer of satellite data analysis technology concerning underground resources development in this project. Information that is effective for metal resources exploration will be utilized by small- and medium-sized mineral exploration companies and investors in mining, and the following economic impact is expected as a result:

- Part of mineral exploration costs will be reduced;
- Domestic mineral exploration activities will become active, and the mining industry and peripheral industries (companies that provide materials and equipment, transportation businesses, various mining service companies, etc.) will be stimulated;
- Investment environment will be improved through the preparation of geological information, and foreign capital introduction will be undertaken;
- Infrastructure will be established in peripheral areas through mining development;
- The volume of exports will increase by the efficient development of useful domestic resources;
- The government will gain royalties, and its financial conditions will be improved.

In the field of environmental and natural hazard analysis, the project is expected to have indirect economic impact, namely, the lessening of damage by disaster prevention and the precognition of disaster. Turkey has incurred serious damage and losses due to a massive earthquake in recent years, and measures against natural disaster are urgent necessities. It will become possible to specify the areas at high risk of disaster such as landslides and active fault zones more accurately, and systems for the preparation of hazard maps and disaster prevention will be established. In this way, the project is expected to lessen the risk of damages and losses through the disaster prevention measures of the government. Therefore, the economic impact is considered to be indirect, but it is actually unpredictable.

E. Possibility Of Independent Development*

*Whether the effects caused by project implementation are expected to persist even after the end of aid and whether C/P agencies will be able to continue activities while developing independently are verified.

1. Organizational Ability

The implementing agency of this project, the Mineral Research and Exploration Institute of Turkey (MTA), was established in 1935 and has now been engaged in development and survey activities for underground resources for 67 years. It has been stably operated as a body. The Eighth National Development Plan calls for strengthening the structure of the Headquarters such as by reducing the scale of the MTA, due to national financial difficulty. In these circumstances, the MTA clarified its position as a research and development agency, and is attempting to transform itself into a body that introduces cutting-edge exploration technology.

2. Financial conditions

The period of the Eighth National Development Plan is from 2001 to 2005, while the period of this project is from 2002 to 2006. The draft of the detailed budget that the MTA will bear for the project implementation was prepared for the period up to 2006, the last year of the project. It is vital that there will be no drastic change of position of mining sector in the Ninth National Development Plan and that financial conditions will be continuously ensured even after the end of the project.

3. Acceptability

The key to independent development is whether the approaches used in this project (transfer of the latest satellite data analysis technology, preparation of geological maps and theme maps, training on advanced remote sensing for research institutes and neighboring countries, delivery of data information) have the foundation for being accepted by participants (implementing agency, beneficiaries, residents, etc.) from social, environmental and technical standpoints.

a. Social and Environmental Acceptability

The social and environmental acceptability of underground resources development is considered high among the implementing agency and beneficiaries (researchers at other institutes, persons concerned in mining development, etc.). As for acceptability among local residents, while plus factors, such as social infrastructure building and the correction of gaps between regions through underground resources development, are expected, minus factors such as environmental problems due to underground resources development are assumed.

The content and outputs of technology transfer concerning environmental conservation and disaster prevention are considered to have a high foundation for being accepted by participants from the social and environmental standpoints, since environmental conservation and disaster prevention are issues directly related to citizens.

b. Technical Acceptability

The approaches probably have high technical acceptability among the implementing agency, trainees who will be trained in advanced remote sensing technology, persons concerned in mining development and persons concerned in disaster prevention measures. Residents are excluded from the consideration of technical acceptability since the results caused by technology will confer indirect benefit to them. In addition to the foundation for technical acceptability, the following should be taken into consideration as conditions for the implementing agency to become able to develop independently. In other words, technical innovation in satellite data processing and analysis is constantly advancing even at present, and therefore, the implementing agency, MTA, needs to independently update technology transferred through this project to cutting-edge technology. When the MTA acquires the ability and systems for updating, it will become able to develop independently.

F. Comprehensive Validity Of Implementation*

*The validity of project implementation is comprehensively verified based on the above five evaluation items (1. Validity, 2. Effectiveness, 3. Efficiency, 4. Impact and 5. Possibility of Independent Development).

The comprehensive validity of the project implementation is unpredictable in some parts in relation to impact, but many positive outputs can be expected. In particular, as mentioned in relation to the public interest brought by the project, it becomes possible to carry out basic surveys requiring huge amounts of investment cost that could not be borne by private companies. The results of these surveys are considered to produce large outputs for the national economy in some cases. The government can think of supplementing part of the costs with profits obtained by selling the obtained information at a fair price and by carrying out development activities for highly reliable information by itself or through selling the developing rights.

Moreover, as a result of technology transfer under this project, the MTA is expected to become the central agency in charge of the provision of geological data utilizing advanced remote sensing and the dissemination of technology in the field of the mineral resources exploration, environmental conservation and disaster prevention in Turkey and its neighboring countries. In the Middle East, including the neighboring countries of Turkey, and Central Asia, only Turkey, which is a more developed country, has the foundations for accepting advanced remote sensing technology, in consideration of present technical levels. Therefore, it is significant in terms of overviewing the possibility of mineral resources development within the region that this project is implemented centering on Turkey, as Middle East and Central Asia countries are involved.

Furthermore, the aspect of environmental conservation and disaster prevention is directly related to the safety of citizens' lives and welfare, so the project is extremely suitable as a project to be implemented by the government.

Chapter VII

Appendix for Project Document

PDM (Sub-project A : Mineral Resources Exploration)

A Ver.0-3
June.11.2002

Project Name : Geologic Remote Sensing Project
Project Site : Ankara

Duration : 4 years (August 01, 2002- July 31, 2006)
Target Group : MTA Geologists

Implementing Agency of Japan : JICA
Implementing Agency of Turkey : MTA

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
(Super Goal) Investment in mineral resources development is promoted.			
(Overall Goal) 1 MTA/RSC is able to extract promising areas utilizing advanced remote sensor data, such as ASTER (and/or PALSAR). 2 Basic data with analytical results utilizing advanced remote sensor data are supplied to mining sector. 3 Technical expertise focusing on analysis of the remote sensor data for mineral resources exploration is transferred to other institutes and third countries through training courses.	By 2008: 1 Analysis of the detailed survey (100km^2) area extracted from the semi-detailed survey areas is completed and the methodology of evaluation of possible mineral deposit is established. 2 System of data distribution is established. 3 Training curriculum focusing on the advanced remote sensing and necessary materials are made and the training is held.	1 Report on the analysis of extraction of potential target 2 Records of distribution 3 Training curriculum, textbooks, plan and record of training course	· No hindrance for field activities in the target areas. · A proper scheme is prepared to disseminate information on the training course in/outside Turkey.
(Project Purpose) MTA/RSC is able to utilize advanced remote sensor data such as ASTER and/or PALSAR data for geological analysis aiming at mineral resources exploration.	Analysis of the semi-detailed survey (1000 km^2) areas extracted from three (3) proposed case study areas is completed by the trained C/P personnel before the termination of the project.	· Report of analysis for the evaluation of mineral potential of the area. · Report of the field survey of the selected area	· The government policy concerning mining sector is maintained.
(Outputs) 1 The project operation unit (RSC) is established. (In common with the sub-project A and B) 2 Equipment and advanced satellite data are introduced and maintained properly. (In common with the sub-project A and B) 3 Image processing of ASTER data for mineral resources exploration can be carried out by the C/P personnel. 4 Case studies of mineral resources exploration utilizing ASTER data are accumulated. 5 Spatial analysis by GIS can be carried out by the C/P personnel. 6 and 7 refer to the sub-project B 8 MTA/RSC can provide necessary technical support to implement training courses. (In common with the sub-project A and B)	1-1 Personnel, budgets and facilities of the MTA/RSC are secured. 1-2 Monitoring and meetings of the committee are working as planned. 2 Contents and condition of equipment are put in order. 3 Essential part of the technology of the image processing is transferred by 2004. 4 120 frames of ASTER data coverage over the three (3) proposed case study areas are processed and interpreted by 2006. 5 Essential part of the technology of the spatial analysis by GIS is completed by 2003. 8 Technical support program and materials for the Third Country Training Program (TCT) are produced by 2004.	1-1, 1-2 Annual reports, monitoring reports and records of meetings 2 Property records, operation and maintenance records 3 Records of evaluation made by both sides 4 The number of produced images of ASTER data 5 Records of interpretation and analysis 8 Program, textbooks and materials for training	· Project budget is properly allocated as planned. · Trained C/P personnel continue to work at the MTA/RSC
(Activity) 1-1 Allocate staff as planned. 1-2 Make plan of operation. 1-3 Make budgetary plan. 1-4 Make and implement monitoring plan. 1-5 Operate the Joint Coordinating Committee. (In common with the sub-project A and B) 2-1 Procure and install necessary equipment. 2-2 Operate and maintain equipment properly. (In common with the sub-project A and B) 3-1 Introduce application of ASTER data. 3-2 Introduce processing of VNIR and SWIR data. 3-3 Analyze TIR data. 3-4 Generate regional DEM processing ASTER stereo mode data. 3-5 Transfer technology of effective application of ASTER data. 3-6 Carry out data acquisition of spectrometer and construction of spectral databases. 4-1 Collect data of the proposed areas and input data. 4-2 Analyze data of the proposed areas. 4-3 Select the promising areas. 4-4 Carry out ground-truth. 5-1 Transfer technology of integrated spatial analysis integrating various geologic data. 5-2 Transfer technology how to select exploration areas utilizing GIS. 5-3 Carry out resource area evaluation utilizing GIS. 6 and 7 refer to the sub-project B 8-1 Make technical support program for TCTP. 8-2 Prepare textbooks for TCTP. 8-3 Support seminars and/or workshops for TCTP. 8-4 Support field excursions for TCTP. 8-5 Carry out training courses (other than TCTP). (In common with the sub-project A and B)	(Inputs) Japanese side 1 Dispatch of experts (Long-term) - Chief Adviser - Coordinator - Image Processing expert - Geologic Remote Sensing expert (Short-term) - Expert(s) on (1) TIR analysis (2) DEM Processing with ASTER data (3) Interferometry with SAR data (4) Environmental Analysis (5) GIS-based Integrated Spatial Analysis (6) Photo-geology 2 Training of C/P in Japan One(1) or two(2) per year 3 Provision of equipment	Turkish side 1 Buildings and facilities 2 Allocation of C/P 3 Preparation of equipment 4 Local costs	· C/P personnel remain at the MRT/RSC · Equipment is delivered and installed without delay (Preconditions) · Renovation of building and facilities for the project is completed.

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PDM (Sub-project B: Analysis of environmental and natural hazard)

B Ver.0-3
June. 11.2002

Project Name : Geologic Remote Sensing Project
Project Site : Ankara

Duration : 4 years (August 01, 2002- July 31, 2006)
Target Group : MTA Geologists

Implementing Agency of Japan : JICA
Implementing Agency of Turkey : MTA

Narrative Summary	Objective Verifiable Indicators	Means of Verification	Important Assumption
(Supper Goal) Achievements realized by the MTA/RSC concerning utilization of the advanced remote sensing technology contribute to the revision of the environment and natural disaster policies or regulations by the Turkish government.	Policies or regulations are revised by 2010.	The 10th five year development plans (2010−2015) and other regulations of governmental level	
(Overall Goal) 1 Accumulation and utilization of the advanced remote sensor data such as ASTER and/or PALSAR data for environmental conservation and disaster prevention are expanded and enhanced at the MTA/RSC. 2 Technical expertise focusing on analysis of the advanced remote sensor data for environmental conservation and disaster prevention is transferred to other institutes and third countries through training courses.	By 2008: 1-1 Analyzed data of the domestic priority areas is accumulated 1-2 Data analysis for environment and natural hazard requested by other institute can be carried out. 2 Training curriculum focusing on the advanced remote sensing is made and the training is executed.	1-1, 1-2 Annual report, Analysis data, Data supply records 2 Training plans, curriculums and textbooks	· Cooperation from land owners continues.
(Project Purpose) MTA/RSC is able to utilize the advanced remote sensor data such as ASTER and/or PALSAR data for environment and natural hazard analysis.	By 2006: Trained C/P personnel extract the priority areas and start the analysis of the advanced remote sensor data for environmental conservation and disaster prevention.	· Records of extraction of priority areas · Records of analysis	· No drastic changes occur on the government policies concerning the environment and natural hazard.
(Outputs) 1 The project operation unit(RSC) is established. (Common to the sub-project A and B) 2 Equipment and advanced satellite data necessary for utilizing satellite data are operated and maintained properly. (Common to the sub-project A and B) 3, 4 and 5 refer to the sub-project A 6 Analysis for natural hazard area using the SAR and ASTER data can be carried out by the C/P personnel. 7 Environmental analysis using remote sensor data can be carried out by the C/P personnel. 8 MTA/RSC can provide necessary technical support to implement training courses. (Common to the sub-project A and B)	By 2006: 1-1 Personnel, budgets and facilities of the MTA/RSC are secured. 1-2 Monitoring and committee of meetings are executed as planned. 2 Contents and condition of equipment are put in order. 6 Essential part of the technical transfer for the natural hazard area analysis is completed by 2005. 7 Essential part of the technical transfer for the environmental analysis is completed by 2004. 8 Technical support program and materials are produced by 2004	1-1, 1-2 Annual reports, monitoring reports and records of meetings 2 Property records, operation and maintenance records 6, 7 Records of analysis Records of evaluation made by both sides 8 Program, textbooks and training materials	· National budget is properly allocated as planed. · Trained C/P personnel continue to work at the MTA/RSC
(Activity) 1-1 Allocate staff as planned. 1-2 Make plan of operation. 1-3 Make budgetary plan. 1-4 Make and implement monitoring plan. 1-5 Operate the Joint Coordinating Committee. (Common to the sub-project A and B) 2-1 Provide and install necessary equipment. 2-2 Operate and maintain equipment properly. (Common to the sub-project A and B) 3, 4 and 5 refer to the sub-project A 6-1 Introduce basic knowledge of utilization of satellite data for disaster monitoring. 6-2 Transfer technology how to extract possible hazard area utilizing ASTER and/or SAR image. 6-3 Transfer technology how to extract area of ground surface movement utilizing InSAR data. 6-4 Verify InSAR results by ASTER image and ground-truth 7-1 Transfer technique how to select environmental indicator such as vegetation index. 7-2 Introduce remote sensing technology applicable to environmental problems in Turkey. 7-3 Strengthen capability of designing environmental survey plan. 8-1 Make technical support program for TCTP. 8-2 Prepare textbooks for TCTP. 8-3 Support seminars and/or workshops for TCTP. 8-4 Support field excursions for TCTP. 8-5 Carry out training courses (other than TCTP). (Common to the sub-project A and B)	(Inputs) Japanese side 1 Dispatch of experts (Long-term) - Chief Adviser - Coordinator - Image Processing expert - Geologic Remote Sensing expert (Short-term) Refer to Sub- project-A 2 Training of C/P in Japan One(1) or two(2) per year 3 Provision of equipment	Turkish side 1 Buildings and facilities 2 Allocation of C/P personnel 3 Preparation of equipment 4 Local costs	· C/P personnel remain at MRT/RSC · Equipment is delivered and installed without delay (Preconditions) · Refurbishment of building and facilities for the project is completed.

Plan of Operation *for Geologic Remote Sensing Project*

Abbreviations: (Japanese Side) CA <Chief Advisor>, PCJ <Project Coordinator>, LE <Long-term Expert(s)>, SE <Short-term Expert(s)>
Abbreviations: (Turkish Side) PD <Project Director>, PM <Project Manager>, PCT <Project Coordinator>, C/P <Counterparts>

PO June 11, 2002 Page1/1

Calendar: 2002, 2003, 2004, 2005, 2006
Japanese Fiscal Year: 2002 (I–IV), 2003 (I–IV), 2004 (I–IV), 2005 (I–IV), 2006 (I–II)

	Output	Activity	In charge: Japan	In charge: Turkey
1	The project operation units(RSC) is established. In common with the Sub-project A & B	1-1 Allocate staff as planned.	CA	PM
		1-2 Make plan of operation.	CA	PM
		1-3 Make budgetary plan.	CA	PM
		1-4 Make and implement monitoring plan.	CA	PM
		1-5 Operate the Joint Coordinating Committee.	CA	PM
2	Equipment and advanced satellite data are introduced and maintained properly. In common with the Sub-project A & B	2-1 Procure and install necessary equipment.	LE,PCJ	C/P
		2-2 Operate and maintain equipment properly.	LE	C/P
3	Image processing of ASTER data for mineral resources exploration can be carried out by the C/P personnel. For the Sub-project A	3-1 Introduce application of ASTER data.	LE	C/P
		3-2 Introduce processing of VNIR and SWIR data.	LE,SE	C/P
		3-3 AnalyzeTIR data.	LE,SE	C/P
		3-4 Generate regional DEM processing ASTER stereo mode data.	LE,SE	C/P
		3-5 Transfer technology of effective application of ASTER data.	LE	C/P
		3-6 Carry out data acquisition of spectrometer and construction of spectral databases.	LE	C/P
4	Case studies of mineral resources exploration utilizing ASTER data are accumulated. For the Sub-project A	4-1 Collect data of the proposed areas and input data.	LE	C/P
		4-2 Analyze data of the proposed areas.	LE	C/P
		4-3 Select the promising areas.	LE	C/P
		4-4 Carry out groundtruth.	LE	C/P
5	Spatial analysis by GIS can be carried out by the C/P personnel. For the Sub-project A	5-1 Transfer technology of integrated spatial analysis integrating various geologic data.	LE,SE	C/P
		5-2 Transfer technology how to select exploration areas utilizing GIS.	LE,SE	C/P
		5-3 Carry out resources area evaluation utilizing GIS.	LE,SE	C/P
6	Analysis for natural hazard area using Japanese SAR and ASTER data can be carried out by the C/P personnel. For the Sub-project B	6-1 Introduce basic knowledge of utilization of satellite data for disaster monitoring.	LE	C/P
		6-2 Transfer technology how to extract possible hazard areas utilizing ASTER and/or SAR image.	LE	C/P
		6-3 Transfer technology how to extract area of ground surface movement utilizing InSAR data.	LE,SE	C/P
		6-4 Verify InSAR results by ASTER image and ground-truth	LE,SE	C/P
7	Environmental analysis using remote sensor data can be carried out by the C/P personnel. For the Sub-project B	7-1 Transfer technique how to select environmental indicator such as vegetation index.	LE	C/P
		7-2 Introduce remote sensing technology applicable to environmental problems in Turkey .	LE	C/P
		7-3 Strengthen capability of designing environmental survey plan .	LE	C/P
8	MTA/RSC can provide necessary technical support to implement training couses. In common with the Sub-project A & B	8-1 Make technical support program for TCTP.	LE	C/P
		8-2 Prepare textbooks for TCTP.	LE	C/P
		8-3 Support seminars and/or workshops for TCTP.	LE	C/P
		8-4 Support field excursions for TCTP.	LE	C/P
		8-5 Carry out training courses (other than TCTP).	(LE)	C/P

June 11.2002

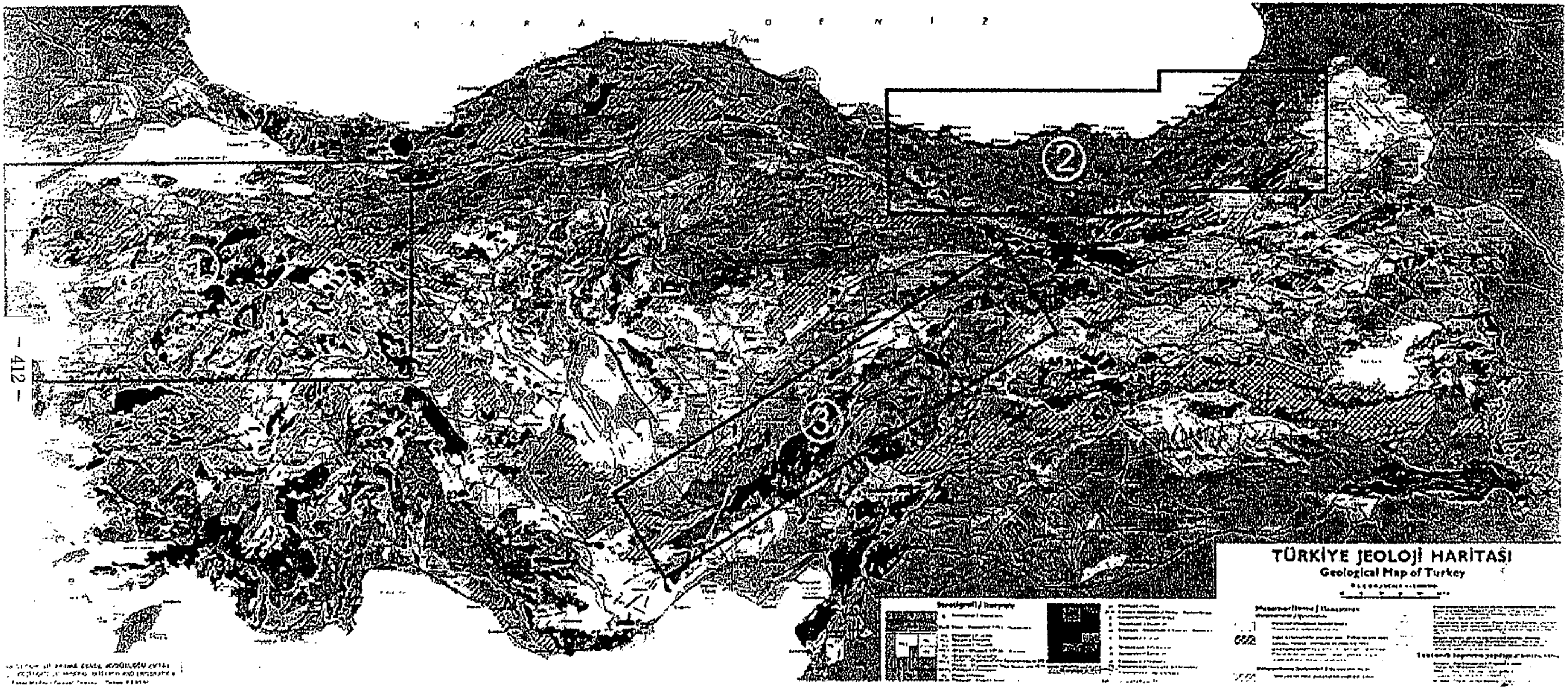
Equipment necessary for technology transfer in the Project

Hardware	Total	Specification
PC(Desktop)	9	CPU(Pentium4 2.2GHz),OS(Win 2000), 1GB-RAM, 64MB-VRAM, 60GB-SCSI, CDWR, CD, SCSI-card, Network-card
Display1	9	21 inch
Display2(for dual monitor)	3	21 inch
Videocard(for dual monitor)	3	for Dual monitor
PC(Laptop)	2	CPU(Mobile Pentium3 1GHz),OS(Win 2000), 1GB-RAM, 64MB-VRAM, 60GB-SCSI, CDWR, CD, SCSI-card, Network-card
Printer(B0)	1	42inch(B01067mm), 600×600dpi, color thermal incjet,128MB-RAM, 5GB-HDD
Printer(A3)	1	400dpi(Pictrography)
Printer(A3)	2	Incjet 1440dpi
Printer(A4)	1	Laser color 600dpi
Scanner(A0)	1	Color 36inch, 600dpi
Scanner(A3)	1	Color A3, 1200dpi
HDD(external)	5	60GB-IDE, USB
CD-writer(external)	1	x40 reading, x24 writing(CDR)
DVD-writer	3	9.3GB, USB/SCSI
MO-drive	3	630MB
PC application server	1	CPU(Pentium4 2.2GHz),OS(Win 2000 server), 512MB-RAM, 32MB-VRAM, 60GB-SCSI, CD, SCSI-card, Network-card, Monitor-17inch
PC file server + DDS	1	CPU(Pentium4 2.2GHz),OS(Win 2000 server), 1GB-RAM, 32MB-VRAM, SCSI-Disk array, 12 slotts for internal HDD, Internal-HDD(72GB*12units),CD, SCSI-card, Network-card, Monitor-17inch, DDS-4mm
GPS receiver+Map module	4	
CCD projecter	1	XGA (1024x768), 1000 Lumens
Digital camera	2	4MB pixel, battery-AA4, Compact Flush-128MB
Spectle meter	1	Portable,Measures radiance, irradiance, reflectance and transmittance from 0.35 to 2.5 microns.Spectral resolution(3nm(700nm), 11nm(1400-2100nm))

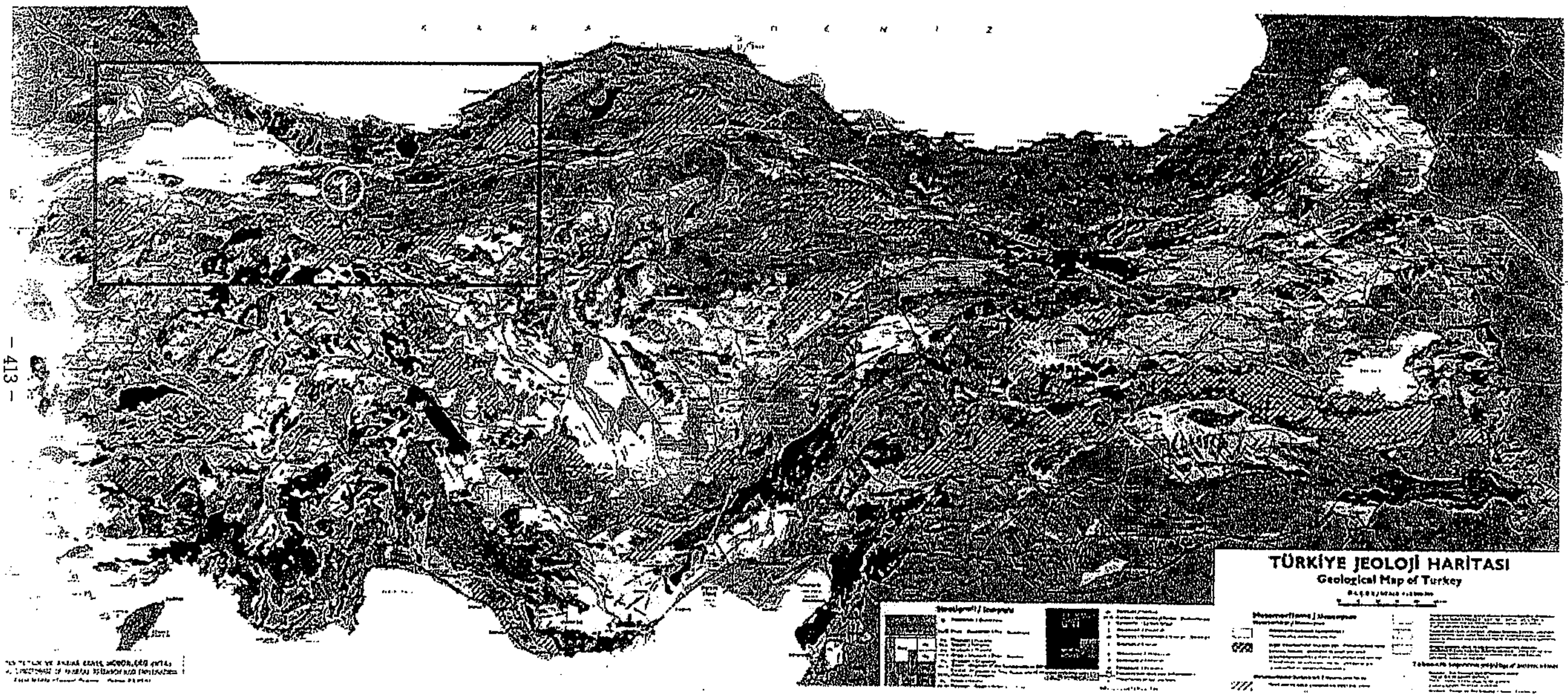
Software	Total	Specification
ERDAS Imagine 8.5	3	
ERDAS Imagine/Orthobase	1	DEM module
PCI	2	
ATRANTIS SAR	1	without PALSAR module
ENVI	2	
TNT	3	
ArcView 3.2 + Spatial Analyst	2	
ArcView 3D Analyst	1	
MIRIN	1	
Surfer	1	
Photoshop	11	
Illustrator	4	
Pagemaker	4	
PDF wirter	9	
MS Office	11	with MS Acess
Visual Basic	4	

Future option(If PALSAR launch on schedule)

Earth Veiw for PALSAR	1	After PALSAR launch



MTA - JICA Geologic Remote Sensing Project
1, 2, 3: Proposed Case Study Areas for Natural Resource Exploration



MTA - JICA Geologic Remote Sensing Project
1: Proposed Case Study Areas for Natural Hazard and Environmental Subjects

<Diagram of Project Concept>