REPORT
ON
THE MINERAL EXPLORATION
IN
THE ALTA・FLORESTA AREA
FEDERATIVE REPUBLIC OF BRAZIL

FINAL REPORT

MARCH 2001

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

PREFACE

In response to the request of the Government of the Federative Republic of Brazil, the Japanese Government decided to conduct a Mineral Exploration Project in the Alta Floresta Area and entrusted the project to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

This project was carried out in three years from 1998 to 2000 and completed on schedule with the valuable collaboration of the relevant governmental agencies of the Federative Republic of Brazil, especially of DNPM and METAMAT. This report is a summary of the survey results conducted during these three years.

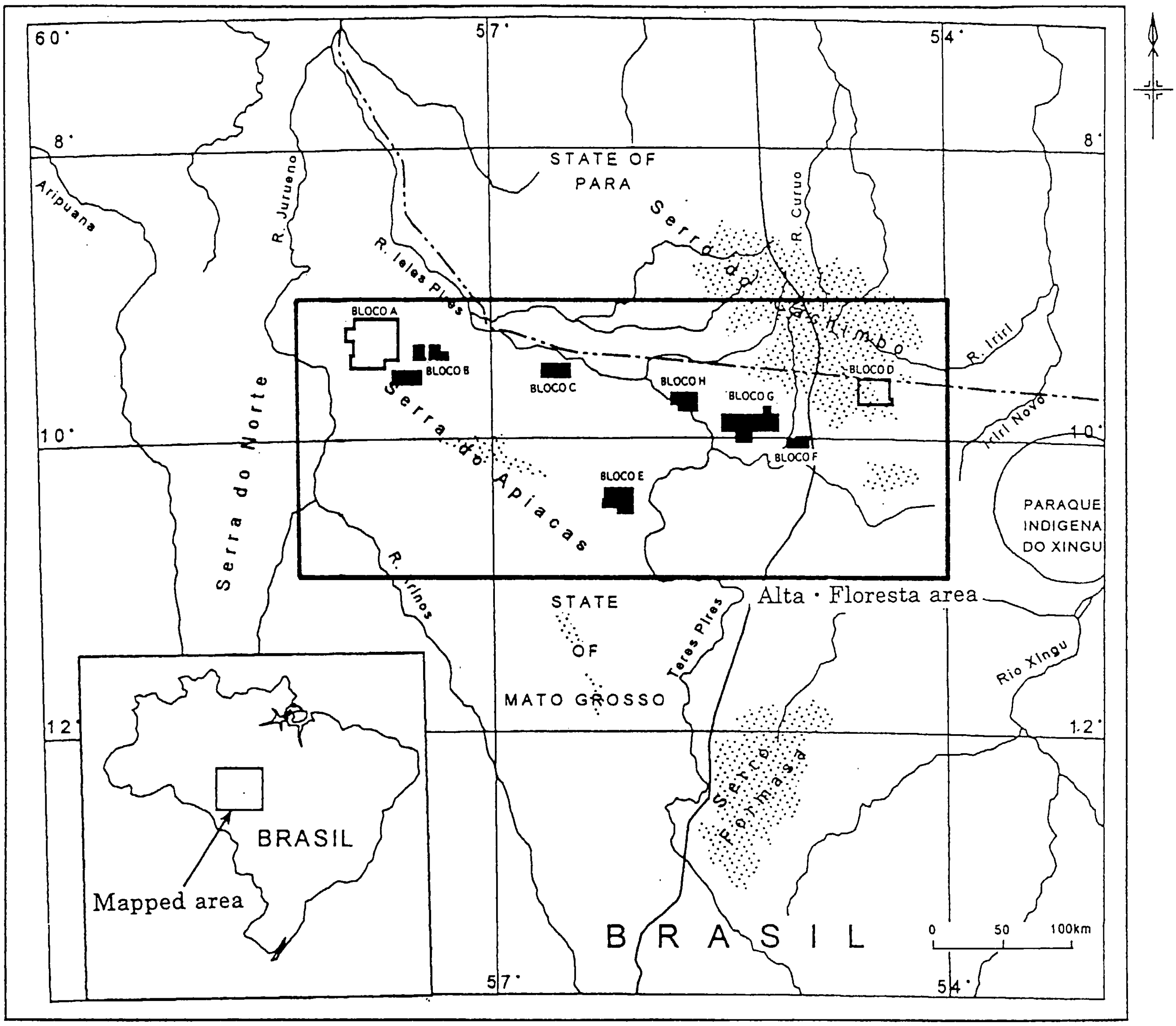
We hope that this report will serve for the development of the mineral resources in Brazil and contribute to the promotion of friendly relations between Japan and Brazil.

We wish to express our deep appreciation to the officials concerned of the Government of Brazil for their close cooperation extended to the team.

March 2000

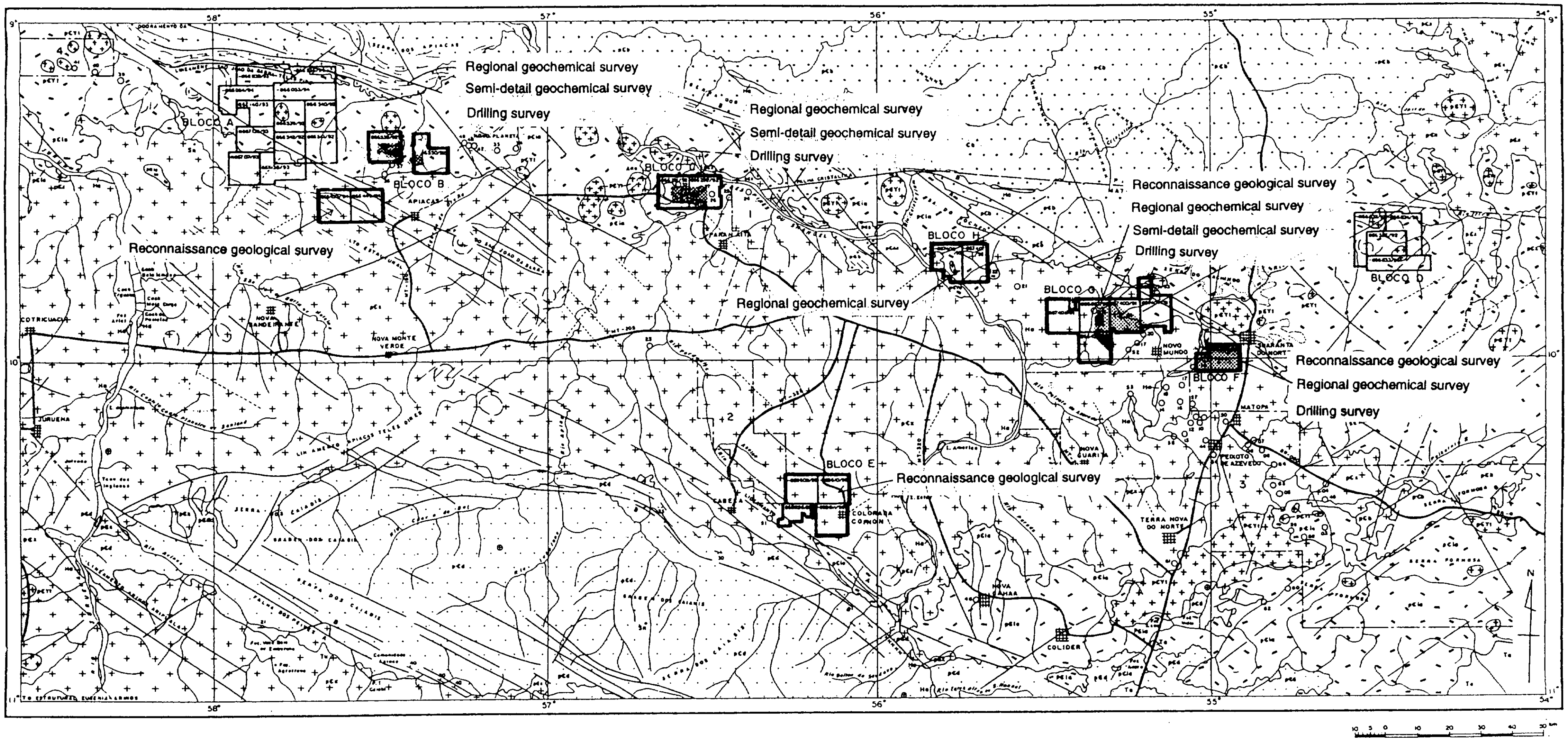
Kunihiko Saito
President
Japan International Cooperation Agency

Naohiro Tashiro
President
Metal Mining Agency of Japan



▭	Alta Floresta area
■	Survey area in the project area

Fig. 1 Location map of the project area in Brazil



LEGEND

Phase I survey area

Phase II survey area

Phase III survey area

Fig. 2 Location map of the survey area in the Alta Floresta area

ABSTRACT

In accordance with the Scope of Work signed on 6th July 1998 between the Governments of Japan and the Federative Republic of Brazil, a mineral exploration project was carried out in Alta Floresta area, Brazil in order to find new ore deposits by clarifying the geology and the mineral potentiality in the area.

This project with duration of three years started in 1998 and during this period the following survey were conducted:

a) Geological survey in the B Block area, C Block area, E Block area, F Block area, G Block area and H Block area.

b) Geochemical survey in the B Block area, C Block area, F Block area and G Block area.

c) Drilling survey in the B Block area, C Block area, F Block area and G Block area.

The survey results in each block can be summarized as follows:

B Block area: Two trenches confirmed the strike and dip of structures holding gold mineralization in B Block area. Drilling survey using RC and DD methods was then carried out (Fig. II-1-7 to -15) by 75 RC drilling holes (total length of 3,750m) and 11 DD holes (total length of 808.05m). Trench survey results confirmed that gold mineralization in this area is controlled by structures as shearing and quartz veins showing a SW dip. Results from drilling survey clarified that the spatial distribution of the gold mineralization is relatively continuous, but showing a large gold barren section intercalated by mineralization with low to intermediate gold grade. Results from overall surveys indicated that although abundant gold mineralization exists in B Block area, there has not been yet detected any economically potential target for further drilling within the area.

During the DD drilling survey, 10 holes with total length of 804.55 m were drilled along S45W direction. According to the results of the drilling survey, the sheared zone was confirmed and delimited in width. The interpretation map (Fig. II-1-14 and -15) indicates that the gold mineralization occurred in two sheared zones with directions of NW-SE and NE-SW. These mineralized zones do not cross each other and furthermore, they are small in scale and with low gold grades. As shown Fig. II-1-14 and -15, the mineralizations along NW-SE direction are extended in the northeastern part of the drilling survey area where soil anomalies with high gold values were partially extended. Several continuous soil gold anomalies were detected in the east and west part outside of the central soil anomalous zone.

C Block area: Two trenches confirmed the strike and dip of structures holding gold mineralization in C Block area. Drilling survey by using the RC and DD method was performed with 68 RC holes (total length of 3,400m) and 10 DD holes (total length of 804.55m). Trench survey results confirmed that shearing structures dipping NE, controlled the gold mineralization in the area and that quartz veins. Results from the drilling survey showed that the gold mineralizations are relatively continuous, but its spatial distribution shows large gold barren sections intercalated by mineralized sections (Fig. II-2-13). Results from overall surveys concluded that, although many gold mineralizations exist in C Block area, not any economically potential target was

detected for further drilling in this area.

Block E: Shearing zones holding promising gold mineralization could not be confirmed during the geological survey within this area. Analytical results of ore samples taken in the E block area also showed very low gold grades proving that promising gold mineralization is not likely to be found within this area.

Block F: Gold mineralizations detected by auger geochemical survey in Serrinha do Guaranta area show a NW-SE extension in a place where the Serrinha do Guaranta garimpo is located. Drilling survey with 2 boreholes (total length of 200.70m) was conducted to confirm the continuity at depth of two gold mineralizations detected by garimpo works. The drilling survey confirmed that these gold mineralizations present low gold grade and are inserted at high angles within the shearing zone.

G Block area: Detailed soil geochemical survey along 108.2 linear Km, which included the collection of 1,127 samples, clarified the existence of three broad concentration of gold anomalies in the Northern, Southern and Southeastern part of the G Block area. Drilling survey using RC and DD methods was then carried out by drilling 43 RC holes (total length of 2,150m) and 3 DD holes (total length of 301.95m). Results from drilling survey demonstrated that the gold mineralizations are associated to brecciated porphyry granite and to rock alteration as silicification, potassification and pyrite dissemination and films, quartz veins and veinlets. Most of drilling intercepted gold mineralizations and among them, the ones with higher gold grade are closely associated to sites with high dissemination of pyrite or to high concentration of pyrite films. Characteristics of the gold mineralization in G Block show similarities with gold mineralization described as Matupa type and Luizao type, which according to RTZ, this kind of mineralization corresponds to a porphyry type gold mineralization. From drilling data, it was estimated a geological ore reserve of 10.4 million tons and an average ore grade of 0.439g/t, totalizing 4.5 tons of gold.

Block H: From the results of the geological survey, an alluvial garimpo of unknown gold origin is inferred in the central part of this block. Analytical results of ore samples taken in the H Block area showed very low gold and base metal grades, proving that promising gold mineralization is not likely to be detected within block area.

From the above survey results the following recommendations are suggested for each block area of the Alta Floresta region.

B Block: Further survey is recommended to evaluate the possibility of finding stockwork type or sheeted quartz veinlets type gold mineralization around Jacare garimpo. However, additional work is not recommended within the large gold anomalous area surveyed by drilling.

C Block: Further survey is recommended to evaluate the possibility of detecting high-grade gold mineralization below soil anomalies with higher gold grade. Additional work is not recommended within the large gold anomalous area surveyed by drilling.

G Block: Further survey oriented to target the possibility of porphyry gold type mineralization is recommended.

E, F and H Blocks: No further works can be recommended.

CONTENTS

Part I Generalities

Part II Survey Results

Part III Conclusions and Recommendations

PART I GENERALITIES

CHAPTER 1 INTRODUCTION

1-1 Background and Objectives

In accordance with the Scope of Work signed on 6th July 1998 between the Governments of Japan and the Federative Republic of Brazil, a mineral exploration project was carried out in Alta Floresta, Brazil.

This project was carried out in three years from 1998 to 2000 and it aimed at discovering new mineral deposits in the survey area.

The mining activities in the region started in 1966 with gold discovery by garimpeiros in the Juruena River. After that, the mining activities spread to Peixoto de Azevedo and Alta Floresta areas. Today garimpeiro activities are restricted to garimpo reserve, with few small-scale activities in hard rock. International Mining companies as RTZ and Western Mining has surveyed the areas surrounding big scale hard rock garimpo.

1-2 Survey area and outline of work

Alta Floresta area is located in the northern-most part of Mato Grosso state in Brazil, within a distance of about 800 km north from the capital Cuiaba of Mato Grosso state.

The gold ore deposits are distributed in the northern end and southern end of the area where Xingu complex is extended east to west and in the area where Uatuma group surrounds the Xingu complex. The gold ore deposits in the survey area are composed of placer deposits, residual deposits and primary deposits. The Alta Floresta region, including all the survey areas, is located in a residual plateau known as Depressoes da Amazonia Meridional. Original forest is still present at the northern part of the Alta Floresta region. But at the southern part, cattle farms and large plantations are widely distributed. The elevations at the northern and southern portion are higher than 500 m.

Exploration survey for all block started with a regional geochemical survey, and inside of the newly detected anomalous zone were performed detailed geochemical survey, auger survey and scout drilling. RC drilling survey by grid was carried out only inside of the soil gold anomalies detected by detailed geochemical survey. Outline of the three years survey was compiled in the Fig. I-1-1.

During Phase I survey, regional geological survey, regional soil geochemical survey and data compilation were carried out. The regional geological survey was carried out in the E block, F block, G block and H block. The regional geochemical survey was carried out in B block and C block.

During Phase II survey, detailed geological survey, regional and detailed soil geochemical survey and drilling survey were carried out. Regional geological survey was carried out in B block, C block

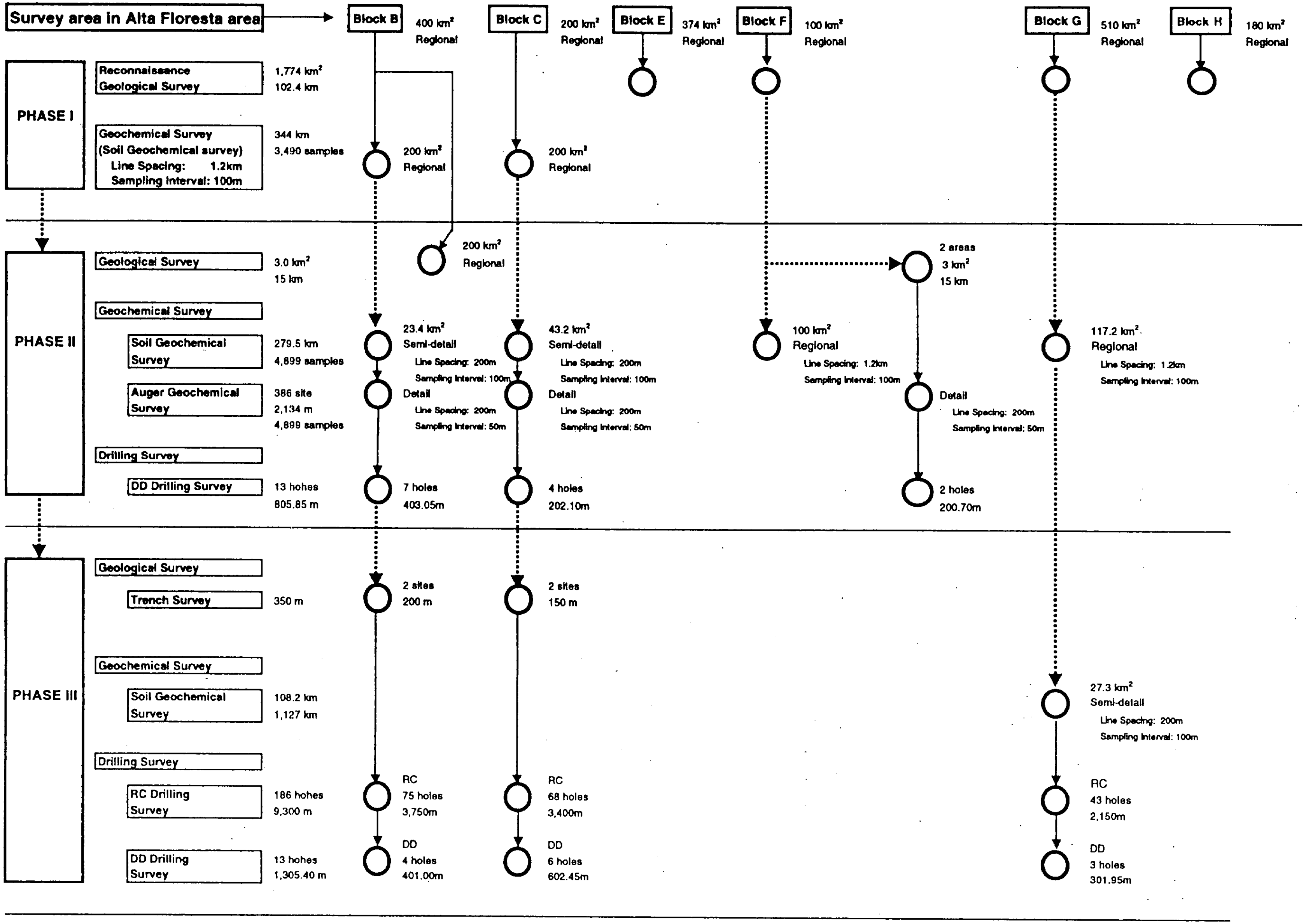


Fig. I-1-1 Flow of the project

and F block. Regional geochemical survey was carried out in F block and detailed geochemical survey was carried out in B block, C block and F block. Drilling survey was performed in B block, C block and F block.

During Phase III survey, geological survey by trench, detailed soil geochemical survey and drilling survey in grid were carried out. The geological survey was carried out in B block and C block, geochemical survey was carried out in G block and grid-drilling survey was performed in B block, C block and G block.

The amounts of work and laboratories studies conducted during these three years are summarized in table I-1-1 and the amount of drilling survey is shown in the Table I-1-2.

1-3 Survey Members of the Project

The members who participated in the project were as follows:

(1) Project planning and negotiation

Japanese counterpart		Brazilian counterpart	
Tadashi Ito	(MMAJ)	Miguel Navarrete Fernandez Junior	(DNPM)
Takeshi Harada	(MMAJ)	Kiomar Oguino	(DNPM)
Tomoo Hayakawa	(JICA)	Emanuel Teixeira de Queiroz	(DNPM)
Yoshihisa Yamamoto	(MMAJ Santiago office)	Carlos Schobbenhaus	(DNPM)
		Claudio Recht	(DNPM)
		Carmindo Francisco Ferreira	(METAMAT)
		Wanderlei Magalh„es de Resende	(METAMAT)
		Nilson Batista De Souza	(DNPM/MT)

MMAJ: Metal Mining Agency of Japan
JICA: Japan International Cooperation Agency
DNPM: Departamento Nacional de Producao Mineral
METAMAT: Companhia Matogrossense de Mineracao

(2) Administration of field work

(a) Phase I:

Takeshi Harada	(MMAJ)
Koji Hirai	(MMAJ)
Susumu Nagae	(MMAJ)
Yoshiaki Igarashi	(MMAJ Santiago office)

(b) Phase II:

Takeshi Harada	(MMAJ)
Yoshiaki Igarashi	(MMAJ Santiago office)

(c) Phase III:

Tadashi Ito	(MMAJ)
Takeshi Harada	(MMAJ)
Takashi Kamiki	(MMAJ Santiago office)

Table I-1-1 Contents and amount of works of the project

	PHASE I	PHASE II	PHASE III
Geological Survey	**Reconnaissance survey** Survey block: Block E, F, G and H Survey area: 1,774 km^2 Survey route: 102.4 km	**Detailed survey** Survey block: Block F Survey area: 3.0 km^2 Survey route: 15.0 km	**Trench survey** Survey block: Block B and C Total length: 350 m Block B (2 trenches): 200 m Block C (2 trenches): 150 m
Geochemical Survey	**Soil sampling** Survey block: Block B and C Line length: 344 km Soil samples: 3,490 samples	**Soil sampling** Survey block: Block B, C, F and G Line length: 479.5 km Soil samples: 4,899 samples **Auger sampling** Survey block: Block B, C and F Line length: 17.05 km Auger sample sit: 364 sits Digging length: 2,134 m Soil samples: 4,899 samples	**Soil sampling** Survey block: Block G Line length: 108.2 km Soil samples: 1,127 samples
Drilling Survey		**DD drilling survey** Total length: 805.85 m Block B (7 holes): 403.05 m Block C (4 holes): 202.10 m Block F (2 holes): 200.70 m	**RC drilling survey** Total length: 9,300 m Block B (75 holes): 3,750 m Block C (68 holes): 3,400 m Block F (43 holes): 2,150 m **DD drilling survey** Total length: 1,305.40 m Block B (4 holes): 401.00 m Block C (6 holes): 602.45 m Block F (3 holes): 301.95 m
Laboratorial Studies	**Geological and geochemical survey** Thin section: 41 samples Polished section: 30 samples X-ray diffraction analy: 34 samples Ore assay: 236 samples Fluid inclusion: 11 samples Dating: 5 samples Soil chemical analysis: 3,490 samples Soil check samples: 102 samples	**Geological and geochemical survey** Thin section: 32 samples Polished section: 39 samples X-ray diffraction analysi: 36 samples Ore assay: 204 samples Fluid inclusion: 20 samples Dating: 9 samples Soil chemical analysis: 7,133 samples Soil check samples: 102 samples **Drilling survey** Thin section: 58 samples Polished section: 44 samples X-ray diffraction analysi: 46 samples Ore assay: 838 samples Fluid inclusion: 5 samples	**Geological and geochemical survey** Thin section: 15 samples Polished section: 16 samples X-ray diffraction analysi: 19 samples Ore assay: 26 samples Fluid inclusion: 4 samples Dating: 2 samples Soil chemical analysis: 1,127 samples **Drilling survey** Thin section: 16 samples Polished section: 17 samples X-ray diffraction analysi: 46 samples Ore assay for RC: 4,650 samples Ore assay for RC: 1,301 samples Core check samples: 25 samples Fluid inclusion: 4 samples

Table I-1-2 Drilling survey conducted in the project

(1) RC Drilling Survey

Area Name	Survey Line	Number of holes	Length of a hole (m)	Length planned (m)	Length executed (m)	Direction	Inclination (deg.)	Date of Start	Date of Finish
Block B	B1 Line	15	50	750	750	N45E	50°	11-Aug-00	22-Aug-00
	B2 Line	15	50	750	750	N45E	50°	30-Aug-00	16-Sep-00
	B3 Line	15	50	750	750	N45E	50°	06-Sep-00	16-Sep-00
	B4 Line	10	50	500	500	N45E	50°	30-Aug-00	05-Sep-00
	B5 Line	20	50	1,000	1,000	N45E	50°	22-Aug-00	30-Aug-00
Block C	C1 Line	23	50	1,150	1,150	S45W	50°	19-Sep-00	28-Sep-00
	C2 Line	20	50	1,000	1,000	S45W	50°	20-Sep-00	10-Oct-00
	C3 Line	15	50	750	750	S45W	50°	28-Sep-00	05-Oct-00
	C4 Line	10	50	500	500	S45W	50°	05-Oct-00	10-Oct-00
Block G	G1 Line	12	50	600	600	N45E	50°	25-Oct-00	30-Oct-00
	G2 Line	16	50	800	800	N45E	50°	13-Oct-00	19-Oct-00
	G3 Line	15	50	750	750	N45E	50°	19-Oct-00	25-Oct-00
Total length				9,300	9,300				

(2) DD Drilling Survey

Area Name	Hole No.	Location		Length planned (m)	Length executed (m)	Direction	Inclination (deg.)	Date of Start	Date of Finish
		S	W						
Block B	MJBA-7	9°23'47"	57°27'18"	50	50.80		90°	26-Oct-99	27-Oct-99
	MJBA-8	9°23'56"	57°27'18"	100	100.15		90°	15-Oct-99	18-Oct-99
	MJBA-9	9°24'05"	57°27'17"	50	50.05		90°	19-Oct-99	21-Oct-99
	MJBA10	9°24'10"	57°27'17"	50	50.55		90°	21-Oct-99	25-Oct-99
	MJBA-11	9°22'19"	57°29'07"	50	50.15		90°	04-Nov-99	05-Nov-99
	MJBA12	9°22'25"	57°29'07"	50	50.65		90°	01-Nov-99	03-Nov-99
	MJBA-13	9°22'32"	57°29'07"	50	50.70		90°	29-Oct-99	31-Oct-99
	MJBA-14	9°22'31"	57°29'05"	100	100.05	N45E	50°	16-Oct-00	20-Oct-00
	MJBA-15	9°22'22"	57°28'56"	100	100.50	N45E	50°	21-Oct-00	29-Oct-00
	MJBA-16	9°22'17"	57°28'51"	100	100.30	N45E	50°	30-Oct-00	02-Nov-00
	MJBA-17	9°24'03"	57°27'17"	100	100.15	N45E	50°	03-Nov-00	05-Nov-00
Block C	MJBA-3	9°29'52"	56°35'30"	50	50.30		90°	09-Oct-99	11-Oct-99
	MJBA-4	9°29'58"	56°35'30"	50	50.45		90°	06-Oct-99	08-Oct-99
	MJBA-5	9°30'05"	56°35'30"	50	50.70		90°	01-Oct-99	04-Oct-99
	MJBA-6	9°30'11"	56°35'29"	50	50.65		90°	29-Oct-99	01-Oct-99
	MJBA-18	9°30'26"	56°34'56"	100	100.15	S45W	50°	10-Nov-00	13-Nov-00
	MJBA-19	9°30'24"	56°35'13"	100	100.30	S45W	50°	14-Nov-00	20-Nov-00
	MJBA-20	9°30'06"	56°35'14"	100	100.30	S45W	50°	21-Nov-00	25-Nov-00
	MJBA-21	9°30'06"	56°35'14"	100	100.55	S45W	50°	26-Nov-00	30-Nov-00
	MJBA-22	9°30'03"	56°35'11"	100	100.75	S45W	50°	30-Nov-00	04-Nov-00
	MJBA-23	9°30'00"	56°35'24"	100	100.40	S45W	50°	05-Nov-00	08-Nov-00
Block F	MJBA-1	9°58'16"	54°58'33"	100	100.15	S45W	60°	01-Sep-99	09-Sep-99
	MJBA-2	9°58'14"	54°58'44"	100	100.55	N20E	90°	14-Sep-99	22-Sep-99
Block G	MJBA-24	9°57'23"	55°18'34"	100	100.30	N45E	50°	20-Nov-00	27-Nov-00
	MJBA-25	9°57'12"	55°18'41"	100	100.30	N45E	50°	25-Oct-00	03-Nov-00
	MJBA-26	9°57'09"	55°18'53"	100	101.35	N45E	50°	07-Nov-00	18-Nov-00
Total length				2,100	2,111				

(2) Field survey

(a) Phase I:

Japanese counterpart		Brazilian counterpart	
Motomu Goto	Team leader	Nilson Batista de Souza Principal geologist	(DNPM/MT)
Junichi Yamagata	Geochemist	Amóss de Melo Oliveira Geologist	(DNPM/MT)
Yoshimitsu Negishi	Geochemist	Jair de Freitas Geologist	(DNPM/MT)
Katsuhiko Maeda	Geochemist	Jocy Gonçalo de Miranda Geologist	(DNPM/MT)
Masaharu Kaedei	Geochemist	Clàudio Recht Geologist	(DNPM/BRS)
Masahiko Nono	Geologist	Jose Raimundo dos Anjos Geologist Assistant	(DNPM/BRS)
Masato Ouchi	Geologist	Emanuel Teixeira de Queiroz Director	(DNPM/BRS)
		Carlos Schobbenhaus DivisionChief	(DNPM/BRS)
		Jose da Silva Luz Regional Chief	(DNPM/MT)
		Gercino Domingos da Silva Geologist	(METAMAT)
		Isaias Mamore de Souza Geologist	(METAMAT)
		Antonio João Paes de Barros Geologist	(METAMAT)
		Wanderlei Magalhães de Resende Director	(METAMAT)

(b) Phase II:

Japanese counterpart		Brazilian counterpart	
Motomu Goto	Team Leader	Nilson Batista de Souza Principal geologist	(DNPM/MT)
Junichi Yamagata	Geochemist	Amóss de Melo Oliveira Geologist	(DNPM/MT)
Hisashi Matsuba	Geochemist	Jair de Freitas Geologist	(DNPM/MT)
Yoshimitsu Negishi	Geochemist	Jocy Gonçalo de Miranda Geologist	(DNPM/MT)
Masaharu Kaedei	Geochemist	Claudio Recht Geologist	(DNPM/BRS)
		Jose Raimundo dos Anjos Geologist Assistant	(DNPM/BRS)
		Emanuel Teixeira de Queiroz Director	(DNPM/BRS)
		Carlos Schobbenhaus DivisionChief	(DNPM/BRS)
		Jose da Silva Luz Regional Chief	(DNPM/MT)
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		Isaias Mamore de Souza Geologist	(METAMAT)
		Antonio João Paes de Barros Geologist	(METAMAT)
		Jesue Antonio da Silva Geologist	(METAMAT)
		Wanderlei Magalhães de Resende Director	(METAMAT)

(c) Phase III:

Japanese counterpart		Brazilian counterpart	
Motomu Goto	Team Leader	Nilson Batista De Souza	
Junichi Yamagata	Geologist	Principal geologist	(DNPM/MT)
Soichiro Kageyama	Geochemist	Amóss de Melo Oliveira	
Masaharu Kaedei	Geochemist	Geologist	(DNPM/MT)
		Jair de Freitas	
		Geologist	(DNPM/MT)
		Emañuel Teixeira de Queiroz	
		Chief	(DNPM/BRS)
		Carlos Schobbenhaus	
		Chief	(DNPM/BRS))
		Jose da Silva Luz	
		Chief	(DNPM/MT)
		Gercino Domingos da Silva	
		Geologist	(METAMAT)
		Isaias Mamore de Souza	
		Geologist	(METAMAT)
		Jesue Antonio da Silva	
		Geologist	(METAMAT)
		Wanderlei Magalhães de Resende	
		Director	(METAMAT)

1-4 Survey Period

Period of the field survey in this phase is as follow:

(a) Phase I:

Geological survey:	7th October 1998 to 1st November 1998
Geochemical survey and data compilation:	26th August 1998 to 19th November 1998

(b) Phase II:

Geological survey:	2^{nd} August 1999 to 17th August 1999
Geochemical survey:	7th July 1999 to 28th November 1999
Drilling survey:	1st September 1999 to 28th November 1999

(c) Phase II:

Geological survey:	17th July 2000 to 9th September 2000
Geochemical survey:	17th July 2000 to 6th October 2000
Drilling survey:	27th July 2000 to 22nd December 2000

CHAPTER 2 GEOGRAPHY OF THE SURVEY AREA

2-1 Locations and Accessibility

The Federative Republic of Brazil, accounting as the biggest country in South America, has an area of approximately 8.540.000 km^2. The population is about 157 million and its capital city is Brasilia.

Alta Floresta area is located in the northern part of the Mato Grosso State at about 800 km north from capital Cuiaba (Fig.1).

The main road that accesses the survey area is the BR163, which connects the capital Cuiaba with Santarem City in the Para State. The BR163 crosses the eastern part of the survey area at the city of Matupa. It takes about 12 hours by vehicle for 790 km from Capital Cuiaba to Alta Floresta City. From Alta Floresta City to Apiacas City it take about 6 hours by vehicle for about 180 km of gravel road.

2-2 Topography and Drainage System

The Alta Floresta region, including all the survey areas, is located in a residual plateau known as Depressoes da Amazonia Meridional. The topography of the region is almost flat but present at northern and southern portion a continuous range of high topographic relief. The high topography is related to two graben structures that run along WNW-ESE direction. The altitude at the central part of the area has an elevation of 150 m to 350 m and it forms gentle hills within the area. The elevations at the northern and southern portion are higher than 500 m.

The main river that runs in Alta Floresta region is the Rio Teles Pires with many tributaries as Rio Apiacas and Rio Paranaita.

2-3 Climates and Vegetation

The survey area belongs to Amazon tropical rain forest that presents high temperature and high humidity. Original forest is still present at the northern part of the Alta Floresta region. But at the southern part, cattle farms and large plantations are widely distributed.

In the survey area there are two well-defined seasons i.e., dry season from April to October and rainy season from November to March.

CHAPTER 3 EXISTING GEOLOGICAL DATA

3-1 General Geology of the Surrounding Area

The Fig I-3-1 that shows the study area is an interpretation map from Landsat TM Imagery and its generalized stratigraphic column is shown in the Fig I-3-2.

Geology of the survey area is mainly composed of Xingu Complex of Archean to Paleoproterozoic age, Pre-Uatuma Granites of early Proterozoic age, Uatuma supergroup of middle Proterozoic age, Cachimbo graben of middle Proterozoic age, Dardanelos formation of middle Proterozoic age, dykes and sills.

In view of structural geology, Up-lift zone is widely extended east to west in the survey area. Cachimbo graben is located in the northern part of the up-lift zone and Caiabis graben in the southern part. Xingu Complex, Pre-Uatum,, Granites and Uatum,, supergroup are distributed in the up-lift zone, Beneficente group in the Cachimbo graben and Cachimbo graben in the Caiabis graben.

The Alta Floresta area is located at the southwestern margin of the Central Amazonian Province. The granites of the Amazonian craton have been tentatively grouped, and the most complete classification of granites has been summarized by Dall Agnol et al. (1987) as:

①Archean granites (>2.5Ga);

②Paleoproterozoic (Transamazonian age) granitoids (2.1-1.9Ga);

③Mesoproterozoic (1.8-1.4Ga) anorogenic granites of the Central Amazonian Province;

④Mesoproterozoic (1.7-1.4 or 1.2Ga) granites of the Rio Negro-Juruena Province; and

⑤Meso- to Neoproterozoic (1.4-0.9Ga) anorogenic granites of the Rio Negro - Juruena, Rondonian and Sunsas Provinces.

Dating of rocks by K/Ar, U/Pb and Pb/AB methods were carried out during the project, and their objectives were to confirm the above classification summarized by Dall Agnol et al. The dating results are shown on Table 1-3-1.

3-2 Mineralization and Mining Activities

3-2-1 Mineralization

The gold mineralization in the survey area is composed from placer deposits, residual gold deposits in soil and primary gold mineralization in hard rock and saprolite. Primary Gold Mineralizations exist in many tectonic environments through the Amazonian craton. For instance, in the Alta Floresta area were identified mainly three Gold Mineralization types, as follow:

(1) Porphyry Gold type

Botelho et al. (1998) associate the gold mineralization of the Alta Floresta region with oxidized type I calc-alkaline plutons, with characteristic either of volcanic arc or post-collision granites. The gold either occurs in small high-grade vein-type deposits or is disseminated in widespread hydrothermal zones with alteration such as sericitization, feldspathization and pyritization.

The presence of hydrothermal magnetite in association with pyrite, sulphur isotope data and the petrological data for the Matupa Monzogranite in the Serrinha deposit are also characteristics of porphyry copper-molybdenum and copper-gold deposits. Sillitoe (1979) predicted the existence of copper-poor porphyry gold deposits and classified the characteristics presented for the Matupa Monzogranite and Serrinha Gold Deposit, allowing its classification as a porphyry gold deposit.

(2) Shear zone hosted quartz veins type

A regional NW-SE direction ductile shear zone crosses the Alta Floresta region. This shear zone has a width of several kilometers and 36 majors gold lodes and hundred of minor gold quartz veinlets zones were recognized inside of the shear zone. The Paraiba gold mine is the only known lode deposit and it has been considered as the most important shear zone hosting lodes in the Alta Floresta area.

(3) Stockwork type

The stockwork type gold mineralization generally is related and controlled by regional lineaments or local shearing structure. The Novo Planeta garimpo is the most studied stockwork type gold mineralization in the Alta Floresta area. The gold mineralization in Novo Planeta garimpo is related to Teles Pires type granite. In Novo Planeta, the Teles Pires granite is intruded in granitoids of the Xingu Complex and the gold mineralization is positioned along the border of the Teles Pires granite.

3-2-2 Outline of the Mining Activities

The mining activities in the region started in 1966 with gold discovery by garimpeiros in the Juruena River, but it was only in 1978 that the garimpo activity spread to Peixoto de Azevedo and Alta Floresta areas due to the opening of the road BR-163 that connects the state capital Cuiaba and the Santarem city of Para state.

The garimpo activities increased sharply after 1978, with the discoveries of Novo Planeta, Novo Satelite and Novo Astro alluvial garimpos and in 1979, with the discoveries of Jau, Ze Vermelho and Ze da Onca alluvial garimpos. The garimpo gold production in the period between 1982 and 1995 was officially reported in 53.0 ton in the Peixoto de Azevedo area and 58.8 ton in the Alta Floresta area, totaling 111.8 ton of gold in the garimpos of the Alta Floresta Region

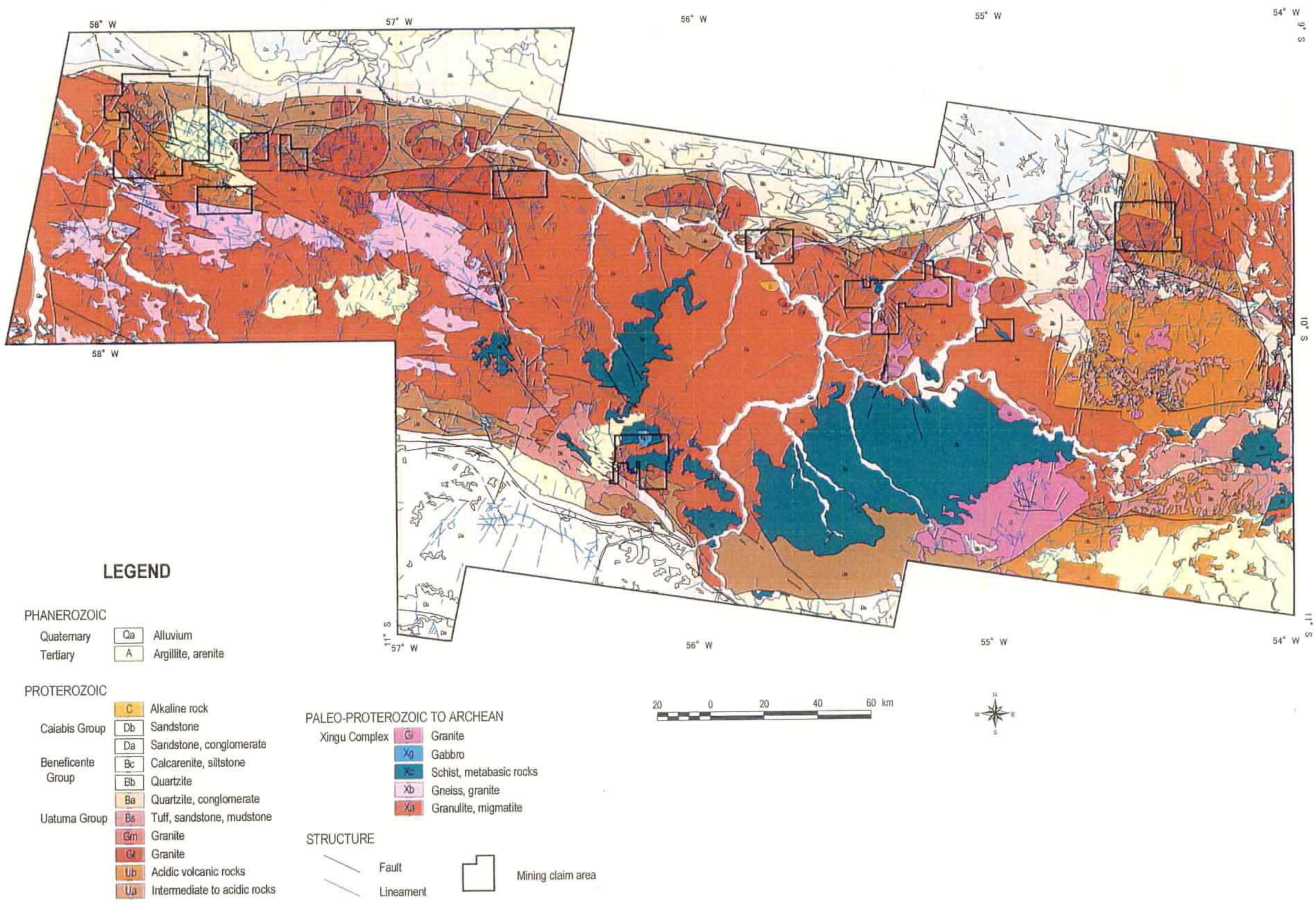

Fig. I-3-1 Geological interpretation map of the Alta Floresta area by Landsat images

EON	ERA	COLLUMNAR SECTION	STRATIGRAPHIC UNIT	SYMBOL	LITHOLOGY		IGNEOUS ACTIVITY PLUTON.	IGNEOUS ACTIVITY VOLC.	MINERALIZATION
PHANEROZOIC	QUATERNARY		Recent Alluvium	Qa	Inconsolidated alluvial sediments				Au
	TERTIARY		Residual Sediment	Trs	Elluvial-colluvial sediment, partially lateritic				
PROTEROZOIC	MIDDLE		Dardanelos Formation	Pd	Arkosic sandstone showing cross-stratification		Dikes and Sills		
			Beneficente Group	Pb	Orthoquartzite, sandstone, arkose, siltite, argillite				
			Basic Intrusive	Gb	Gabbro, Basalt		Gabbro		
			Uatuma	Gru	Teles Pires Granite	Calci-alkaligranite, biotite granite, porphyry granite, adamellite, rapakivi granite			
			Supergroup	Pui	Iriri Formation	Rhyollite, rhyodacite, dacite, pyroclastics, quartzite	Granodiorite		
			Pre-Uatuma Granite (Not deformed)	Gr	I / II / III	Type I: adamellite, granodiorite, Hornblende biotite granite; Type II: Two mica granite, biotite monzogranite, hydrothermal granite; Type III: syenitic biotite granite, alkaline granite			Au, Cu
PALEO-PROTEROZOIC TO ARCHEAN			Ductil Shearing Zone	Dsz	Quartz mylonite, micro breccia and ultramylonite		Granite		
			Xingu Complex	Px	Augen gneiss, granite gneiss, amphibolite, metabasite, monzonite, granodiorite, quartzite, BIF, calc-silicate, schists				

Stratigraphy in accordance with: Schobbenhauss et al., 1981 and Antonio Joao P. Barros, 1994; modified.

Fig. I-3-2 Generalized stratigraphic columnar section in the project area

Table I-3-1 Dating results in Alta Floresta area

Geology and Minealization		Existing Data	MMAJ (1999)	MMAJ (2000)	Phase III
Dardanelos Formation		1.4 Ga (Rb/Sr method)			
Beneficiente Group		1.6 to 1.4 Ga			
Basic Intrusive					
Uatuma Group					
	Teles Pires Granite	1.6 Ga	1.104 to 1.341 Ga (K/Ar method)		
	Iriri Formation	1.65 Ga (Rb/Sr method)	1.414 to 1.538 Ga (K/Ar method)	1.786 Ga (U/Pb method)	
Pre-Uatuma Granite					
	Grillb (Block C)			1.802 to 1.803 Ga (U/Pb method)	
	Grillb (Block B)			1.816 Ga (U/Pb method)	
	Grilla (Block B)			1.820 Ga (U/Pb method)	
	Grill			1.823 Ga (Pb/Pb method)	
	Grilll			(U/Pb method)	
	(Gru, Block F)			1.894 Ga (U/Pb method)	
	(Xingu, Block F)			1.937 Ga (U/Pb method)	
	(Xingu, Block G)			1.817 Ga (U/Pb method)	
	Matupa Granite	1.872 Ga			
	Juruena Granite	1.947 Ga			
Gold Minealization					
	Sheared Zone and Dissemination Type (Block G)				1.56 Ga (Pb/Pb method)
	Vein Type (Block C)				1.76 Ga (Pb/Pb method)

The primary vein of the Paraiba gold garimpo was discovered by garimpeiros in 1980, and it was manually mined down to a the depth of about 20 to 30 m. In 1990, the first shaft of 60 m depth was open and 8 holes were drilled by Mineracao Mivale in association with garimpeiros.

Mineracao Porto Estrela S.A. of Paranapanema Group was established in Novo Planeta and Igarape Jau areas by starting a prospection for alluvial gold in 1979 and 4 years later, this company begun mining operations in alluvial deposits of the Novo Planeta area and later in the Jau area. The gold production of Mineracao Porto Estrela S.A. reached 222 kg in 1983 and its peak production reached 575 kg in 1985.

Santo Onofre Mineracao S.A., mining company, surveyed the Igarape Natal and Rio Canama areas in 1983, followed by the development of an experimental mine between 1985 and 1990.

TP Mineracao S.A., mining company, shared by BUMBRAS of Canada and CMP, surveyed the Teles Pires main river during 1983 and developed a mining operation from 1984 until 1989.

Jaruana Mineracao Ind. e Com. S.A. carried out an exploration survey in the Juruena area alluvial deposit from 1981 to 1982 with successful results.

Grupo Eluma S.A. Ind. e Comercio surveyed the Brcao Norte and Terra Nova areas during 1981 and 1984 aiming alluvial and elluvial-colluvial deposits with good results.

CHAPTER 4 SUMMARY OF THE SURVEY RESULTS

4-1 B Block

Geological survey, geochemical survey and drilling survey were carried out in B block. Geological survey including reconnaissance geological survey and trench survey and geochemical survey consisted of regional and detailed surveys were carried out and later, a drilling survey using RC and DD methods were performed.

B block geology consists from the following units; Pre-Uatuma Granite of early Proterozoic, Uatuma Supergroup of middle Proterozoic, Dykes and Quaternary as shown in the Fig.II-1-1 and Fig.II-1-2. Iriri Formation and Teles Pires Granite represent the Uatuma Group. Shearing zones presenting quartz veins were detected in the western B block. Jacare garimpo is located inside one shearing structure and its gold mineralization presents high gold contents with maximum value of 379.36 g/t of Au, related to sheeted quartz veinlets filling shearing planes. Also, a 6m wide channel sampling presented an average grade of 70.52g/t Au and 6.05g/t Ag.

Soil geochemical anomalies with elongation pattern trending NW-SE were detected in B block, with minimum gold values of 25 ppb as shown in the Fig. II-1-4. A total of three gold anomalies zone were detected with elongation along NW-SE that suggest the existence of shearing structure along this direction. Auger survey performed within the above gold anomaly zones indicated that even though the gold anomaly in soil has a relative great size, the gold distribution in the saprolite is narrow with spots of high gold grade (Fig. II-1-5).

Drilling survey was distributed in five RC drilling survey lines and it aimed to check the shearing structure related to gold anomalies detected by geochemical survey. RC drilling survey consisted of 75 holes and a total length of 3,750m was drilled and the DD drilling survey consisted of eleven holes and total drilling length of 808.05m as shown in the Fig. II-1-8 and Fig.II-1-15. The best analytical results from RC drilling were observed in the line B5, as four samples with gold grade above Au1g/t and a maximum value of Au4.42 g/t. Analytical results of DD drilling survey indicated seven samples with gold content above Au1g/t confirmed in four DD holes and the maximum detected value was Au5.09 g/t. But, most of gold mineralizations intercepted by drilling survey are from low to intermediate grade and its width is thin. The spatial distribution of gold mineralizations is relatively continuous, but it shows large gold barren section between mineralized parts.

4-2 C Block

Geological survey, geochemical survey and drilling survey were also carried out in C block and the survey content and work sequence is similar with B block.

C block geology consists from the following units; Pre-Uatuma Granite of early Proterozoic, Uatuma Supergroup of middle Proterozoic, Dykes and Quaternary as shown in the Fig.II-2-1 and Fig.II-2-2. Iriri Formation and Teles Pires Granite represent the Uatuma Group. Shearing zones presenting quartz veins were detected in the C block with direction as NW-SE and ENE-WSW. Gold garimpo named C7 is located inside one shearing structure and its gold mineralization presents high gold contents with maximum value of 113.44g/t of Au and 194.3g/t of Ag in quartz vein with a width of 30cm. Many others primary gold garimpo exist in the area, but all garimpo pit is underwater. Outside of the block, at eastern side is located the Waldemar garimpo and quartz vein samples taken from its garimpo tailing presented gold values of 174.00 g/t, 40.4 g/t of silver and 0.40% of copper.

Soil geochemical survey showed 5 anomalies zone, but the central anomaly was selected as the main target area for auger survey and drilling survey as shown in the Fig. II-2-4. Auger survey performed in the central gold anomaly zone indicated that even though the gold anomaly in soil has a relative great size, the gold distribution in the saprolite is narrow with spots of high gold grade (Fig. II-2-5).

Drilling survey was distributed in four RC drilling survey lines and it aimed to check in depth, the gold anomalies detected by geochemical survey. RC drilling survey consisted of 68 holes and a total length of 3,400m was drilled and the DD drilling survey consisted of 10 holes and total drilling length of 804.55m as shown from the Fig. II-2-7 to Fig.II-2-13. Analytical results from RC drilling confirmed gold mineralization in the C1, C2, C3 and C4 lines and maximum values were Au 1.92 g/t, Au 3.38 g/t, Au 4.04 g/t and Au 3.06 g/t. Analytical results of DD drilling survey indicated two samples with gold content above Au1g/t in two holes and the maximum gold value was Au 2.72 g/t. But, most of gold mineralizations intercepted by drilling survey are from low to intermediate grade and its width is thin. The spatial distribution of gold mineralizations is relatively continuous, but it shows large gold barren section between mineralized parts.

4-3 E Block

Only a regional geological survey was carried out in the E block. As shown in the Fig.II-3-1, the region of E block is represented by the following geologic units: Xingu Complex (Px), Pre Uatuma, granite (GrI), Iriri Formation and Granite of Uatuma Group (Pui), Middle Proterozoic Basic intrusive (Gb), Tertiary age Residual Sediment (Trs), Dykes (Db) and Quaternary age Recent alluvium.

The Cabeca alluvial garimpo is by far the biggest alluvial gold mineralization in the E block region and the source of the Cabeca alluvial gold mineralization is probably related to quartz veins and veinlets that fill the ductile shearing with N70W to N80W direction.

But, the geological survey carried out within E block, clearly indicated that the area related to E block does not present any favorable geological or tectonic condition to host a major gold deposit and consequently, the potentiality of this block is considered to be low.

4-4 F Block

Geochemical survey, geological survey and drilling survey were carried out in the F block as shown in the Fig. II-4-2.

Archean to Lower Proterozoic Xingu Complex (Px), Dykes and Quaternary sediment compose the geology of F block and geologic structure as shearing zones hold the primary gold garimpo, as Aluizio and Serrinha do Guaranta.

Regional soil geochemical survey carried out in the entire area of the F Block showed soil gold anomalies in the areas surrounding Serrinha do Guaranta garimpo and Aluizio Garimpo (Fig. II-4-3).

Results of Phase I geological survey indicated promising results for gold mineralization in Serrinha do Guaranta and Aluizio garimpo. Drilling survey was recommended in these garimpo areas, during Phase II, aiming to clarify the geological structure associated to gold and copper mineralization in Serrinha do Guaranta (Fig.II-4-6) and also to evaluate the gold mineralization at depth in Aluizio area (Fig.II-4-8). The location of borehole MJBA-1 and MJBA-2 were presented in the Fig II-4-9 and Fig II-4-10.

The borehole MJBA-1 confirmed gold mineralization and copper mineralization in Serrinha do Guaranta garimpo area and it was associated, respectively to quartz vein filling sub-vertical shearing zone and black schist. The best results presented an average gold grade of 2.51g/t (width 4m) in strongly brecciated schist, mixed with quartz fragments. The average copper grade of 1.41% Cu was observed in 10m widths core.

The borehole MJBA-2 confirmed that the gold mineralization in Aluizio garimpo is not wide and it is associated to quartz veins filling shearing zone. The best intercept confirmed by MJBA-2 is 0.67g/t in 3m widths core.

4-5 G Block

Geological survey, geochemical survey and drilling survey were carried out in the G Block area.

The G block is represented by the following geological units: Xingu Complex (Px), Pre-Uatuma granite (GrII and GrIII), Teles Pires granite from Uatuma Supergroup (Gru), Middle Proterozoic Beneficente Group (Pb), Dykes (Db) and Quaternary age Recent alluvium as shown in the Figures, between Fig II-5-1 to Fig II-5-3.

Zanete garimpo and Pezao garimpo are two of the principal gold primary garimpo found in G block. Edmar garimpo and Luizao garimpo are two others big garimpo located outside at the vicinities of the survey area. Zanete garimpo showed gold results between Au28.73g/t and Au45.06g/t in quartz veins and the Pezao garimpo presented gold values between Au0.65g/t and Au35.71g/t in sulfide rich silicified rock.

Results of Phase I geological survey indicated a high potentiality for gold mineralizations in the G block and a regional geochemical survey was carried out during Phase II survey. The gold anomalies detected by geochemical survey are concordant with the direction of regional shearing and it suggests a shearing structure controlling gold mineralizations in the G block. An anomalous map for gold was elaborated by using the threshold values of 20 ppb, 50ppb and 100ppb. Soil gold anomaly in G block shows three broad concentration of gold anomaly in soil with threshold value of 20ppb, at the Northern, Southern and Southeastern part of the surveyed area (Fig II-5-5).

In order to understand the distribution and the continuity in depth of gold mineralization detected by geochemical survey at southeastern part of block G (Fig. II-5-6 to Fig II-5-11) and also to acquire geologic and tectonic information related to the gold mineralization, a reverse circulation drilling (RC) program were conducted in G block, and later a total coring drilling (DD) were conducted to check the gold mineralization detected by RC.

Most of drilling holes intercepted gold mineralization with a maximum gold result of Au6.89g/t in 2m sample and these gold mineralizations were frequently associated to brecciated or sheared porphyry granite with dissemination and films of pyrite and also to quartz veins and veinlets filling granite.

Drilling results in G block show many similarities with porphyry type gold mineralization.

4-6 H Block

Only a regional geological survey was carried out in H block. H Block region is represented by the following geological units: Xingu Complex (Px), Pre Uatuma granite (GrI), Uatuma Group Iriri Formation (Pui) and Teles Pires Granite (Gru), Dykes (Db) and Recent alluvium (Qa) (Fig. II-6-1).

Alluvial gold garimpo is found in Rochedo River and Teles Pires River, as well as in the rivers of the central part of H Block. A strong silicic, sericitic and hematitic alteration were observed in sheared rocks and as gravel of the alluvial garimpo in the central part of H block, however the analytical results indicated neither anomalies for gold nor anomalies for others elements.

Judging from the geological survey results, the potentiality for hosting gold mineralization within H block can be considered as very low.

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

5-1 Conclusions

During 3 years from 1998 to 2000, the following surveys were carried out in the Alta Floresta area: geological, geochemical and drilling surveys in B Block, C Block, F Block and G Block, and geological survey in E Block and H Block. The following results were obtained during these studies:

(1) B Block

Results of the overall survey in B block showed that although many gold mineralizations exist in the drilled area, not any economically potential target could be found for further drilling. However, the geochemical survey indicated a quite continuous soil geochemical anomaly at the eastern edge of the B Block, around Jacare garimpo. Also, a 6m wide gold mineralization was confirmed in sheeted quartz veinlets during geological survey in the garimpo Jacare, suggesting the presence of a stockwork type or sheeted quartz veinlets type gold mineralization below soil anomaly.

(2) C Block

Results of overall survey carried out in this area indicated that, although abundant gold mineralization exists in the drilled area, there is not clear indication of detecting any economically potential target for further drilling. In spite of these results, the geological survey in the garimpo area confirmed quartz vein holding high-grade gold mineralization in the C7 mineral showing and in the Waldemar garimpo. Geochemical survey found continuous soil anomalies with high-grade gold in the vicinities of the drilled area and as a result, it can be expected quartz veins with high gold grade below these soil anomalies.

(3) E Block

Absence of a favorable geological unit or a trap structure to host a major gold deposit and the absence of any younger granitic intrusion, are both indications that the E Block area has indeed very low potential to host major gold deposits.

(4) F Block

Soil geochemical survey showed two major trends for gold anomalies and it was learned that the gold mineralizations as Serrinha do Guaranta garimpo and Aluizio garimpo are strongly controlled by these shearing. Two boreholes were performed to confirm the continuity at depth of two gold mineralizations located below these two garimpo working. The drilling confirmed that these gold mineralizations are found inserted within a high angle-shearing zone conforming a narrow mineralization with low to medium gold grade.

(5) G Block

Detailed soil geochemical survey showed three broad concentrations of gold anomalies in the Northern, Southern and Southeastern part of the G Block area. Drilling survey by RC and DD method, demonstrated that the gold mineralizations are associated to brecciated porphyry granite and to rock alteration, such as silicification, potassification and pyrite dissemination and films. Most of drilling intercepted gold mineralizations but the intercepts with higher gold grade are inferred to be closely associated to sites with high dissemination of pyrite or to high concentration of pyrite films. Characteristics of the gold mineralization in the G Block show similarities with the gold mineralization described as Matupa type, considered by RTZ as porphyry type gold mineralization. From drilling data, it was estimated a geological ore reserve of 10.4 million tons and an average ore grade of 0.439g/t, totalizing 4.5 tons of gold.

(6) H block

Results from regional geological survey showed the presence of an alluvial garimpo of unknown gold source in the central part of the block. But, analytical results of all ore samples taken in the H area showed very low gold and base metal grades, proving that promising gold mineralization is not likely to be detected within H block area

5-2 Recommendations

From the overall survey results obtained in the B Block, C Block, E Block, F Block, G Block and H block it is recommended the follow.

(1) B Block

No additional work will be necessary within the large gold anomalous area surveyed by drilling during Phase III. But, further survey would be needed to evaluate the eastern edge of the B Block, around Jacare garimpo, where a quite continuous soil geochemical anomaly is present and it is still open to the east of the area. There exists the possibility to find a stockwork type or sheeted quartz veinlets type gold mineralization below this soil anomaly.

(2) C Block

No additional work is recommended within the large gold anomalous area surveyed by drilling during Phase III. However, further survey is recommended in order to evaluate some of the soil gold anomalies located outside of the drilled area. These soil gold anomalies are continuous and present gold grade much higher than the broad gold anomaly drilled during this year. There exists the possibility that below the above-mentioned anomaly, it can be found a high-grade gold mineralization type related to shearing zone, as exemplified by Paraiba gold mine.

(3) E Block

No further works are recommended in the E block.

(4) F Block

No further works are recommended in the F block.

(5) G Block

Further drilling survey is recommended in the vicinities of the area drilled during Phase III survey aiming to confirm the continuity of the detected gold mineralization and also to confirm if the detected gold mineralization is a porphyry type gold mineralization. A porphyry type gold mineralization is likely to exist below others soil gold anomalies detected during soil geochemical survey in G Block area and for this reason; further drilling survey is recommended to clarify these anomalies. Pezao garimpo has been assumed to be a disseminated high-grade gold mineralization filling shearing zone, but there exists the possibility that it corresponds to the central part of a porphyry type gold mineralization and accordingly, additional drilling survey is recommended to further clarify the above mentioned characteristics.

(6) H block

No further works are recommended in the H block.