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

(PHASE II)

MARCH [illegible]

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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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).

JICA and MMAJ sent to Brazil a survey team headed by Mr. Motomu Goto from August 26, 1998 to November 19, 1998.

The team exchanged views with the officials concerned of the Government of Brazil and conducted a field survey in the Alta Floresta area. After the team returned to Japan, further studies were made and present report has been prepared. This report includes the survey results of geological and geochemical surveys and data compilation in Phase I.

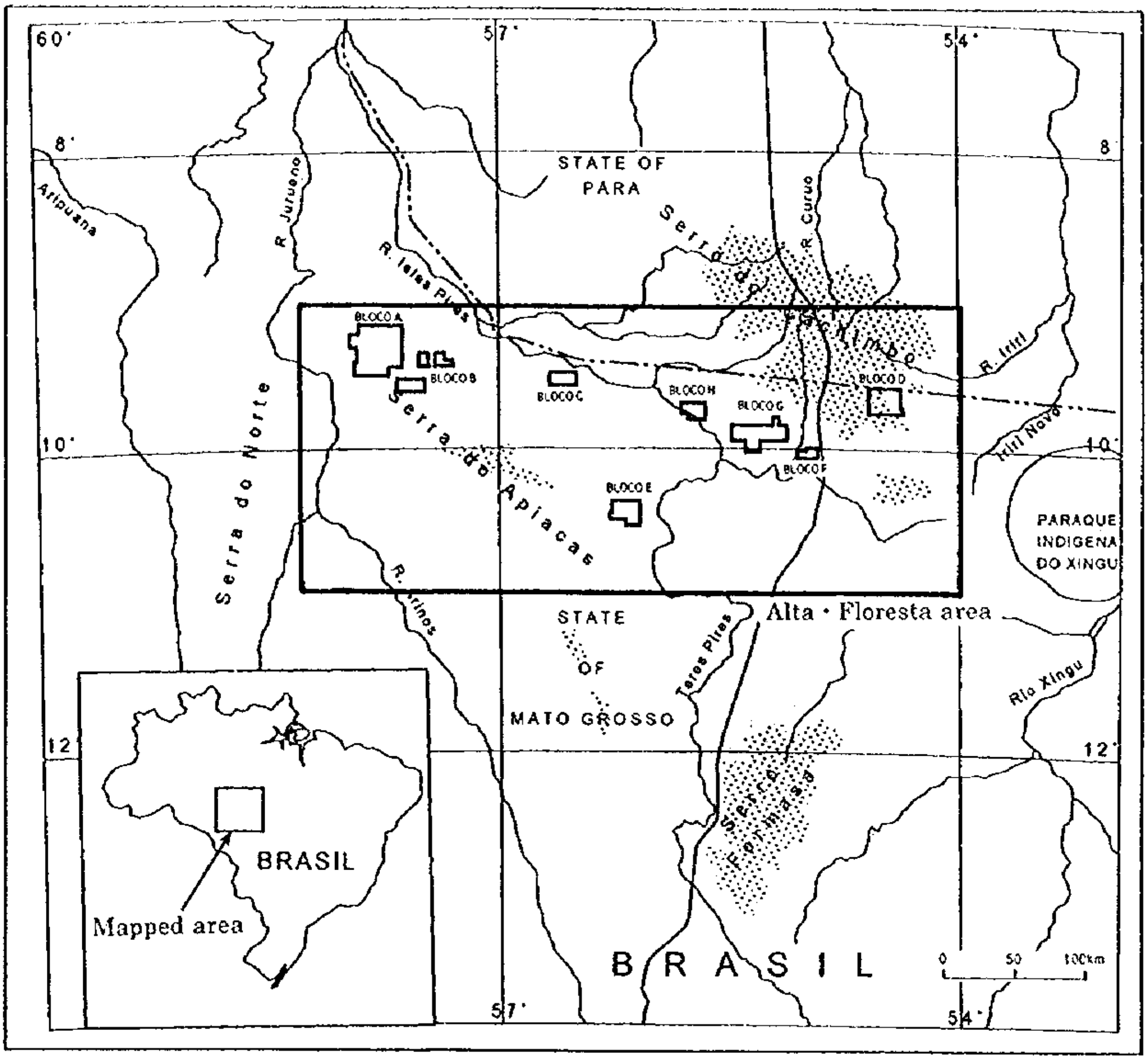
We hope that this report will be useful for the development of the mineral resources in Brazil and contribute to the promotion of friendly relations between Japan and Brazil.

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, 1999

Kimio Fujita
President
Japan International Cooperation Agency

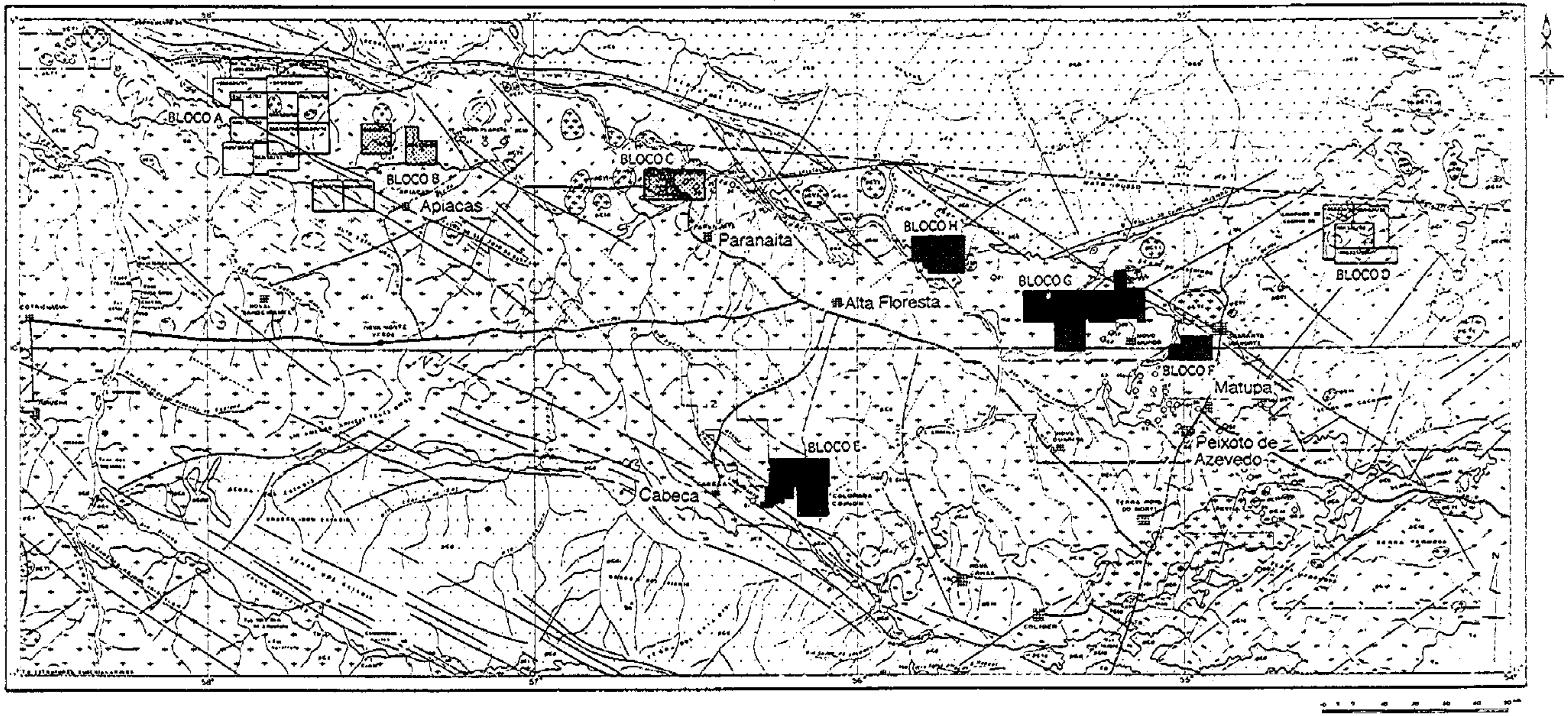
Hiroaki Hiyama
President
Metal Mining Agency of Japan



Alta · Floresta area

Mining claim area

Fig. 1 Location map of the project area in Brazil



Phase I Survey

Geochemical survey area

Geological survey area

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

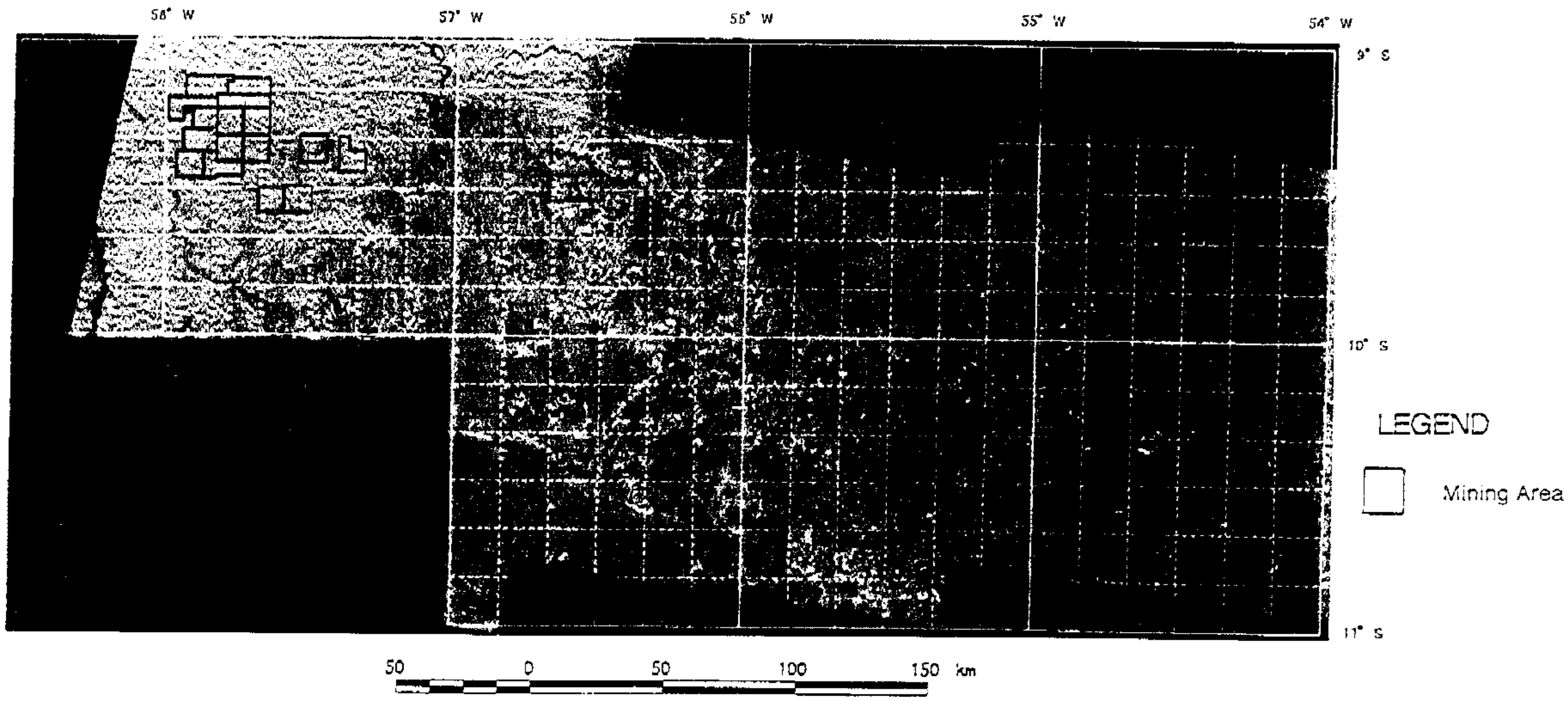


Fig. 3 Landsat image of the Alta Floresta area

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, Brazil in order to find new ore deposits by clarifying the geology and the mineral potential in the area. The project included also the transfer of technical knowledge to our Brazilian counterpart.

This project has duration of three years starting from 1998. The survey in this year (Phase I) consisted of the following works:

a) geological survey in blocks E, F, G and H;
b) geochemical survey in blocks of B and C; and
c) data compilation in Cuiaba, Mato Grosso.

The results of the survey in each of blocks can be summarized as follows:

The geology in block B consists of Pre-Uatumã Granite of early Proterozoic, Uatumã Supergroup of middle Proterozoic, Dykes and Quaternary. The Uatumã supergroup includes Iriri Formation and Teles Pires Granite. Sheared zones with quartz veins are developed in the western block. Based on the result of ore analysis that indicates that quartz veins contain 100.00g/t of gold, 127.2g/t of silver and 3.86% of copper, it can be inferred that the mineral potential in this area is high. As the result of the geochemical survey, gold anomalous zones seem distributed along straight lines with gold values indicating a background of about 31.177 ppb.

The geology in block C consists of Pre-Uatumã Granite of early Proterozoic, Uatumã Supergroup of middle Proterozoic, Dykes and Quaternary. The Uatumã supergroup includes Iriri Formation and Teles Pires Granite. Sheared zones along the main EN-SE direction and local ENE-WSW direction are developed in granitoid bodies of biotite granite (Grillib) and medium grained biotite granite (Grupm). The directions of the sheared zones are parallel to the arrangements of biotite granite (Grupm) bodies. According to the results of ore analyses which indicated that quartz veins and mineralized zones contain 130.00g/t to 4.44g/t of gold and 6.50g/t to 0.8g/t of silver, it can be inferred that the mineral potential in block C is high. The geochemical survey indicated gold anomalous zones in the shape of horseshoe elongated along the east-west direction with background gold values of about 24.950 ppb.

In block E, the sheared zones are not related to gold mineralization. In consequence, the low gold values shown by the gold assay analyses indicate that the mineral potential in block E is low.

In block F, the average value of copper obtained from 32 m channel samples resulted in 0.43%,

while the average value of copper from 12 m channel samples within schist zone resulted in 0.86%. The above confirms that the gold mineralization is related to high copper values within schist intruded by granitoid, and on this basis, it is thought that further exploration studies are needed by keeping in mind the idea of porphyry-type models.

In block G, a very wide sheared zone exists along NW-SE direction, which represents an excellent geological setting for gold deposits. Gold, pyrite and bornite are observed in the garimpos (artisan miner workings) within the sheared zone. Ores rich in sulphide include mainly pyrite and locally bornite and malachite. Many garimpos exist in the sheared zone. Accordingly, block G has high potential for gold mineralization.

In block H, gold mineralization was confirmed by the existence of alluvial garimpos in the central part, however, ore assay analysis did not detect any gold.

As the results of the phase I survey, promising potential for gold and copper mineralizations exists in blocks B, C, F and G. Consequently it is necessary that further detailed survey is carried out in these blocks in order to clarify the mineralization.

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Part I Generalities

Part II Survey Results

Part III Conclusions and Recommendations

PART I Generalities

Chapter I Introduction

1-1 Background and Objectives

In accordance with the Scope of Work signed on 6th July 1998 between the Government of the Federative Republic of Brazil and the Government of Japan, a mineral project of three years duration was carried out in the Alta Floresta, Brazil (fig. 1) from 1998.

The purpose of this survey is to clarify the geology and the mineral potential in this area for the future development of mineral resources. The project also included the transfer of technical knowledge to our Brazilian counterpart.

1-2 Coverage and Outline of Phase I

The Alta Floresta area is located in the northern end of Mato Grosso State at 800 km north from the capital of Cuiaba. The survey area, as shown in Fig. 1, consists of a rectangular shape delimited by the following four coordinates:

Northwest point (58°00' W, 9°00' S)	Northeastern point (54°00' W, 9°00' S)
Southwest point (58°00' W, 11°00' S)	Southeastern point (54°00' W, 11°00' S)

The survey during this year consisted of the following works: geological survey, geochemical survey and data compilation. Field survey areas are shown in Fig. 2.

The geological survey was carried out in Blocks E, F, G and H in order to clarify the distribution in lithology, geological structure, igneous activity and related mineralization corresponding to the survey area.

The geochemical and geological surveys were carried out in the areas corresponding to Blocks B and C in order to detect the geochemical anomalies related mainly to gold mineralization, by clarifying the distributions and correlation among 9 elements (Au, Ag, Cu, Pb, Zn, Fe, As, Sb and Hg). A total of 3,790 soil samples were collected in the two blocks.

The work amounts conducted in this phase are summarized in table I-1-1 and the laboratory studies for these surveys are shown in Table I-1-2.

The activities involved in the data compilations were: i) Compilation of the existing data submitted by the Brazilian organizations, ii) Collection of data related to the results of geological and metallogenic survey and the existing exploration in the areas, and iii) Acquisition of the necessary information in order to totally analyze in an integrated way, all the results of the geological and geochemical surveys.

Table Ⅰ-1-1 Summary of work amounts

Area and Content	Amount of work	
Geological Survey	Survey Block	Block E, F, G and H.
	Survey Area	1,774 km^2
	Survey route	102.4 km
Geochemical Survey	Survey Block	Block B and C
	Line extension	344 km
	Soil sample collection	3,490 points
	(Number of soil samples	3,490 samples)

Table Ⅰ-1-2 Work amounts of laboratorial studies

Survey Contents	Laboratory work	
Geological Survey and Geochemical Survey	1)Thin section	41 samples
	2)Polished section	30 samples
	3)X-ray diffraction analysis	34 samples
	4)Ore assay (Au,Ag,Cu,Pb,Zn,Fe,As,Sb,Hg)	236 samples
	5)Fluid inclusion	11 samples
	6)K-Ar Dating	5 samples
	7)Soil analysis (Au,Ag,Cu,Pb,Zn,Fe,As,Sb,Hg)	
	(for soil samples)	3,490 samples
	(for check samples)	102 samples

1-3 Survey Members of the Project

The members who participated in the project were as follows:

1-3-1 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 Magalhães de Resende	(METAMAT)
		Nilson Batista De Souza	(DNPM/MT)

MMAJ: Metal Mining Agency of Japan

JICA: Japan International Cooperation Agency

DNPM: Departamento Nacional de Produçao Mineral

METAMAT: Companhia Matogrossense de Mineraçao

1-3-2 Administration of field work

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

1-3-3 Field survey

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	Claudio Recht	Geologist	(DNPM/BRS)
Masahiko Nono	Geologist	Jose Raimundo dos Anjos	Geologist Assistant	(DNPM/BRS)
Masato Ouchi	Geologist	Emanuel 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)
		Antonio João Paes de Barros	Geologist	(METAMAT)
		Wanderlei Magalhães de Resende	Director	(METAMAT)

1-4 Survey Period

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

Geological survey : 7th October 1998 to 1st November 1998

Geochemical survey : 26th August 1998 to 19th November 1998

Reporting : 1st November 1998 to 26th February 1999

Chapter 2 Geography of the Survey area

2-1 Location and Accessibility

The Federative Republic of Brazil, accounting for the biggest country in South America, has an area of approximately 854 km^2 and a population of about 157 million. Its Capital is Brasilia.

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

The main road to the survey area is Route 163 which connects the capital Cuiaba and Santarem city in Para State, and crosses from north to south the eastem part of the survey area. There are many roads connecting cities and towns with the main road. The distance from Capital Cuiaba to Alta Floresta City is about 790 km and it takes 12 hours by asphalt road. The distance from Alta Floresta city to Apiacas City including block B of the survey area, is about 180 km and it takes about 6 hours by gravel road.

Gold ore deposits were discovered after the completion of the road in 1978. Thereafter, many gold ore deposits were discovered around the existing deposits. As a result of the creation of many kind of projects related the activity of gold production in the area, the government of Mato Grosso State planned to construct the new road to connect the mining area to some towns and villages existing in the area. The road connecting the survey areas of this project is one in 10 km^2 in average. Maintenance for the roads is needed at the present time. The numbers of garimpos is decreasing in the area.

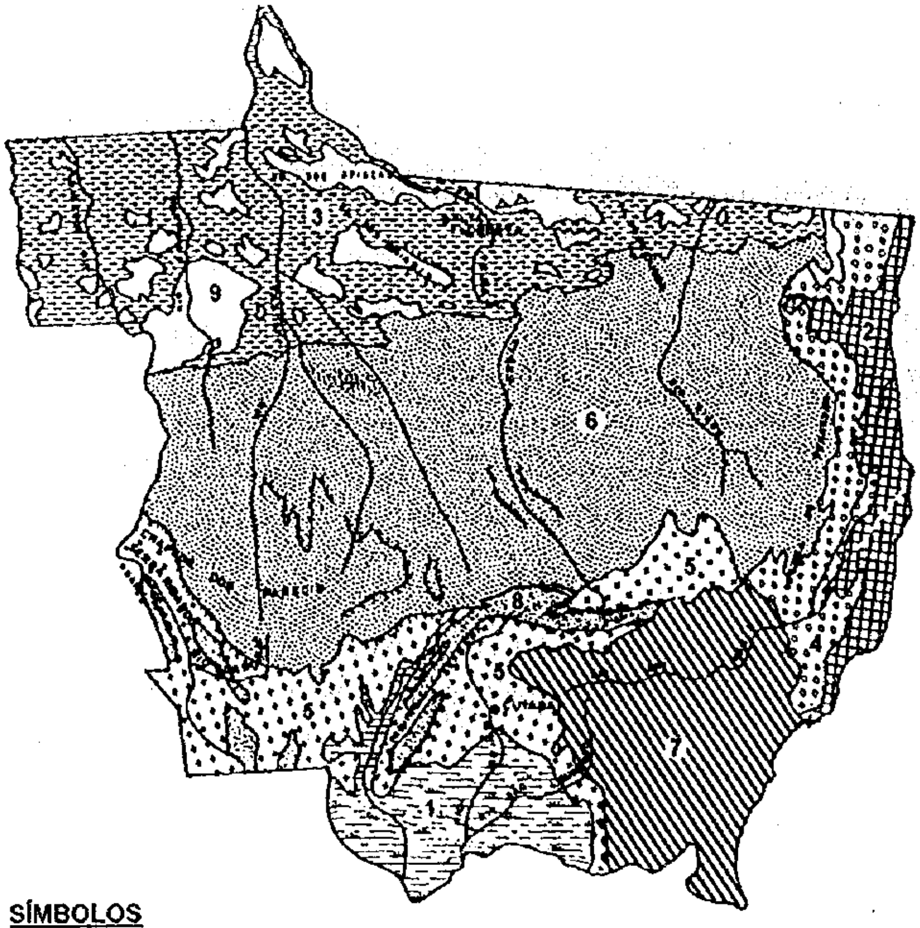
2-2 Topography and Drainage System

Alta Floresta, which includes all the survey areas, is located in lowland and residual plateau in south Amazon(Fig. I-2-1). The area is flat in geography and includes as topographic features, two large graven structures running along WNW direction. The flat plane is located in central part of the area within the elevations of 150 m to 350 m above sea level and with a gentle hill existing also in the area. The northern part and southern part of the central part of the project area are flats with elevations of more than 500 m.

The main river running in the Alta Floresta area is Rio Teles Pires and its tributaries are Rio dos Apiacas, Rio Paranaita, etc.

2-3 Climate and Vegetation

The area belongs to Amazon tropical rain forest with high temperature and humidity.



SÍMBOLOS

- ESCARPA
- BORDA DE RELEVO DOBRADO
- CUESTA
- BORDA DE RELEVO FALHADO

Fonte: MATO GROSSO (1992)

LEGENDA:

1 - Planícies e Pantanais Mato-grossenses
2 - Planície do Bananal
3 - Depressões da Amazônia Meridional
4 - Depressões do Araguaia-Tocantins
5- Depressões do Alto Paraguai-Guaporé
6 - Planalto dos Parecis
7 - Planalto da Bacia Sedimentar do Paraná
8 - Planaltos Residuais do Alto Paraguai-Guaporé
9 - Planaltos Residuais da Amazônia Meridional

Fig. I -2-1 Geomorphological map of the Mato Grosso state

Two seasons can be recognized, i.e., dry season from April to October and rainy season from November to March. The annual temperatures, rainfall and humidity at Porto Velho and Conceição do Araguaia, located at the same latitudes as the survey area, are shown in Table 1-2-1.

The survey area is located in the south end of Amazon tropical rain forest. A virgin jungle is distributed in northern part of the Alta Floresta area with many cattle farms and plantations found widely distributed in the area.

Table Ⅰ-2-1 Statistics of temperature, humidity and rainfall

Month	Porto Velho			Conceicao do Araguaia		
	Temperature (℃)	Humidity (%)	Rainfall (mm)	Temperature (℃)	Humidity (%)	Rainfall (mm)
January	25.4	87	298.9	25.1	86	244.2
February	25.4	87	314.9	24.9	87	248.4
March	25.3	87	301.7	25.3	87	257.5
April	25.5	87	237.8	25.7	85	191.3
May	25.3	84	121.9	25.9	80	64.7
June	24.6	78	39.4	25.5	75	16.5
July	24.6	71	30.5	25	71	8.9
August	25.5	68	51.5	26	66	11.4
September	25.9	75	113	26.2	73	66.4
October	25.8	81	182.7	25.9	80	160.3
November	25.7	84	215.2	25.6	84	179.3
December	25.5	86	315.5	25.5	85	262.3

Maruzen Co., Ltd., 1998: Chronological Scientific Tables 1999.

Chapter 3 Existing Geological Data

3-1 Outline of Previous Exploration Works

In spite of the great progress made in understanding the geology during the last years, reconnaissance studies are still seen as activities that predominate in the area. As a whole, the geological knowledge of the Amazonian region is relatively poor (1:1.000.000 scale in the whole area) and semi-detailed and detailed studies are very incomplete. Detailed studies are available only for areas where mineral exploration exists.

Until 1980, there have been almost no previous systematic exploration activities in the region. The first geological mapping survey, at 1:1,000,000 scale, involving the whole Amazonian area, started in 1980, by the Radambrasil Project (SC.21 Juruena Sheet) of DNPM, using SLAR radar imagery. In 1981, the DNPM published the 1:2,500,000 scale Geological Map of Brazil. In 1985, the Metallogenetic and Prevision of Mineral Resources Maps Project of DNPM-CPRM, prepared the SC.21-Z-B Vila Guarita Sheet, at 1:250,000 scale, involving directly the present survey area.

Other regional scale surveys were conducted by CPRM after 1991, including the Airborne Geophysical Survey of Juruena - Teles Pires region, covering 36,300 km2 and the Gold Prospecting National Program - PNPO. At the present, a large geological mapping program is being developed by CPRM in the Tapajos river area as well as in the Alta Floresta area, in 1:250.000 scale.

Between 1980 and 1998, many isolated surveys in primary garimpo areas were conducted by Metamat or by private mining companies.

3-2 General Geology of the Surrounding Area

As shown in Fig. I-3-1, the survey area is located within the Amazonian craton, which completely covers the whole tropical rainforests of the Amazonian region of Brazil and part of the surrounding South-American countries. As shown in Fig. I-3-2, geology of the survey area is mainly composed of Xingu Complex of Archean to Paleoproterozoic age, Pre-Uatumã Granites of early Proterozoic age, Uatumã supergroup of middle Proterozoic age, Cachimbo graben of middle Proterozoic age, Dardanelos formation of middle Proterozoic age and 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-Uatumã Granites and Uatumã supergroup are distributed in the up-lift zone, Beneficente group in the Cachimbo graben and Cachimbo graben in the Caiabis graben.

Geology and lithology are described as follows:

(a) Xingu Complex

The Xingu Complex is composed mostly by gneiss, schist, granodiorite, quartz-diorite, tonalite, migmatite, BIF and intrusives granitoids. The granitoids are widely intruded in the Xingu Complex and clearly present distinctive characteristics between intrusive ages and genesis.

For the Transamazonian age granitoids, the best-studied example is the Agua Branca (1950 Ma) which is a granitic body of the Juruena type.

(b) Pre Uatumã Granites

as shown Fig. I-3-2, the granites are divided generally into three types. Juruena granitoid and Matupa granite, distributed in the survey area, are characterized as follows:

(1) Juruena Granitoid

The Juruena granitoid shows a variety of lithologic types: tonalitic granite, granodiorite, adamelitic monzonite, quartz-monzodiorite, quartz-diorite and quartz-syenite, with predominance of adamellite or granodiorite. Characteristically, the Juruena-type granitoid consists of a granodioritic mass with basement composition and without intrusive features. They form large batholiths, which are dominantly isotropic, but also foliated and banded with their main composition going from monzogranitic to granodioritic. The Juruena type granitoid was defined as a massif composed of porphyritic rocks, generally gneissic rocks, and coeval with the Transamazonian Orogeny. Dating analysis by Rb/Sr resulted in 1947 Ma. (Santos & Reis Neto, 1982).

(2) Matupa Granite,

The Matupa granite, as the Juruena granodiorite, has been poorly studied, however, it is not seen correlated with the anorogenic magmatism of the central Amazonian Province. As dated as 1872 Ma by the Rb/Sr method, it has been defined as a type I undeformed and homogenous biotite monzogranite (Botelho et al, 1997). Geochemical data indicate that either a volcanic arc or post-collisional emplacement took place soon after the Transamazonian Orogeny (Moura et al, 1995), strengthening the interpretation given by Teixeira et al. (1989) for this area, i.e., the zone of collision between the Rio Negro-Juruena magmatic arch with the Central Amazonian

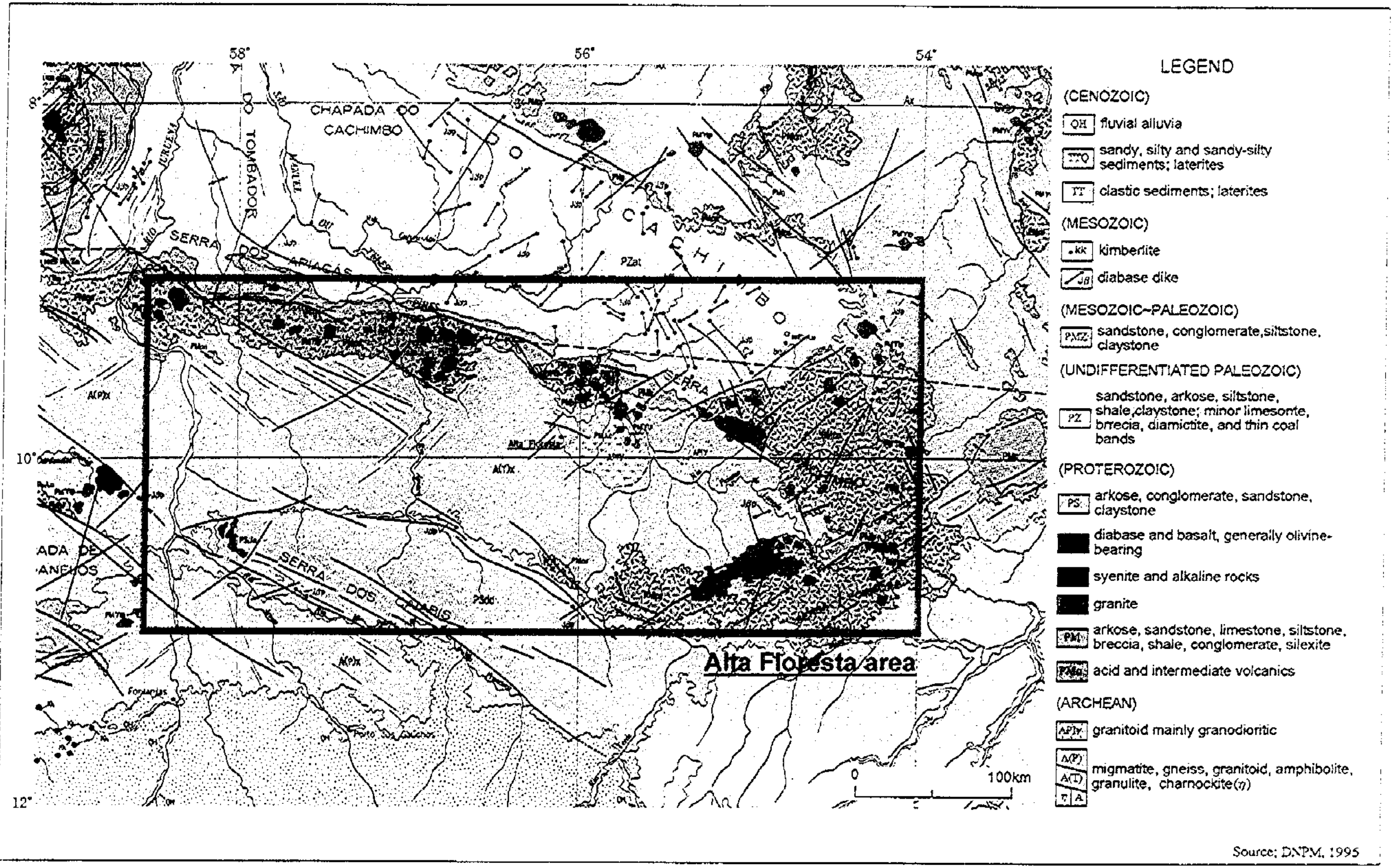


Fig. I-3-1 Geological map of the Alta Floresta area

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 Supergroup	Gru	Teles Pires Granite	Calci-alkaligranite, biotite granite, porphyry granite, adamellite, rapakivi granite	Granodiorite		
				Pui	Iriri Formation	Rhyollite, rhyodacite, dacite, pyroclastics, quartzite			
	EARLY		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	Granite		Cu
PALEO-PROTEROZOIC TO ARCHEAN			Ductil Shearing Zone	Dsz	Quartz mylonite, micro breccia and ultramylonite				
			Xingu Complex	Px	Augen gneiss, granite gneiss, amphibolite, metabasite, monzonite, granodiorite, quartzite, BIF, calc-silicate, schists				Au

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 Alta Floresta area continental mass.

(c) Uatumã Supergroup

The Uatumã magmatism is represented in the Alta Floresta area by low metamorphosed acid to intermediate volcanics of the Iriri Formation (~1650 Ma by Rb/Sr), also called Teles Pires volcanics, and Teles Pires granitic intrusives (~1600 Ma by Rb/Sr).

The volcanic rocks which show a calc-alkaline tendency, were genetically generated in the mantle or lower crust by partial fusion giving an initial basaltic magma. The differentiation to rocks of felsic composition, like dacite, rhyodacite and rhyolite are interpreted to be generated by gradual fractioning during crystallization (Montalvão, 1982).

The granitic intrusions are in general related with circular morphologic features, in association with rocks of subvolcanic characteristics with alaskitic tendency.

The most common Teles Pires granitic lithotypes are porphyry granite, microgranite, rapakivi granite and granite, mainly of calc-alkaline composition (Silva et. al., 1980).

(d) Beneficente Group

More than 1,000 m in thickness of the Beneficente Group was deposited between 1.6-1.4 Ga. in a SE-NW direction oriented continental rift. Morphologically, this unit of very large and uniform regional expression is represented by the Chapada do Cachimbo that occurs in the northern/northwestern sector of the Alta Floresta area.

The continental and shallow marine clastic and carbonatic sediments of this group overlay the Iriri volcanics and the Teles Pires granites. The poorly deformed and unmetamorphosed sedimentary sequence is composed by orthoquartzite, sandstone, arkose, siltite, argillite and carbonate rocks. Dating of the diagenesis of Beneficente sediments by the Rb/Sr method resulted in 1.4 Ga (Tassinari et al., 1978).

(e) Dardanelos Group

This unit occurs in the southern part of the Alta Floresta area and is also represented, like the Beneficente Group, by a very uniform regional morphology known as Serra dos Caiabis. The undeformed sediments deposited in the Caiabis graben represent the Dardanelos Group, composed mostly by arkosic sandstone showing cross-stratification and horizontal bedding. Two different basaltic flows occur intercalated in the Dardanelos sediments, being the lower flow dated 1.4 Ga and the upper one, 1.2 Ga by the Rb/Sr method (Tassinari, 1981).

(f) Basic dikes and sills and alkaline intrusions

The Central Amazonian Province was affected by several magmatic episodes of basic nature, which occurred in the time interval of 1.55 Ga and 1.0 Ga and associated to lineaments like the Tapajos (NE-SW) and the Abacaxis and Canama (NW-SE). Quite in the same time interval (1.45 Ga-1.2 Ga), the region was also affected by an alkaline magmatism (mainly syenites) of cratogenic origin, like the Canama alkaline complex (Tassinari, 1981).

The basic magmatism is represented by diabase dikes and sills of olivine-gabbro composition, which cut all the above described units.

The Alta Floresta area is located at the southwestern margin of the Central Amazonian Province (Fig. I-3-3). As suggested by geochronological data from the Archean to the Mesoproterozoic, this stable platform had its stabilization occurred at the beginning of the Neoproterozoic, at about 900 Ma. Its basement is built up by high to medium-grade metamorphic rocks including granitoids and greenstone belts. These rocks are overlain by a nonmetamorphic and widely distributed platform cover, deposited between about 1.9 Ga. to 1.0 Ga., which was in turn intruded by anorogenic granitoids and, locally, by basic and alkaline rocks. The east-west-trending paleozoic Amazon Basin separated the craton into two shields: the Guiana Shield to the north, and the Central-Brazil or Guapore Shield to the south (Hoppe & Schobbenhaus, 1991).

The oldest unit present in the Alta Floresta area is represented by a granite-gneiss-migmatite terrain referred by Silva et al. (1974) to as the Xingu Complex of archean to paleoproterozoic age. Granitoids are widely intruded in the Xingu Complex and clearly present distinctive relative ages of intrusion. However, the limited geologic information available in the region, restrains any productive discussion aiming to a subdivision of these granitoids accordingly to the character of its genesis or intrusive ages. 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);

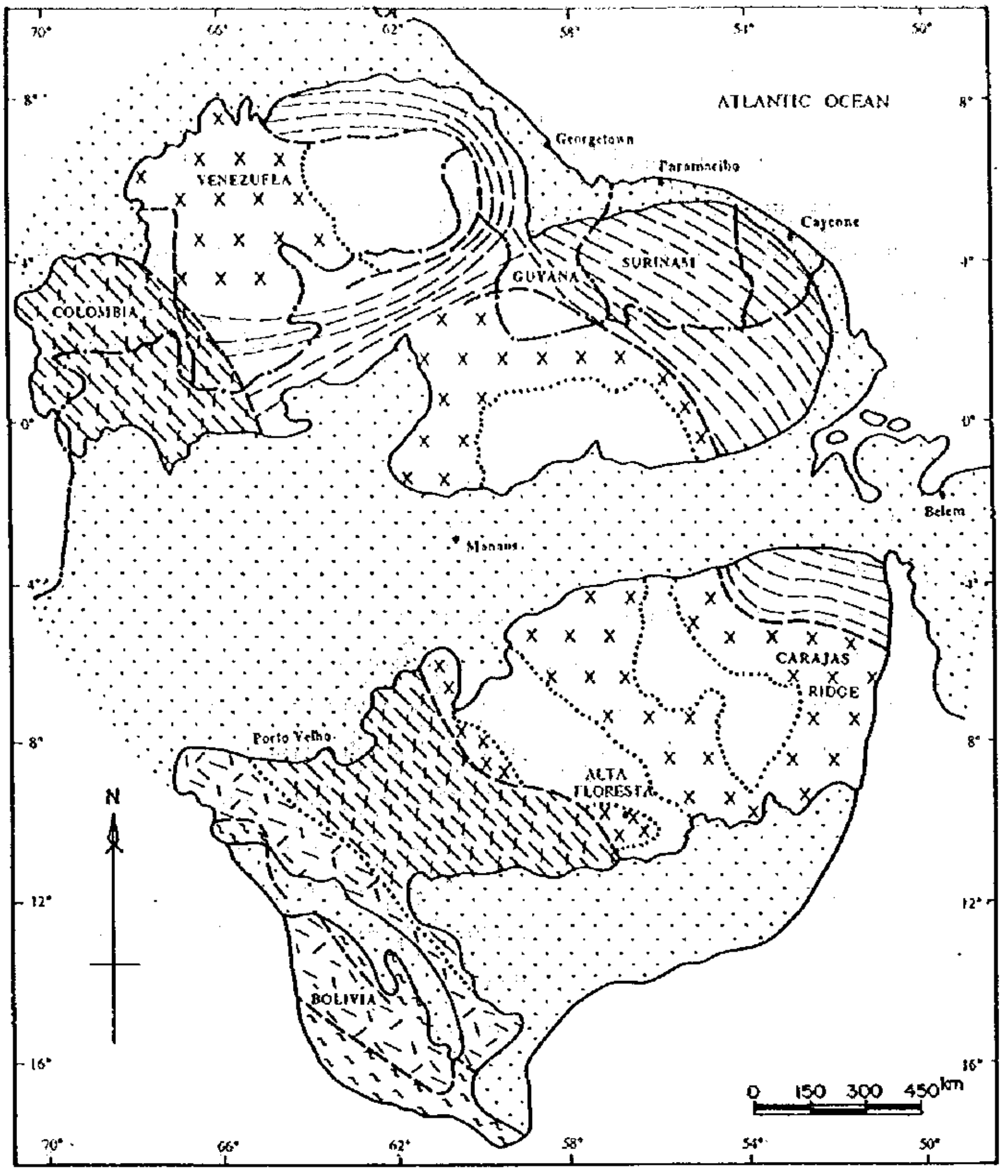
②Paleoproterozoic (Transamazonian age) granitoids (2.1-1.9Ga);

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.

Two different types of granites - which possibly represent Transamazonian units - are



Source: Teixeira et. al. (1989) modified

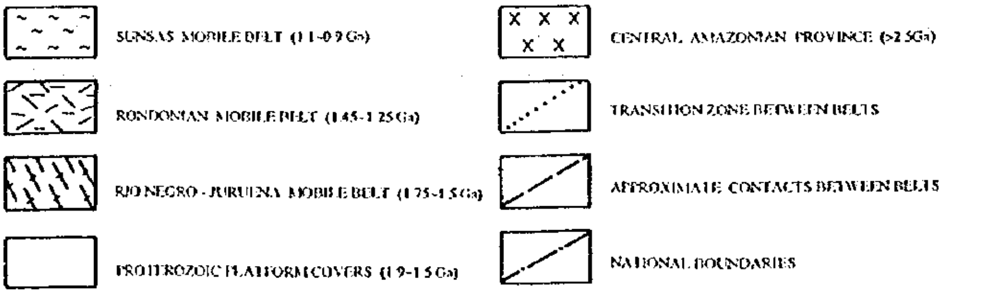


Fig. I -3-3 Tectonic geocronologic Map of the Amazonic Craton characterized in the Peixoto de Azevedo and Matupa regions: the Juruena and Matupa bodies (Moura et al., 1995).

During the Mesoproterozoic, the Amazonian craton was a scenario of a widespread granitic and volcanic event, called the Uatumã Magmatism (Uatumã Supergroup).

Rocks of the Xingu Complex and the Uatumã Supergroup are overlain by Mesoproterozoic platform sediments of the Beneficente and Dardanelos groups.

Finally, also during the Mesoproterozoic, a basic and alkaline magmatism ocurred in the region.

3-3 Geological Setting and Mineralization

a) Geological Setting

Teixeira et al. (1989) divided the Amazonian craton into several provinces (Fig. I-3-3) showing similar geochronological ages complemented by structural, petrological and geochemical data. Following the schema proposed by these authors, an old archean core has been distinguished in the central part of the Amazonian Craton (Central Amazonian Province). This Archean core grew up during the Transamazonian Cycle with the development of the Maroni-Itacaiunas mobile-belt on its notheastern and northern margins, and during the Paleoproterozoic (Maroni-Itacaiunas Province, 2.25-1.9 Ga). Afterwards, the western and southern margins of the Archean core were bordered by three tectonic provinces: the Rio Negro-Juruena mobile belt (1.75-1.5 Ga), the Rondonia mobile belt (1.45-1.25 Ga), and the Sunsas mobile belt (1.1-0.9 Ga). Each belt borders the western margin of the preceding belt, recording a successively younger Mesoproterozoic orogeny.

The Alta Floresta area is located at the southwestern margin of the Central Amazonian Province, at the limit with the Rio Negro-Juruena Province (Fig. I-3-3). Granitic rocks widely intruded in the project area and their activities is related to tectogenesis in Amazonian Craton. The tectonic model for the development of the Rio Negro is shown in Fig. I-3-4. By the interpretation made by the above mentioned authors, the isotopic character of the Rio Negro-Juruena Province strongly suggests a mantle-derived magmatic arch evolution, which collided with the Central Amazonian Province as the result of a eastward directed subduction. In contrast, the Rondonia and Sunsas provinces are ensialic in character and reworked pre-existing continental material.

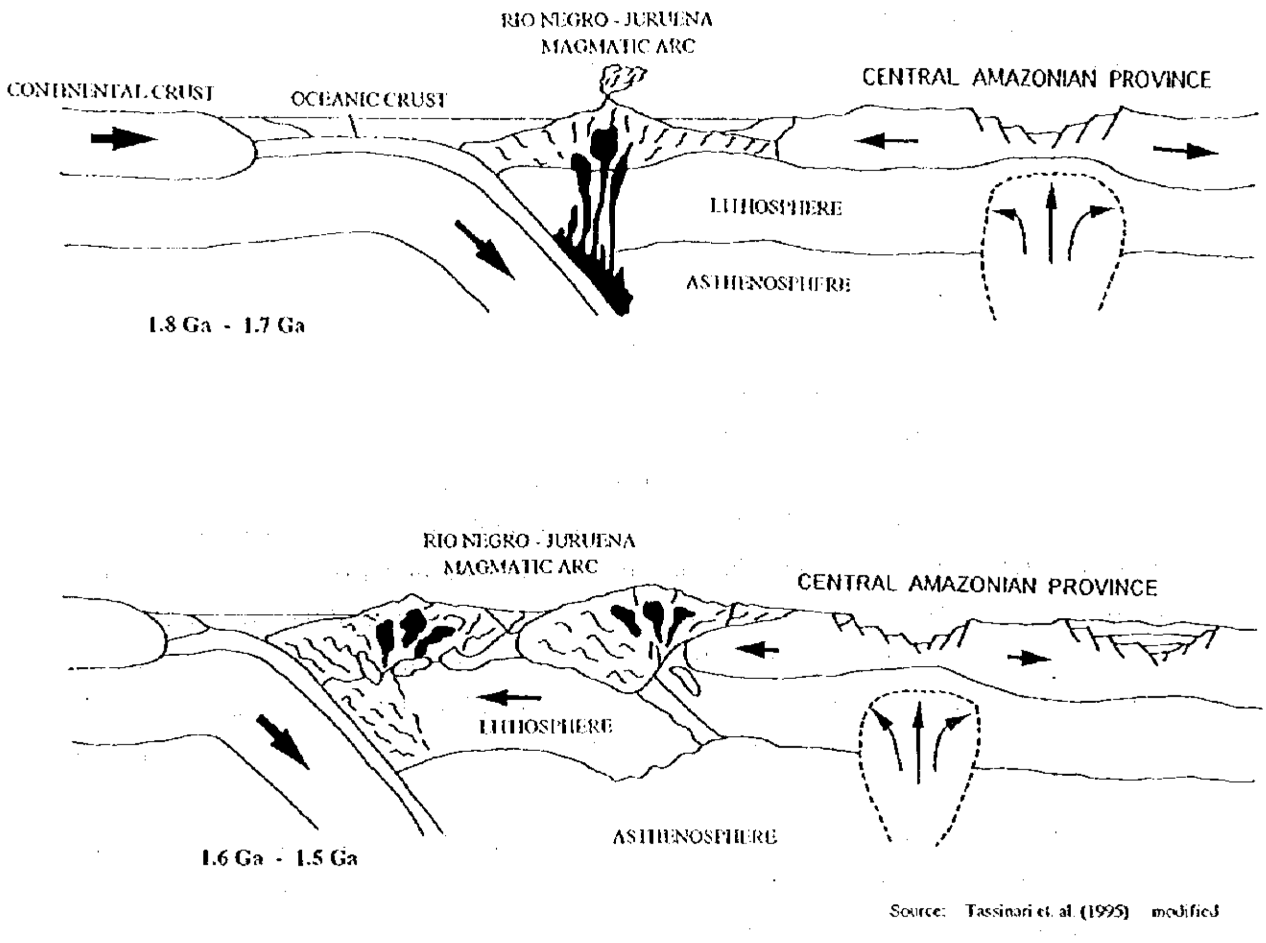


Fig. Ⅰ-3-4 Diagrammatic Sections of the tectonic model for the development of the Rio Negro - Juruena orogeny in the Amazon Craton

(b) Gold Mineralization

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.

Among them, the primary gold mineralization exists in many tectonic environments through the Amazonian craton. For instance, for the case of Alta Floresta area, there are mainly three gold mineralization types, i.e.,

(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-collisional granites. The gold occurs either in small high-grade vein-type deposits or is disseminated in widespread hydrothermal zones with alteration such as sericitization, feldspathization and pyritization. The association of gold with oxidized type I granites and the style of hydrothermal alteration are analogous to the associations presented in world class porphyry-style deposits.

For Botelho et al. (1998), the Matupa Granite in the Alta Floresta region presents the granite-gold association type (1.87 Ga). Its chemical features are important indicators for gold prospecting in the region. It is confirmed by preliminary mappings that indicate a wide distribution of this type of granite in the northern region of the Mato Grosso State.

This granitic massif is a homogeneous, undeformed, equigranular to porphyritic monzogranite, with geochemical characteristics either of volcanic arc granites or of post-collisional granites generated in the presence of an oceanic lithosphere (Moura et al. 1997a).

Small high-grade quartz vein-type deposits occur at the outer margins of Matupa Monzogranite, either hosted in andesite-rhyollite volcanic rocks or related to shear zones in hydrothermally altered granodiorite and tonalite (Paes de Barros, 1994; Siqueira & Leite, 1997). The Serrinha gold deposit is located at the northern border of the Matupa Monzogranite and contains many hydrothermally altered zones with disseminated gold concentrations.

The general sequence of the hydrothermal alteration in Serrinha was K-silicate, albitic, chloritic, sericitic and pyritic alteration phases. Pyrite is generally related to hydrothermal magnetite and rutile.

Gold is found either disseminated or by filling fractures in pyrite related to potassic, chloritic, sericitic and albitic alterations. Other sulphides are not common, but minor chalcopyrite, sphalerite, galena and pyrrhotite occur as inclusions in pyrite. Sulphide $\delta^{34}S$ values near 0% indicate a deep source of sulfur, for which the related ore deposits are interpreted to have formed from magmatic fluids (Ohmoto & Rye, 1979).

In the Serrinha deposit, ^{34}S values together with petrological data, are consistent with the idea that the gold mineralization has a magmatic origin and related probably to fluids as similar to those described in some porphyry-type deposits (Eastoe, 1983; Gallagher et al., 1992; Ren et al., 1995; Weihed & Fallick, 1994). The spatial association between the Matupa Monzogranite and the Serrinha Deposit is indicative of hydrothermal alteration types related to the gold mineralization. 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, 1997). Nevertheless, the Serrinha deposit presents low levels of Cu and Mo, which precludes its classification as base metal rich in porphyry. In spite of this fact, 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 recognizing inside of it, 36 majors gold lodes and hundred of minor gold quartz veinlets zones (Abreu Filho et al., 1992; Barros, 1993).

These quartz veinlets zones and lodes display preferential directions along N20-60E, NNE, N30-60W and E-W. The approximate location of some of the lodes and quartz veinlets can be estimated from remote sensing techniques by analyzing the strong structural lineaments visible on Landsat images.

Within the Alta Floresta region, the Paraiba underground mine has been considered as the most important shear zone hosting lodes with a reserve of around 4.3 ton Au.

The Paraiba lode presents gold and copper bearing quartz veins network, showing parallel bands with different amount of sulphides.

In the vicinity of Peixoto de Azevedo City, most of the lodes are concentrated inside a 10 km x 4 km zone with several hills composed by quartz-mylonite lenses, folded in Z form, and orientated N45-60W.

(3) Stockwork type

The gold mineralization related to the Teles Pires Suite is always controlled by regional lineaments or shear zones, being most of the gold occurrences of alluvial type and of small scale. Teles Pires type alkaline granites are widespread in the Alta Floresta region and distributed as irregular bodies in the Xingu Complex or as rounded bodies in the volcanic terranes of the Iriri Formation.

The Novo Planeta garimpo is the most studied gold mineralization 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.

3-4 Outline of the Mining Activities

The mining activities in the region started in 1966 with gold discovery by garimperos in the Juruena River, but it was only in 1978 that the garimpo activity spread to Peixoto de Azevedo and Alta Floresta areas (Fig. I-3-5) 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 (Table I-3-1 and Table I-3-2).

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 Mineração Mivale in association with garimpeiros.

Mineração 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 Mineração Porto Estrela S.A. reached 222 kg in 1983 and its peak production reached 575 kg in 1985 (Table I-3-3).

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

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

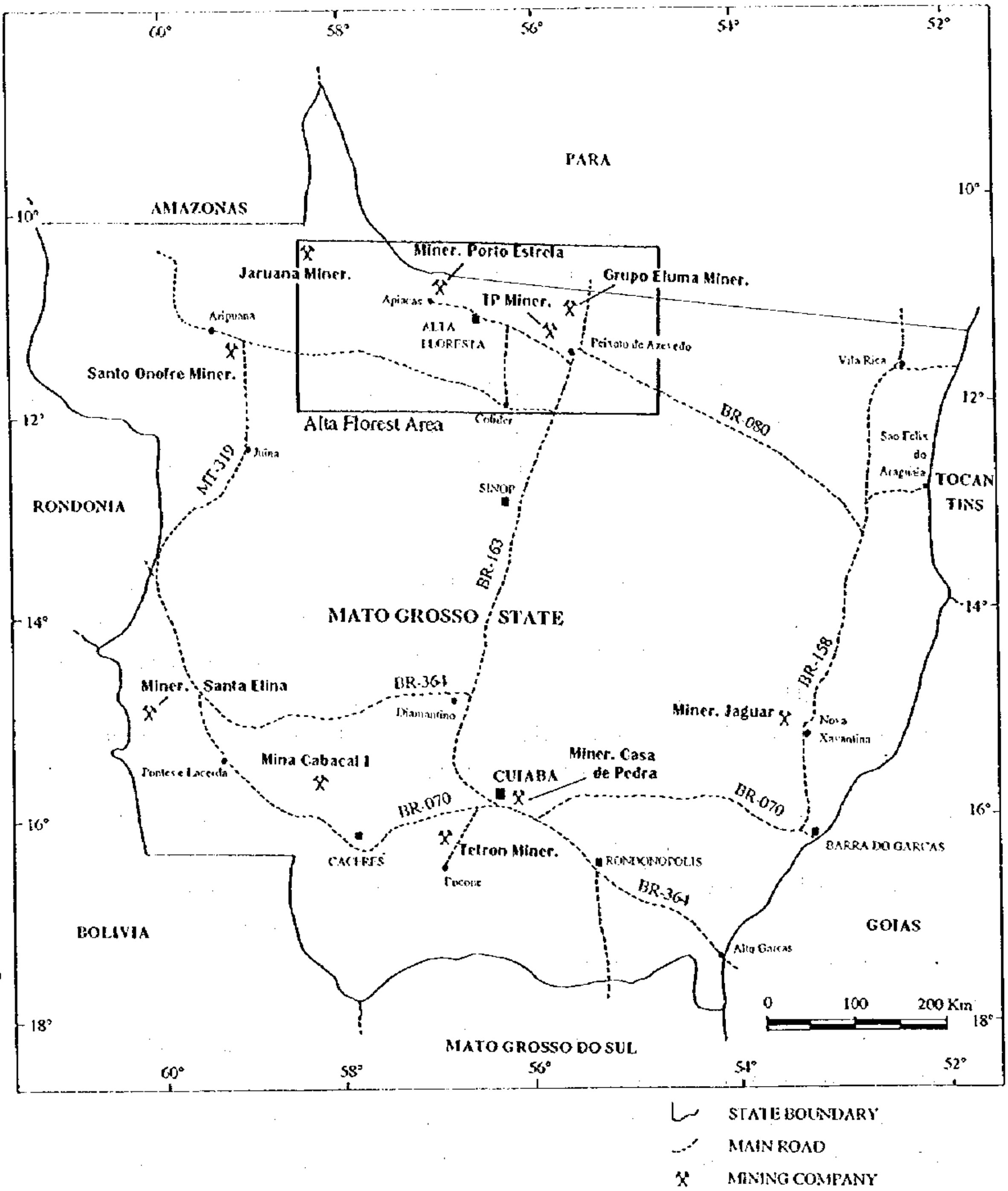


Fig. I -3-5 Location of the main mining companies in the Mato Grosso state

Table Ⅰ-3-1 Gold Production in garimpo of the Peixioto de Azevedo region (kg)

YEAR	Peixoto de Azevedo		Colider		Matupa		T. Nova do Norte		Guaranta do Norte		Total	
	Official	Estimated	Official	Estimated	Official	Estimated	Official	Estimated	Official	Estimated	Official	Estimated
1982	621	1186									621	1186
1983	1618	2168									1618	2168
1984	2687	4730									2687	4730
1985	2587	7653									2587	7653
1986	950	4617									950	4617
1987	1688	5804									1688	5804
1988	2073	5451									2073	5451
1989	1828	4926									1828	4926
1990	7266	5565	527	403	240	184	608	465	1628	1247	10269	7864
1991	5708	4281	388	291	1329	997	1249	937	1209	907	9883	7413
1992	5858	4629	355	281	449	355	648	512	734	580	8044	6357
1993	4295	3753	261	228	330	288	475	415	538	470	5899	5154
1994	2106	2106	67	67	780	780	176	176	338	338	3467	3467
1995	904	904	50	50	120	120	33	33	318	318	1425	1425
Total	**40189**	**57773**	**1648**	**1320**	**3248**	**2724**	**3189**	**2538**	**4765**	**3860**	**53039**	**68215**

source: BRASIL(1996)

Table Ⅰ-3-2 Gold production in garimpo of the Alta Floresta region (kg)

YEAR	Alta Floresta		Apiacas		Paranaita		Aripuana		Total	
	Official	Estimated	Official	Estimated	Official	Estimated	Official	Estimated	Official	Estimated
1982	1552	2964							1552	2964
1983	3075	4121							3075	4121
1984	3362	5919							3362	5919
1985	1917	5670					12	35	1929	5705
1986	1706	8286					19	91	1725	8377
1987	2675	9196					24	84	2699	9280
1988	1821	4788					44	115	1865	4903
1989	1604	4323					39	105	1643	4428
1990	6301	4826	561	429	1168	895	244	187	8274	6337
1991	7247	5435	1365	1024	1247	936	211	158	10070	7553
1992	5896	4659	943	745	1128	892	243	192	8210	6488
1993	4323	3778	691	604	827	723	178	156	6019	5261
1994	2990	2990	519	519	500	500	44	44	4053	4053
1995	4095	4095	134	134	87	87	29	29	4345	4345
Total	**48564**	**71050**	**4213**	**3455**	**4957**	**4033**	**1087**	**1196**	**58821**	**79734**

source: BRASIL(1996)

Table Ⅰ-3-3 Gold production by mining companies in the Mato Grosso state (kg)

	YEAR													
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	TOTAL
Mineracao Porto Estrela S/A	222	490	575	381	41									1709
Miner. Sta. Elina Ind. Com. Ltda			211	166	212	230	260	376	433	347	925	808	635	4603
Mineracao Manati Ltda					510	1736	1127	874	615	284				5146
Santo Onofre Mineracao S/A			13	23	40	26	25	25						152
Braserem Emp. Mineracao Ltda			5											5
TP Mineracao S/A					54	66								120
Jaruana Miner. Ind. e Com. S/A						41								41
Cia Adm. Morro Vermelho					7	1	3				5	3	2	21
Miner. Casa de Pedra Ltda						144	81	81	180	62	68	65	62	743
TOTAL	**222**	**490**	**804**	**570**	**864**	**2244**	**1496**	**1356**	**1228**	**693**	**998**	**876**	**699**	**12540**

SOURCE: BRASIL(1996)

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

Chapter 4 Summary of the Phase I Survey Results

4-1 Correlation Between Mineralization and Geological Control

Both alluvial and primary gold mineralizations are widely distributed along the southern border of the Cachimbo graben zone in the WNW direction. However, most of these mineralizations were poorly or not surveyed. Consequently, the understanding of these types of mineralization and processes as well as their association with any type of granitic intrusion are still far from being clarified.

Based in analysis of most of the published works on gold mineralization types in the region and in the results of the field surveys of this year, three types of primary gold mineralizations were recognized as potential types for the surveyed region as follow:

(I) **Porphyry (disseminated) Gold type**, e.g. Serrinha do Matupa Gold Deposit;

(II) **Shear Zone hosted quartz veins type**, e.g. Paraiba Vein type;

(III) **Stockwork type**, e.g. Novo Planeta garimpo area.

Porphyry (disseminated) gold type is associated with oxidized type I calc-alkaline pluton. According to Botelho et al. (1998), the Matupa type Granite represents this type of granite-gold association in the Alta Floresta region. The age of the Matupa granite (1.87 Ga.) together with its chemical features, are important indicators for gold prospecting in the region. A preliminary mapping indicates a wide distribution of this type of granite in the northern region of the Mato Grosso State.

Shear zone hosted quartz vein type gold mineralization is related to the regional NW-SE direction ductile shear zone that crosses the Alta Floresta region. This shear zone has a width of several kilometers, recognizing inside about 36 majors gold lodes and hundred of minor gold quartz veinlets zones. The Paraiba underground mine has been considered as the most important shear zone hosted by lodes with a reserve of around 4.3 ton Au.

Stockwork type gold mineralization is related to the Teles Pires Suite and controlled by regional lineaments or shear zones. This type of gold mineralization is seen in the Novo Planeta area where the Teles Pires granite is intruded in granitoids of the Xingu Complex and the gold mineralization are positioned along of the border of the Teles Pires granite.

Based on the results of the Phase I geological and geochemical surveys, the following types of gold mineralization are expected within the following blocks:

(1) Block B

There exist primary gold garimpos that have been mined from open-pits. One of these garimpos, the so called garimpo Satelite, is mined and its gold is being collected from there. The primary garimpos accompany pyrite dissemination and quartz veins along the sheared zones. Mineralization is recognized in areas of granite near intruded by diabase in southern part and in the silicified zones. Pyrite dissemination and decolorization of host rock by hydrothermal alteration are found accompanied with hematite, goethite and limonite of pseudomorph of pyrite by oxidation and weathering.

The block B area shows potentiality for gold mineralization of the types II and III. In the block B area the gold mineralization is related to shear zones that intersect granitic intrusion, as exemplified by the most important gold garimpos in the area, such as Jacare garimpo and Satelite garimpo.

(2) Block C

In this block, many gold placer deposits exist along the rivers where garimpeiros mining.

Quartz veins are developed along the sheared zones in the primary garimpos. Mineralization with dissemination of pyrite, chalcopyrite and chalcocite is observed and alteration of host rock is accompanied with sericite, chlorite and epidote. An altered zone is seen 2 km along north-south and 4 km along east-west. Some oxidized zones are found in the area. Direction elongated is WNW-ESE.

The block C area shows potentiality for gold mineralization of the types I and II. The large E-W elongated gold anomaly detected by soil geochemistry in the central part of the block C area shows the possibility for disseminated gold mineralization, as well as for shear zone hosted quartz vein type gold mineralization, as exemplified by many primaries gold garimpo in the block C area.

(3) Block E

The block E area shows no potentiality for any of the mineralization types mentioned above. Since the Cabeça garimpo schist zone was confirmed to outcrop only outside the block E area, the most expected type of gold mineralization within the block E area indicates low gold grade mineralization in quartz veins and pegmatoid veins filling gneissic rock.

(4) Block F

The block F area shows strong potentiality to hold gold mineralization of types I and II. Gold mineralization of type II is expected within the ductile shear zone as exemplified by the gold and sulphide rich sigmoidal quartz vein in talc chlorite schist of Serrinha do Guaranta area. Another gold mineralization of type II is expected in the Aluizio Garimpo area where parallel quartz veins bearing gold fill the shear zone of N80W direction.

Disseminated gold mineralization of type I is expected within the talc chlorite schist of the Serrinha do Guaranta area, considered as a large deposit with high grade copper and low grade gold mineralization.

(5) Block G

The block G area shows strong potentiality to hold gold mineralization of types I, II and III, related to large and strong shearing in the central part of Block G area with intrusions of several granitic batholiths types.

Gold mineralization of types I and II are expected within the Luizão primary garimpo which is hosted by two strongly sheared and locally mylonitized mica granitic batholith. The gold is found associated to dissemination of pyrite, chalcopyrite and bornite.

A disseminated gold mineralization are also possible in the garimpo Pezão area where the gold mineralization are associated to sulphide rich brecciated quartz vein presenting dissemination of pyrite, and local enrichment of bornite and malachite.

A gold mineralization of type II is highly possible inside the sheared zone, between Luizão garimpo and Pezão garimpos, as evidenced by the gold mineralization in sheared granite gneiss and quartz veinlets network within sheared granitic rock.

(6) Block H

The block H area shows potentiality to host gold mineralization of type III. A strong chlorite-epidote-pyrite alteration was observed in sheared granodiorite of Xingu Complex age in the proximity of Teles Pires granite. Stockwork type gold mineralization is expected in the contact zone of Teles Pires granite.

4-2 Correlation between Geochemical Anomaly and Mineralization

As the results of geochemical survey, the threshold values of gold are 31.177 ppb in block B and 24.950 ppb in block C. The anomalous zones of gold detected in these two blocks include gold values of more than 100 ppb. The maximum values of gold are 415 ppb in block B and 654 ppb in block C.

Though the line space was kept in 1.2 km and the sampling space in 100 m, the gold anomalous zones of some of the elements extended continuously along the directions WNW-ESE, NW-SE, ENE-WSW and EW. Continuous geochemical anomalies along lines were not found related to the lithological distribution. However, they indicated the possibility that unidentified sheared zones exist besides the identified sheared zones in the survey areas. Consequently, the distribution of geochemical anomalous zones suggests that the gold mineralization in the survey area is probably of shear zone quartz veins-hosted type and of stockwork type.

The gold geochemical anomaly in center of block C which is seen concentrated along a continuous W-E direction, is thought to be related to the mineralization type described as shear zone quartz veins-hosted type. The gold geochemical anomaly seen as a horseshoe shape brings the possibility that the anomaly is related to the mineralization around an unidentified granitic body. The results of comparison with the radiometric potassium content map indicate that the center of the horseshoe shape is located in a zone of relative high potassium content. The results indicating the relation of gold and potassium bring also the possibility that the anomaly is related to the porphyry-style gold mineralization type.

4-3 Preliminary Evaluation of Mineral Potentiality

Based on results of regional potentiality made prior to 1998, blocks B and C were considered as the most promising areas to be selected for semi-detailed geological and geochemical survey, while the areas covered by blocks E, F, G and H were selected for regional geological survey. The results of these surveys and the results of the evaluation of the mineral potentiality in these areas are summarized below:

(1) Block B

Fig. II-2-17 shows a compiled map indicating the geological and geochemical surveys results in block B.

The oldest geologic unit is represented by early Proterozoic pre-Uatumã Granite that is partially covered by middle Proterozoic Iriri Formation volcanics and intruded by Teles Pires Granite. Diabase dykes cut the above mentioned units. Sheared rocks with ENE-WSW and WNW-ESE trends were observed in the region.

Results of mineral showings (primary garimpo) surveys in block B indicate samples with gold values of 4.81 g/t and 4.35 g/t and silver values of 2.7 g/t and 3.0 g/t, at garimpo Satelite. The sulphide rich quartz vein from the mineral showing B4 presented results with gold value of 100.0

g/t, silver of 127.2 g/t, and 3.86 % of copper. The samples of pyrite disseminated silicified granite from Novo Planeta garimpo area indicated the values of 11.70 g/t of Au and 1.2 g/t of Ag.

The geological and geochemical survey results showed a high potentiality in block B to host major gold deposits.

(2) Block C

Fig.II-2-33 shows a compiled map of block C indicating the results of geological and geochemical surveys.

The oldest geologic unit is represented by early Proterozoic pre-Uatumã Granite that is partially covered by middle Proterozoic Iriri Formation volcanics and intruded by Teles Pires Granite. Diabase dykes cut the above mentioned units. Sheared rocks with predominant NW-SE direction and subordinate ENE-WSW direction were observed in biotite granite (GrIIIb) and medium grained porphyritic biotite granite (Grupm).

Results of mineral showings (primary garimpo) surveys in block C indicated samples with gold values ranging from 130 g/t to 4.44 g/t and silver values from 6.5 g/t and 0.8 g/t for sulphide rich quartz vein samples taken from garimpo da Anta. Samples A1206 and A1207 from silicified granite with disseminated pyrite collected in the primary garimpo at 5400m north of Line C12, resulted in gold values of 1.30 g/t and 11.20 g/t and Silver values of 2.4 g/t and 4.2 g/t. Quartz vein samples taken from garimpo do Waldemar, located outside and to the east of block C presented gold values of 174.00 g/t, 40.4 g/t of silver and 0.40% of copper.

The geological and geochemical survey results showed a high potentiality in block C to host major gold deposits.

(3) Block E

Geology in the area can be summarized as mostly constituted by gneiss, augen gneiss, granite gneiss, schist, amphibolite and BIF representing the Xingu Complex unit.

The most important gold mineralization in the region within block E is the alluvial garimpo named Cabeça, located within a wide schist zone, however, it was confirmed during the 1998 year Geological Survey that this schist zone is not present inside of block E.

Quartz veins and pegmatoid veins with N60W direction are intruded in the gneissic rocks of the Xingu Complex unit and show large tourmaline and muscovite on soil. The gold source of the small-scale alluvial garimpo present in the block E area is probably related to these low gold grade bearing quartz veins and pegmatoid veins.

The absence of a favorable geological unit or a trap structure to host a major gold deposit, as well as the absence of a younger granitic intrusion indicates that block E has very low potentiality to host a major gold deposit.

(4) Block F

The geology in this area can be summarized as mostly constituted by gneiss, granite gneiss and schist representing the Xingu Complex unit. The schist, mainly talc chlorite schist has limited exposure and outcrops only in Serrinha do Guaranta area.

Results from the geological survey in Serrinha do Guaranta area during 1998, showed a large copper dissemination of talc chlorite schist. Analytical results from 32 meters of channel sampling in weathered talc chlorite schist showed a lateral average grade of 0.43% Cu. Gold results in the above mentioned 32 meters sample, indicated low grades gold values distributed within talc chlorite schist. Best obtained values were 2.33 ppm, 0.52 ppm, and 0.13 ppm averaged in 2 meters. Analytical results of samples taken from garimpo tailing, which is supposed to represent the main gold bearing sulphide rich quartz vein, indicated Au: 1.91ppm; Ag: 68.5ppm and Cu: 1.35%.

The geological survey in Aluizio Garimpo confirmed gold mineralization in parallel quartz veins bearing gold associated with iron sulphide that fills the N80W direction shear zone in granitic rock. The milkish white quartz veins with strong dissemination of pyrite are inserted in a shear zone that averages 8 meters width and a confirmed length of more than 500 meters. Analytical results obtained from seven quartz veins samples presented low gold content, mostly with less than 1 ppm order. The results for samples taken from sheared granite that host the quartz veins, presented extremely low gold values, however, the results obtained from one quartz vein showed that high gold values of 25.40 ppm were possible within the shear zone.

The Phase I geological survey indicated that Serrinha do Guaranta and Aluizio areas presented the most favorable geological and tectonical condition to host a major gold and copper deposit in the block F area.

(5) Block G

The geology in this area can be summarized as gneiss and granite gneiss representing the Xingu Complex unit that is intruded by several granitic batholiths of different ages.

The geological survey in block G confirmed that the most promising area to find a major gold deposit is inside a NW trend large shear zone of several kilometers wide connecting the two biggest primary garimpos in the block G region named Luizão garimpo and Pezão garimpo.

The Luizão garimpo is located on the southeastern portion, while the garimpo Pezão is located at the northwestern portion of this shear zone. A strongly sheared and locally mylonitized two mica granitic batholith, with strong K alteration, rich in fluorine and presenting disseminated gold, pyrite, chalcopyrite and bornite host the Luizão primary garimpo.

The Pezão primary garimpo presented a N60W large open pit excavated inside one river and the sulphide rich ore are brecciated, locally mylonitized and composed mostly by pyrite, with local enrichment of bornite and malachite.

The presence of other primary garimpos, inside the shear zone and between Luizão garimpo and Pezão garimpo, is a strong confirmation of the high potentiality of the area to host various type of gold mineralization.

(6) Block H

Geology in block H can be summarized as hornblende biotite granodiorite of Xingu Complex unit intruded by granitic batholith of Juruena and Teles Pires types.

Only alluvial gold occurrences are known on Rochedo river and Teles Pires river, as well as in rivers of the central part of the block H area. Gold occurrences in the Teles Pires and Rochedo rivers probably has upstream sources, but they are rather considered as local sources for the gold occurrences in the streams of the central part of the survey area.

Strong silicic, sericitic and hematitic alteration were observed in sheared rocks at two sites along the road, and a similar altered rock was observed in the central part of the survey area as mixed fragments in gravel of the alluvial garimpo. Analytical results for 9 ore samples, including samples of the altered rocks, did not indicate any anomaly neither for gold nor for base metal elements.

Judging from the survey results, the potential for gold mineralization in block H are considered to be low.

Chapter 5 Conclusions and Recommendations

5-1 Conclusions

Based on the preliminary results of the studies made prior to 1998, blocks B and C were considered as the most promising. For this reason, during this phase they were selected for semi-detailed geological and geochemical survey, while blocks E, F, G and H were selected for regional geological survey. The results of these surveys can be conclusively summarized as follow:

5-1-1 Block B:

The oldest geologic unit is represented by early Proterozoic pre-Uatumã Granite that is partially covered by middle Proterozoic Iriri Formation volcanics and intruded by Teles Pires Granite. Diabase dykes cut the above mentioned units. Sheared rocks along ENE-WSW and WNW-ESE trends were observed in the region.

Results of mineral showing (primary garimpo) surveys in block B indicated samples with gold values of 4.81 g/t and 4.35 g/t and silver values of 2.7 g/t and 3.0 g/t at garimpo Satelite. The sulphide rich quartz vein from mineral showing B4 presented gold value results of 100.00 g/t, silver of 127.2 g/t and 3.86 % of copper. Samples of pyrite disseminated silicified granite from Novo Planeta garimpo area indicated 11.70 g/t of Au and 1.2 g/t of Ag.

The threshold value for gold calculated from analytical results of geochemical soil sampling was 31.177 ppb and by using this value, it is possible to interpret continuous geochemical anomalies along WNW-ESE and NW-SE directions. These linear anomaly zones are not related to any lithological distribution, but they are considered to show evidence of geological structures representative of shear zones. The distribution of these anomalies suggests either a shear zone of quartz vein-hosted type or a stockwork type gold mineralization.

The geological and geochemical surveys in block B showed a large zone with high potentiality to host major gold deposits.

5-1-2 Block C:

The oldest geologic unit is represented by early Proterozoic pre-Uatumã Granite that is partially covered by middle Proterozoic Iriri Formation volcanics and intruded by Teles Pires Granite. Diabase dykes cut the above mentioned units. Sheared rocks with predominant NW-SE direction and subordinate ENE-WSW direction were observed in biotite granite (GrIIb) and medium grained porphyritic biotite granite (Grupm).

Results of mineral showing (primary garimpo) surveys in block C presented samples with gold values ranging from 130 g/t to 4.44 g/t and silver values from 6.5 g/t and 0.8 g/t, for sulphide rich quartz vein of garimpo da Anta. Samples of silicified granite with disseminated pyrite collected in the primary garimpo at 5400m north of Line C12, resulted in gold values of 1.30 g/t and 11.20 g/t and silver values of 2.4 g/t and 4.2 g/t. Quartz vein samples taken from garimpo do Waldemar, located outside and at east of block C presented 174.00 g/t of gold, 40.4 g/t of silver and 0.40% of copper.

The threshold value for gold calculated from analytical results of geochemical soil sampling was 24.950 ppb and by using this value, it is possible to interpret continuous anomalies along WNW-ESE, NW-SE, ENE-WSW and E-W directions. These linear anomaly zones are not related to any lithologic distribution, but considered to give evidences of geological structures representative of shear zones. The soil geochemical gold anomaly located in the central part of block C is wide, elongated to E-W and showing a horseshoe shape.

The geological and geochemical surveys showed a large zone with high potentiality to host major gold deposits in the central part of the block C area, as shown on Fig I-5-2.

5-1-3 Block E:

Geology in the area can be summarized as mainly constituted by gneiss, augen gneiss, granite gneiss, schist, amphibolite and BIF representing the Xingu Complex unit.

The most important gold mineralization in the region within block E is the alluvial garimpo named Cabeça, located within a wide schist zone that the 1998 year Geological Survey confirmed that it was not present inside of the block E area.

Quartz veins and pegmatoid veins of N60W direction are intruded in the gneissic rocks of the Xingu Complex unit. The sources of gold of the small scaled alluvial garimpo within block E are possibly associated to these low gold grade bearing quartz vein and pegmatoid veins.

Chemical analysis of 25 samples did not show neither anomalous values for gold nor for base metal elements.

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

5-1-4 Block F:

Geology in this area can be summarized as mostly constituted by gneiss, granite gneiss and schist representing the Xingu Complex unit. The schist, mainly talc chlorite schist, has limited exposure but outcrops only in Serrinha do Guaranta area.

Results from geological survey in Serrinha do Guaranta area showed a large copper dissemination in talc chlorite schist. Analytical results from 32 meters of channel sampling in weathered talc chlorite schist showed a lateral average grade of 0.43% Cu.

A soil geochemical survey previously carried out by Metamat showed an extension of the copper anomaly to the west-northwest of Serrinha do Guaranta area.

Gold results obtained from the same 32 meters sampling, showed low grade gold results distributed within talc chlorite schist and presenting values of 2.33 ppm, 0.52 ppm, and 0.13 ppm within 2 meters average.

The geological survey in Aluizio Garimpo confirmed gold mineralization within a N80W direction shear zone. The sheared zone, that has 8 meters width in average and a confirmed length of more than 500 meters, is filled by parallel gold bearing quartz veins.

Analytical results of these quartz veins showed that values of gold as high as 25.40 ppm were possible within this shear zone.

The Phase I geological survey indicated that Serrinha do Guaranta and Aluizio areas presented one of the most favorable geological and tectonical conditions to host a major gold and copper deposit in the block F area.

5-1-5 Block G:

The geology within block G can be summarized as gneiss and granite gneiss of the Xingu Complex unit intruded by several granitic batholiths of different ages.

The Phase I geological survey showed a large shear zone of several kilometers wide, with a NW trending that connects two biggest primary garimpos in the region of block G, named Luizão garimpo and Pezão garimpo. The geological survey confirmed also that inside of this shear zone, it can be found the most favorable area to find a major gold deposit in block G.

The Luizão primary garimpo area is hosted by a strongly sheared and locally mylonitized two mica granitic batholith, with strong K alteration, rich in fluorine and with disseminated gold, pyrite, chalcopyrite and bornite.

The Pezão primary garimpo presented a N60W large open pit excavated inside one river. The sulphide rich ore are brecciated, locally mylonitized and composed mostly by pyrite, with local enrichment of bornite and malachite.

There are other primaris gold garimpos distributed inside of this shear zone, between Luizão garimpo and Pezão garimpo and which presents strong indications to be a high potential area to host several large gold mineralizations.

5-1-6 Block H:

The geology within block H area can be summarized as hornblende biotite granodiorite of Xingu Complex unit intruded by Juruena and Teles Pires types granites.

Only alluvial gold occurences are known to exist in Rochedo river and Teles Pires river as well as in the rivers of the central part of block H. The gold in the Teles Pires and Rochedo rivers is probably related to upstream sources, but also considered to be related to a local source from the streams of the central part of the survey area.

Strong silicic, sericitic and hematitic alteration were observed in sheared rocks at two sites along the road. Similar altered rock was observed as mixed fragments in gravel of the alluvial garimpo in the central part of the survey area. Analytical results for 9 ore samples including samples of the altered rocks, indicated neither anomalies for gold nor anomalies for base metal elements.

Judging from the geological survey results, the potentiality for hosting gold mineralization within block H can be considered as very low. The ore sampling results did not either indicate any gold anomaly within block H area that can be considered as target for additional survey.

5-2 Recommendations for the Phase II Survey

The following surveys are recommended for each block area in the Alta Floresta region during the Phase II survey.

(1) Block B:

The Phase I survey results indicated that block B presents a high potentiality to host a major gold mineralization related either to the shear zone quartz vein-hosted type or to a stockwork type. It is considered to carry out a detailed survey to narrow the promising area by clarifying the relation between geology and mineralization in the gold anomalous area of the southeastern part of the western block and the southwestern part of the eastern block, as shown in Fig. I-5-1.

At first, it is considered that the detailed geological survey includes a trench survey and a detailed soil geochemical survey. As a second step, it is considered to carry out geophysical survey by using with IP and magnetic survey methods as well as geological survey by trenching methods

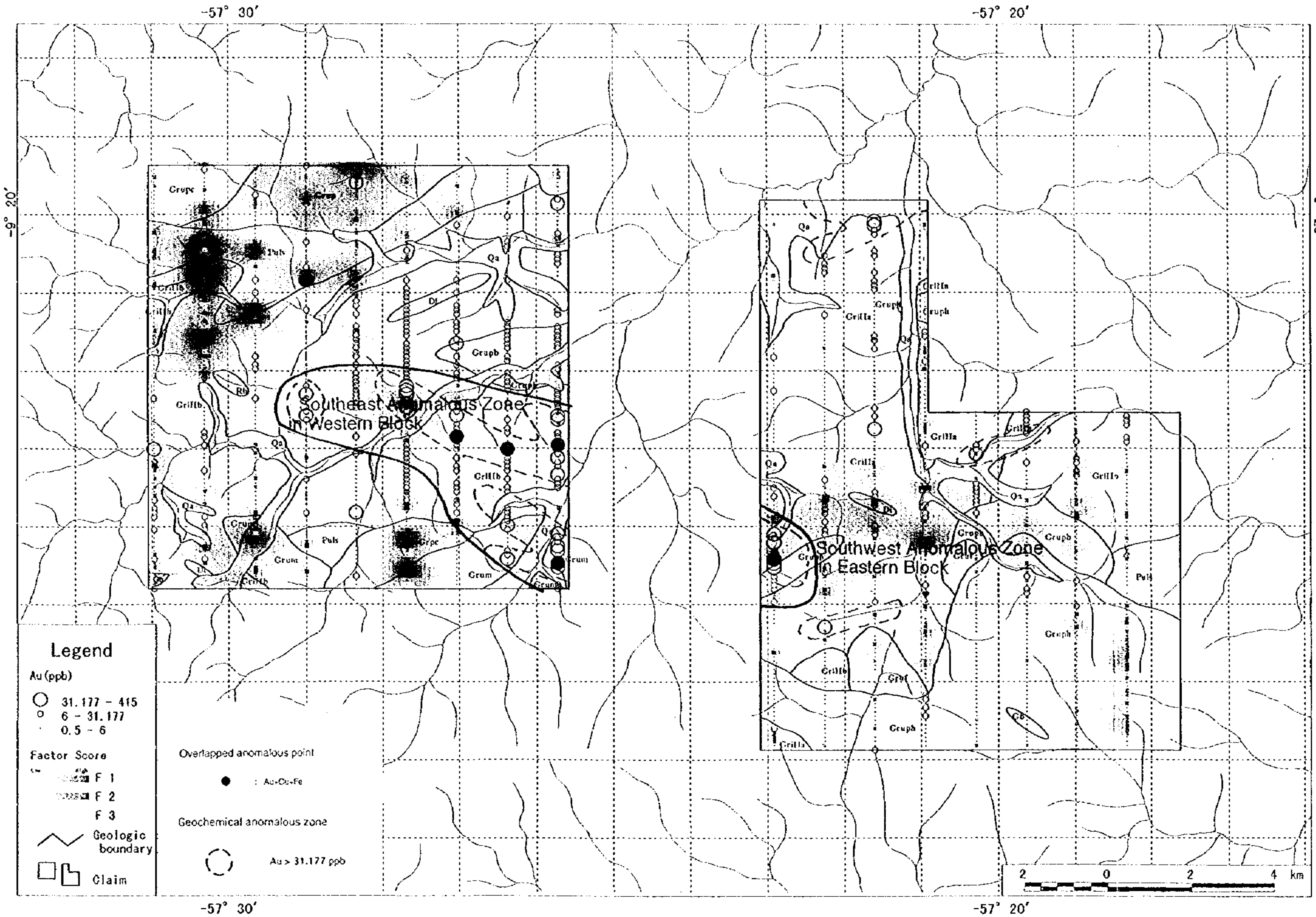


Fig. I-5-1 Recommendation for future work in the B block

delimited by a narrow area. Finally, drilling survey is considered to confirm the gold mineralization in the target areas.

(2) Block C:

The Phase I survey results in this area indicated a high potentiality to host in the central part of the area a major gold mineralization of following types: shear zone quartz vein-hosted type , stockwork type or a disseminated porphyry-style gold type mineralization, as shown in Fig. I-5-2.

It is considered the following follow-up work: (i) Detailed geological survey including trenching survey and detailed soil geochemical survey in the central part; (ii) Ground geophysical survey by using IP and magnetic survey methods, as well as geological survey by trenching in a selected narrow area; and (iii) Drilling survey to confirm the gold mineralization.

(3) Block E:

The survey results clearly indicated that the area related to block E 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. No additional survey is considered in this block for the next year.

(4) Block F:

The Phase I geological survey indicated that Serrinha do Guaranta and Aluizio areas presents the most favorable geological and tectonical conditions to host a major gold and copper deposit of following types: shear zone quartz vein-hosted type , stockwork type or a disseminated porphyry-style gold type mineralization, as shown in Fig. I-5-3.

Accordingly, it is considered for these two areas at first that the geological survey including trench survey and the geochemical survey will be carried out and subsequently that the geophysical survey, such as IP survey and magnetic survey, the detailed geological survey including trench survey and drilling survey will be carried out in order to confirm the mineralized zone.

(5) Block G:

The presence of many other primary garimpos inside of the shear zone including Luizão garimpo and Pezão garimpo is thought to be another strong indication for the detection of a favorable zone to host a promising gold mineralization, as shown in Fig. I-5-4. The potential is thought to be high.

To clarify even more its potential, it is considered first, that a similar soil geochemical survey as performed in blocks B and C and a semi-detailed geological survey be carried out in the shear zone between Luizão garimpo and Pezão garimpo. Finally, it is considered a geophysical survey and drilling survey to be carried out in the promising area in order to confirm the mineralized zones.

(6) Block H:

According to the results of the geological survey in block H, no large scale gold mineralization is expected in the area and in consequence, no additional survey in block H is considered for the next year.

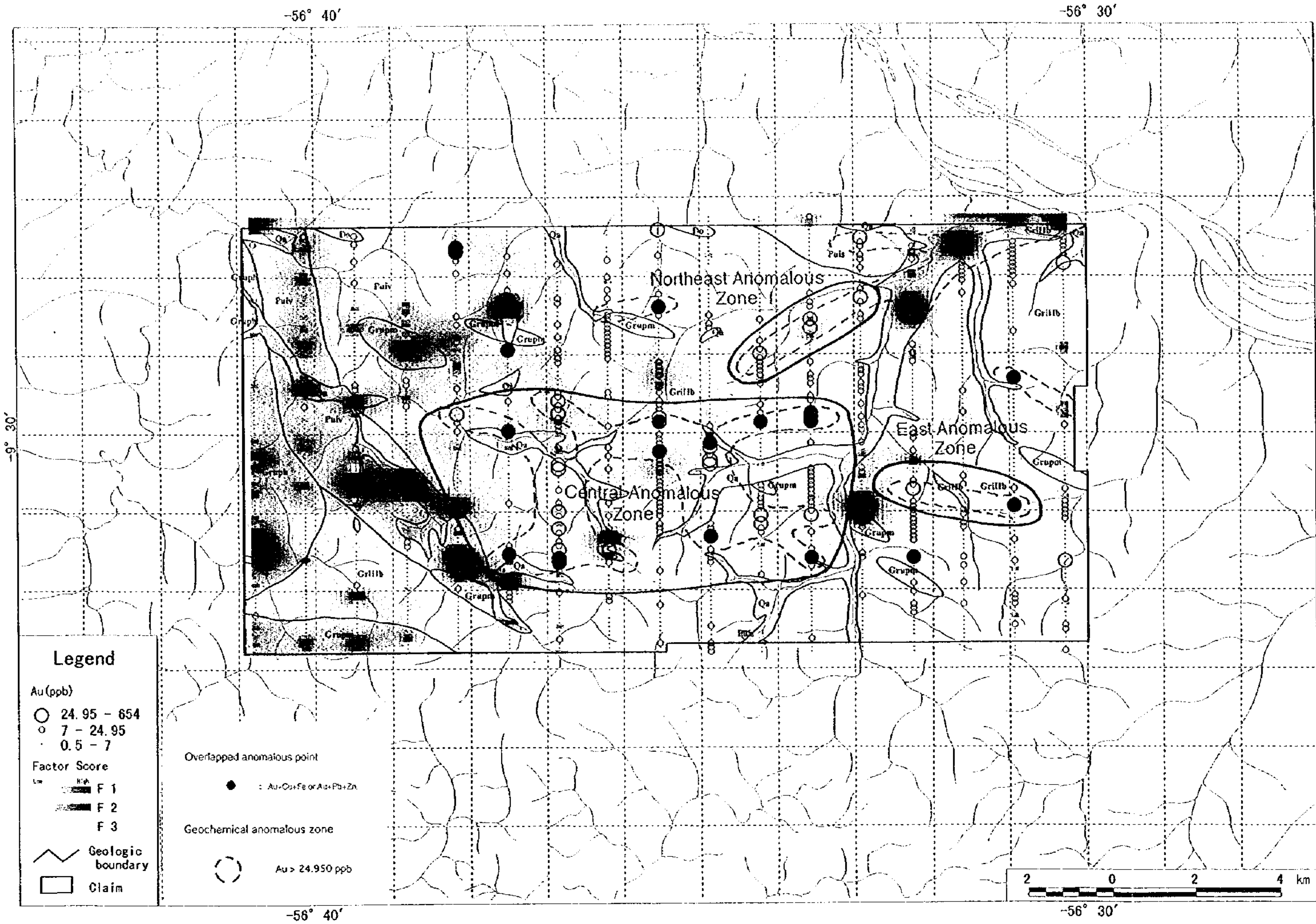


Fig. I-5-2 Recommendation for future work in the C block

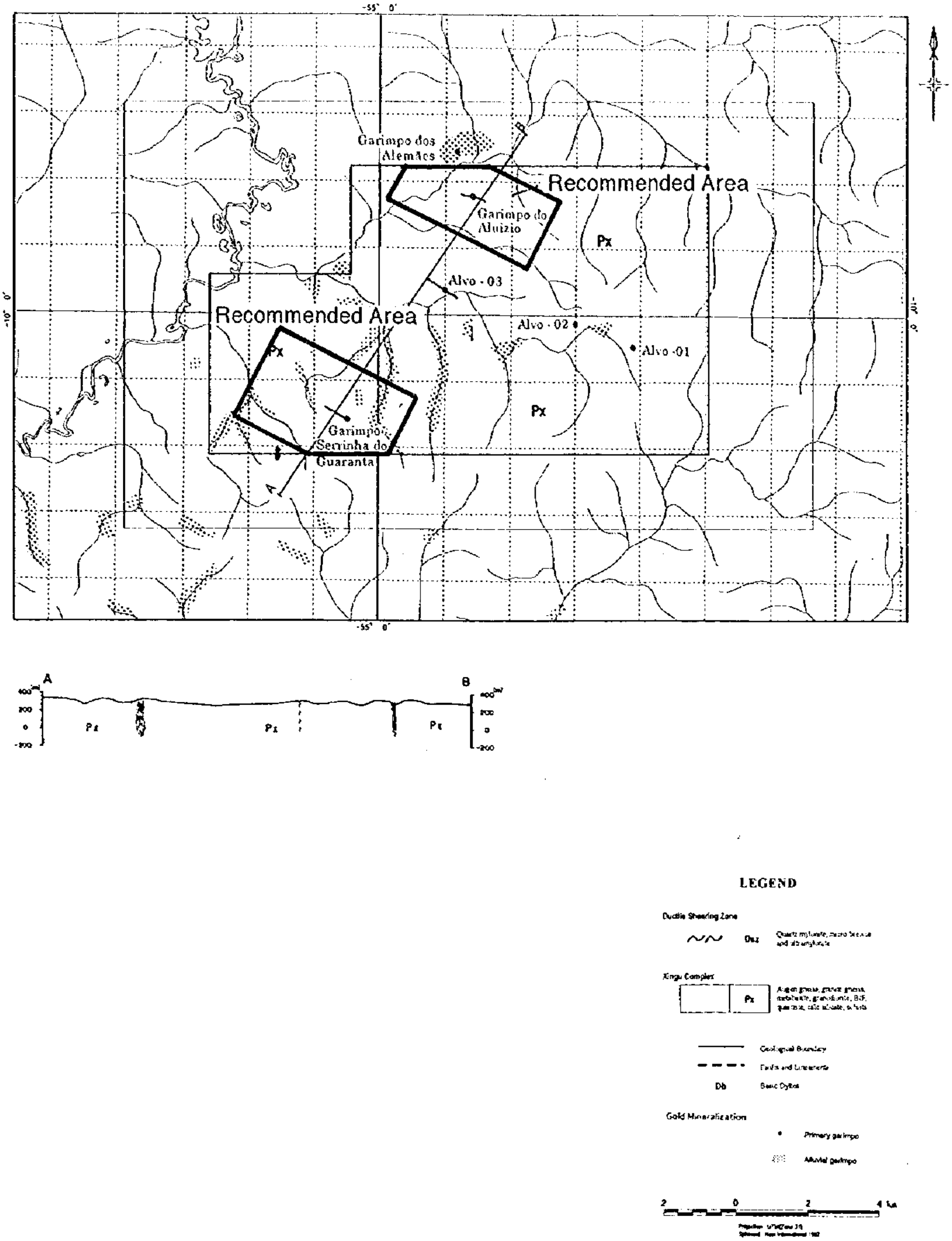


Fig. I -5-3 Recommendation for future work in the F block

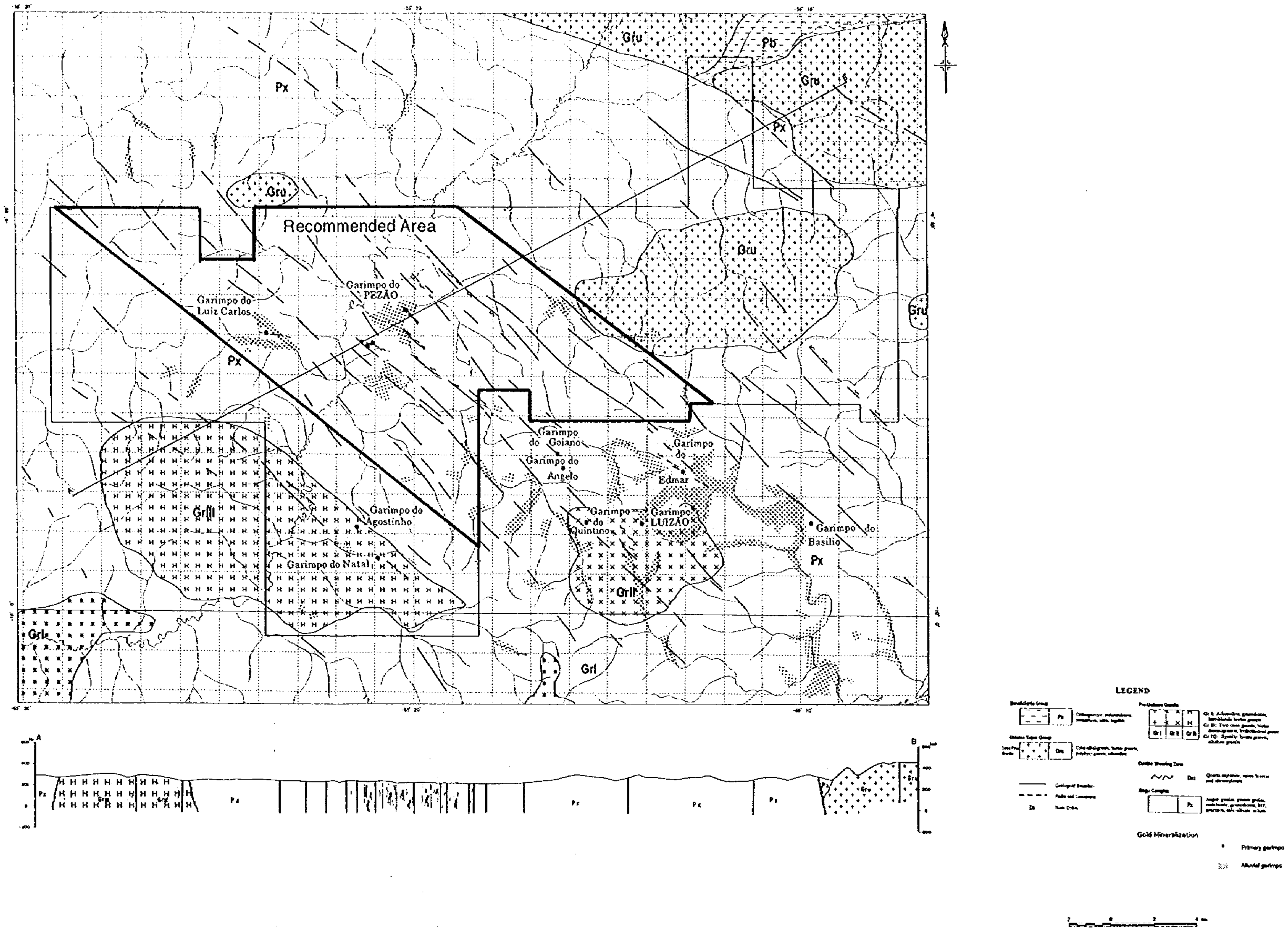


Fig. I-5-4 Recommendation for future work in the G block

PART II Survey Results

Chapter 1 Geological Survey

1-1 Location of the Survey Area

As shown in Fig. 2, the geological survey was carried out within blocks B, C, E, F, G and H. The geological survey in blocks B and C were carried out simultaneously with a geochemical soil sampling. The survey results are described on Chapter 2.

Block E is located in the southern part of the surveyed area at 60 km from Alta Floresta City, as shown in Fig. II-1-1.

Blocks F and G (Fig. II-1-2 and II-1-3) are located in the eastern part of the surveyed area, close to Matupa city. Block F is located 10 km to the north from this city, while block G is located 40 km to the west.

Block E (Fig. II-1-4) is only the block in the central part of the survey area located 25 km northeast of Alta Floresta city.

1-2 Survey Methods

Since only few and incomplete basic geological data were available for the surveyed blocks, the geological survey routes were set up along the access roads connecting blocks E, F, G and H.

During the preparation phase for the field survey, innumerable data from Landsat TM, airborne geophysics and JERS-1 SAR, together with others existing basic geological data were all digitized in computer by using UTM coordinates.

The following data were printed in 1:50,000 scale for use during the field survey:

1) Total magnetic field
2) (K, U, Th) radiometric total count
3) JERS-1 radar image
4) Landsat TM image R(5):G(4):B(1)
5) Landsat TM interpretation map

In general, the survey routes were set up mostly by crossing either the geologic, tectonic regional or mineralization trends. In the cases when the access was feasible, the routes were set up by crossing airborne geophysical anomalies.

The geological survey length within the 4 surveyed blocks totaled 104.2 km and distributed as follows:

Block E	37.8 km
Block F	14.4 km
Block G	35.9 km
Block H	16.1 km

GPS positions were taken on every outcrop or float sites during the geological mapping and plotted on Landsat Image. Outcrops photographs were also taken and a detailed description of the geology were made in all sites where laboratory samples were taken during the geological survey. In addition, detailed photographs and sketches in 1:100 or 1:200 were carried out on the most interesting outcrops or garimpos.

For the geological survey, samples were collected for thin section analysis, polished ore analysis, X-ray analysis, fluid inclusion analysis, datation and chemical analysis for ores.

1-3 Laboratory Tests Results

Laboratory tests samples were taken at several locations during the geological survey and their locations plotted on the Location Maps annexed to this report. These tests included thin section analysis, polished ore analysis, X-ray analysis, fluid inclusion analysis, datation and chemical analysis for ores. Results of these tests are shown in the Tables II-1-1 to II-1-5 and Appendix 1.

The elements for analysis, analytical methods and detection limits adopted for the chemical analysis of ore were as follows:

Elements	Analytical Method	Detection Limit
Au	A.A.	0.01 ppm
Ag	ICP	0.2 ppm
Cu	ICP	1 ppm
Pb	ICP	1 ppm
Zn	ICP	1 ppm
Fe	ICP	0.01 %
As	ICP	2 ppm
Sb	ICP	2 ppm
Hg	ICP	10 ppb

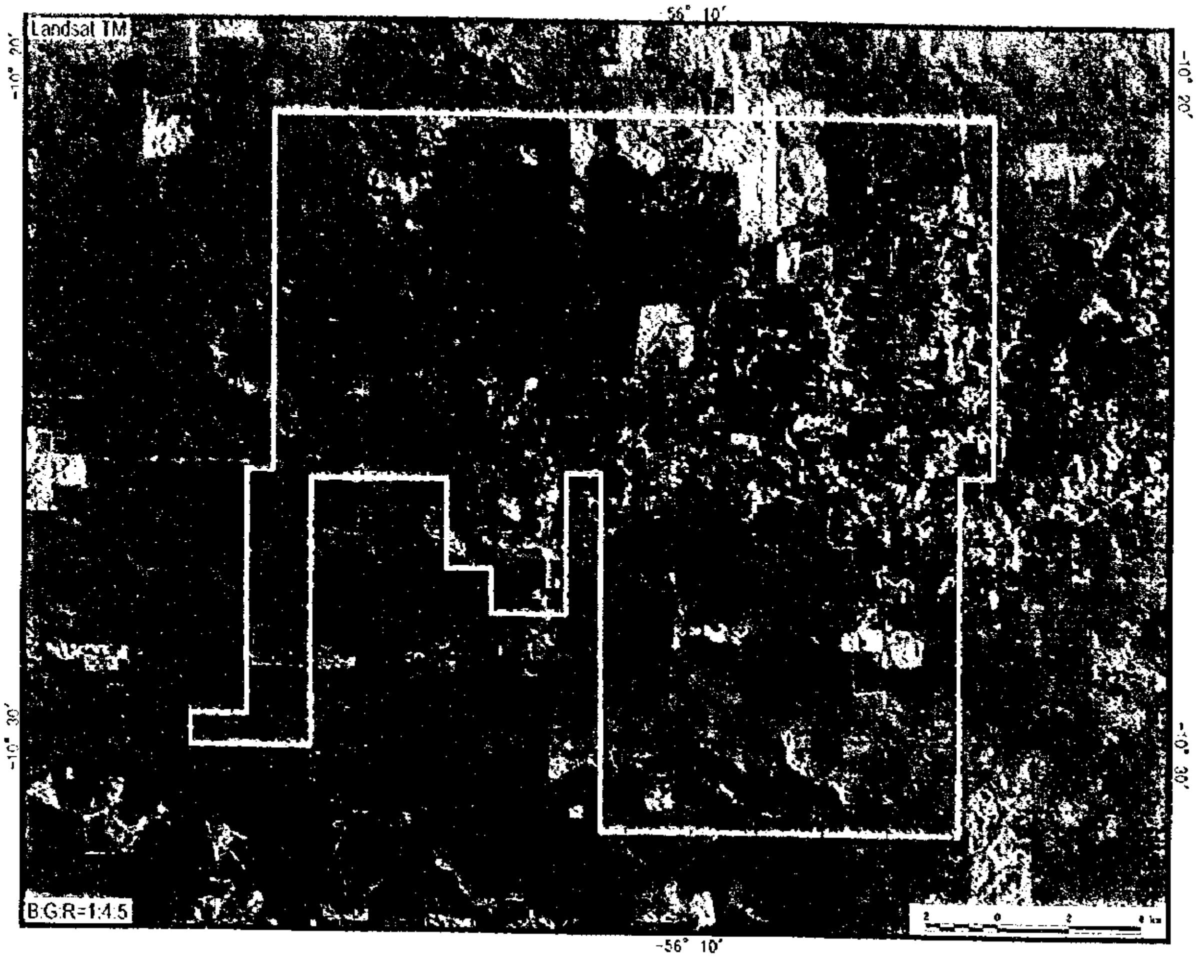


Fig. II-1-1 Geological survey area of the Block E

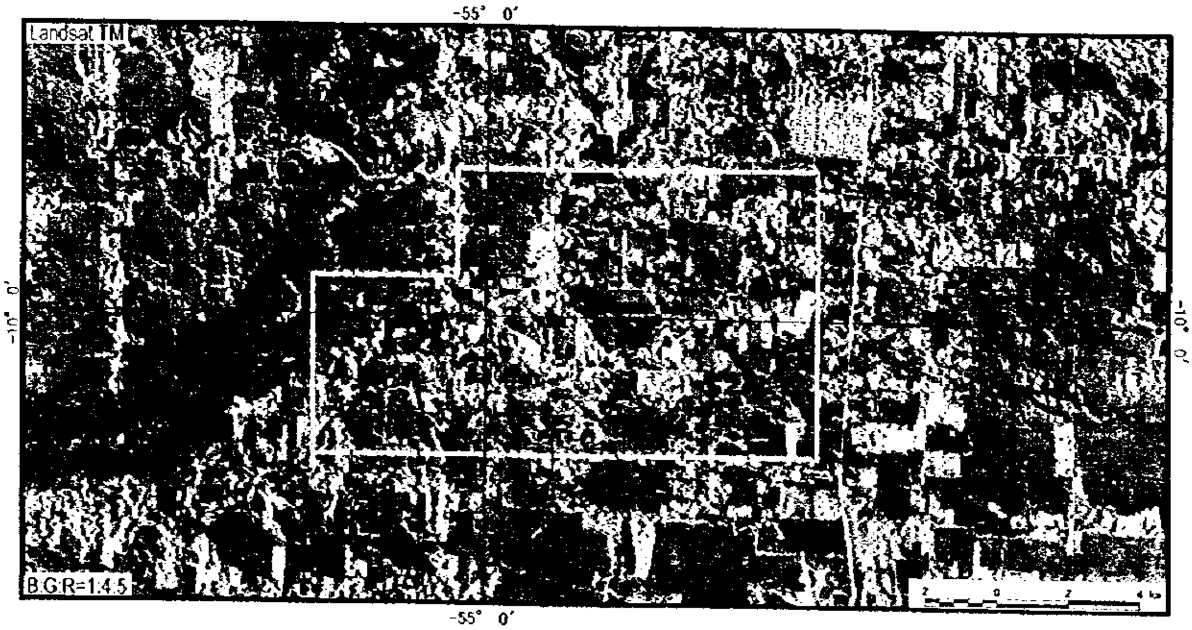


Fig. II-1-2 Geological survey area of the Block F

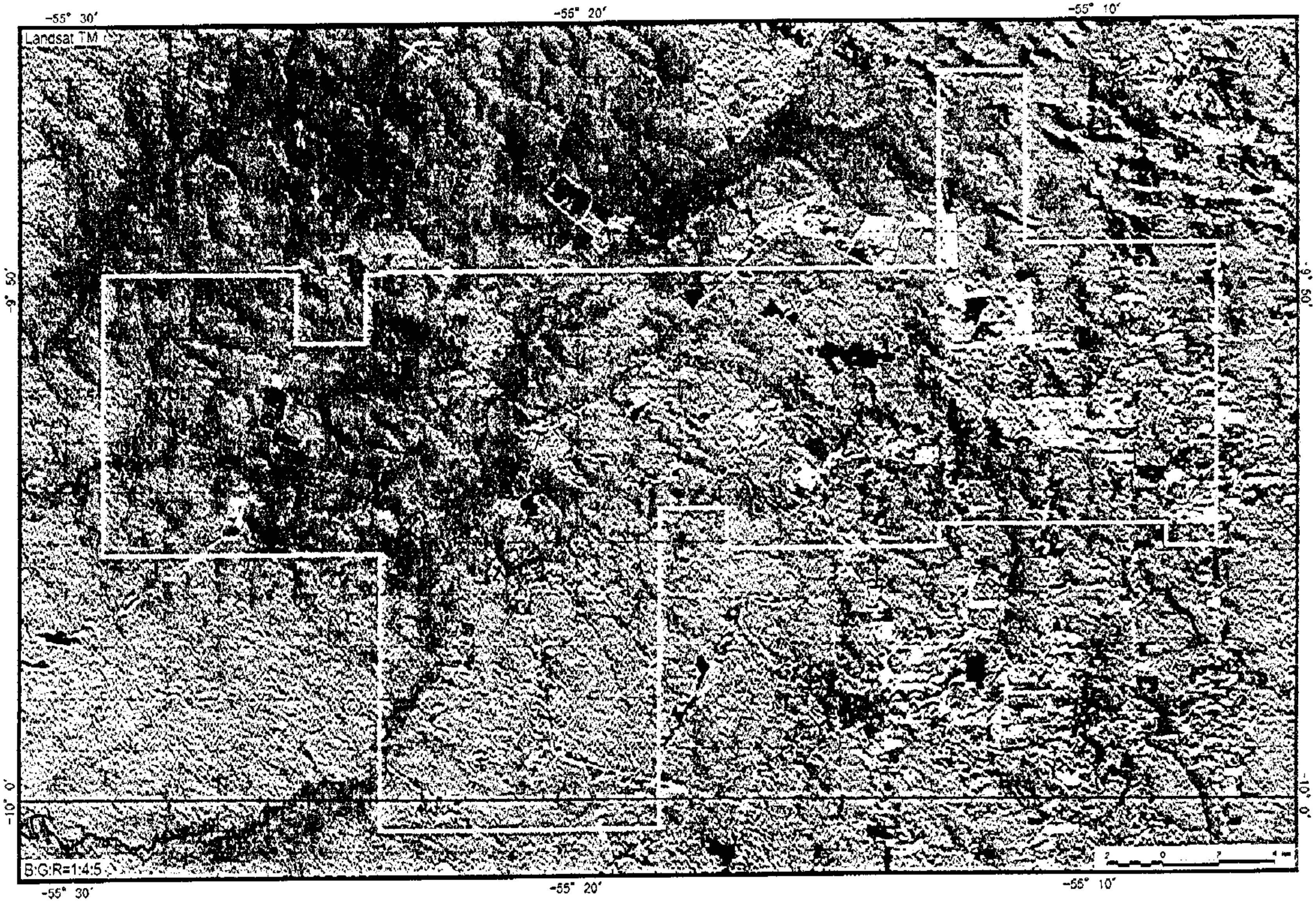


Fig. II-1-3 Geological survey area of the Block G

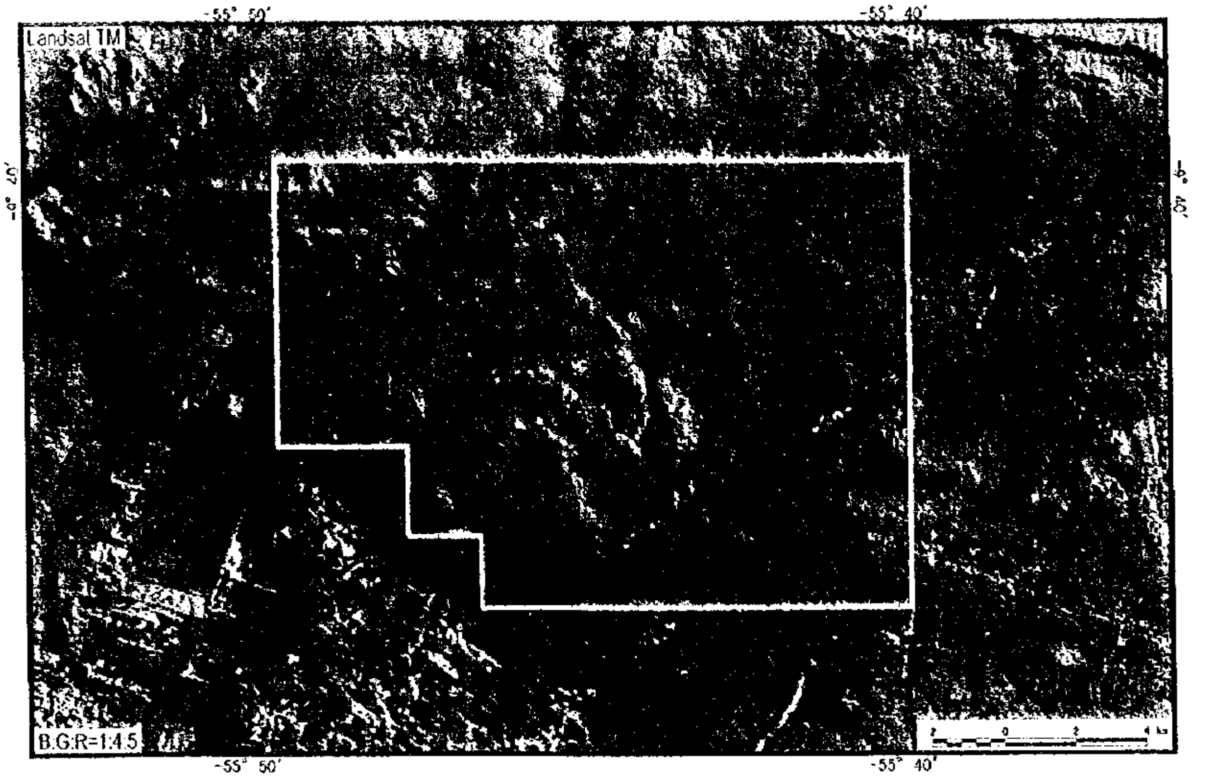


Fig. II-1-4 Geological survey area of the Block H