R1
64

MINISTÉRIO DAS MINAS E ENERGIA

CONVÊNIO GEOFÍSICA BRASIL-ALEMANHA

(Alguns elementos para elaboração do plano de trabalho)

- Some elements for elaboration of working plan -

I/99
CPRM
BIBLIOTECA
Rel. Div.
SUREG-BH
n.11

- November, 1970 -

CONTENTS

			Page
1	-	Abstract of the "Convênio Geofísica Brasil-Alemanha"	1
2	-	Introduction	2
3	-	Some geographic informations:	
	3.1	- Geographic situation	3
	3.2	- Relief	4
	3.3	- Hydrography	6
	3.4	- Climate	8
	3.5	- Vegetation	9
	3.6	- Roads	11
	3.7	- Railroads	12
	3.8	- Airports	13
4	-	Summary of Minas Gerais Geology	14
5	-	View of Minas Gerais mineral resources	22
6	-	Additional informations:	
	6.1	- Data computation	32
	6.2	- Data of magnetic stations	33
	6.3	- Cartography and Aerophography	34

ILLUSTRATIONS (In the plastic cover)

1 - Lithologic control of mineral deposits in Minas Gerais
2 - Map of lines of equal inclination
3 - Map of curves of equal variation of inclination
4 - Map of lines of equal horizontal component
5 - Map of curves of equal annual variation of horizontal component

1 - ABSTRACT OF THE "CONVÊNIO GEOFÍSICA BRASIL-ALEMANHA"

1 - ABSTRACT OF THE "CONVÊNIO GEOFÍSICA BRASIL-ALEMANHA"

The Governments of the Federal Republic of Brazil and the Federal Republic of Germany signed in Bonn, at June, 1st, 1970, a "Convênio", completing the "Acôrdo Básico de Cooperação Técnica" signed at November, 30, 1963, establishing the institution of a Brazilian German Mixed Commission, to execute, in the period of three years, the following geophysical researches in the State of Minas Gerais (except the west side of Meridian 48º) and also in the State of Espírito Santo (except the eastside of the Vitória Meridian):

1) A sistematic airborne geophysical survey,doing magnetometric and cintilometric measurements;

2) A complementar airborne geophysical survey of the regions with anomalies, including methods of electromagnetic measurements;

3) The control of the intended regions founded before by means of aerogeophysical measurements, which must be done with geophysical researchs in the land, according to the respective need, by the application of magnetometry, cintilometry, gravimetry, or of the geoelectric measurements methods;

4) The geological cartography of the ore deposits and geological researches in order to clear the general geological structure;

In its article 12, the "Convênio" stablishes that the Contracting Governments will designate the representants in order to constitute a group of work that, in the period of 90 days after the first meeting, must present a plan of working where will be defined the details of the "Convênio" execution.

2 - INTRODUCTION

2 - INTRODUCTION

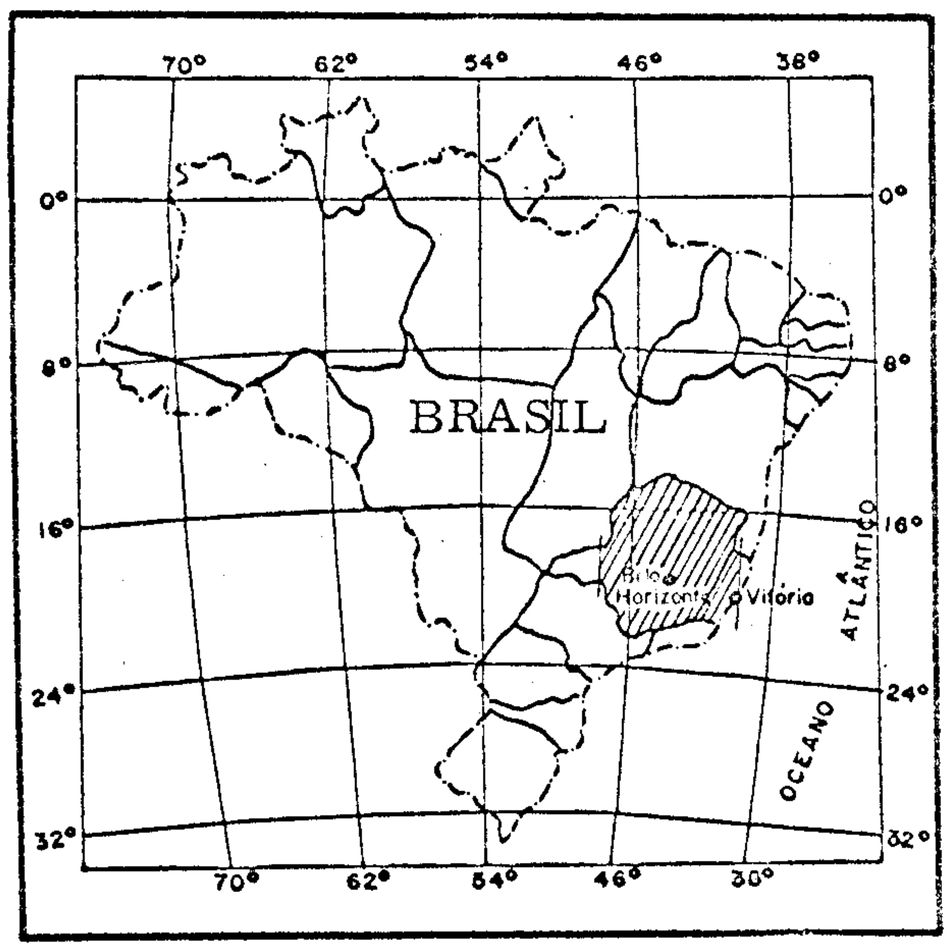
The present report consists in a small selection of elements about the geography, geology, mineral resources, etc., of the area that will be surveyed by the "Convênio Geofísica Brasil-Alemanha". The maps are here presented in a very reduced scale, in order to make them easy to handling.

Its aim is only to offer to the members of the german delegation a global vision of the terms mentioned above, in order to make easy the elaboration of the working plan, mentioned before.

3 - SOME GEOGRAPHIC INFORMATIONS

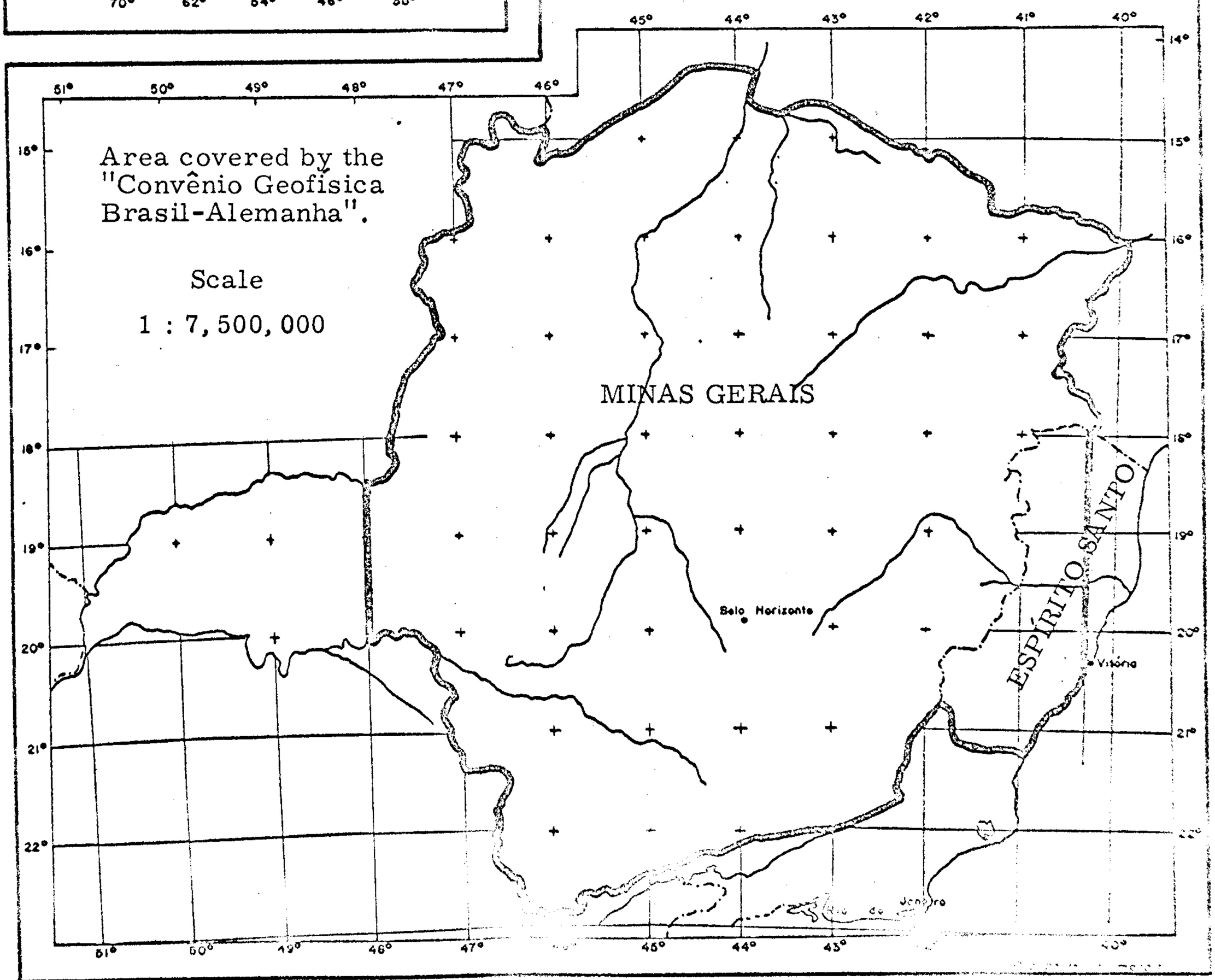
3.1 - GEOGRAPHIC SITUATION

The area that will be surveyed by the "Convênio Geo - física Brasil-Alemanha" is measured approximately in 562,000 km^2 and cover the States of Minas Gerais (except the westside of the Meridian 48° W.Gr.) and Espírito Santo (except the eastside of Vitória Meridian). It covers about 740 counties and the population is about 12,000,000 of inhabitants.



Location map (at left):

Showing in hachuries the area covered by the "Convênio Geofísica Brasil-Alemanha".



3.2 - RELIEF

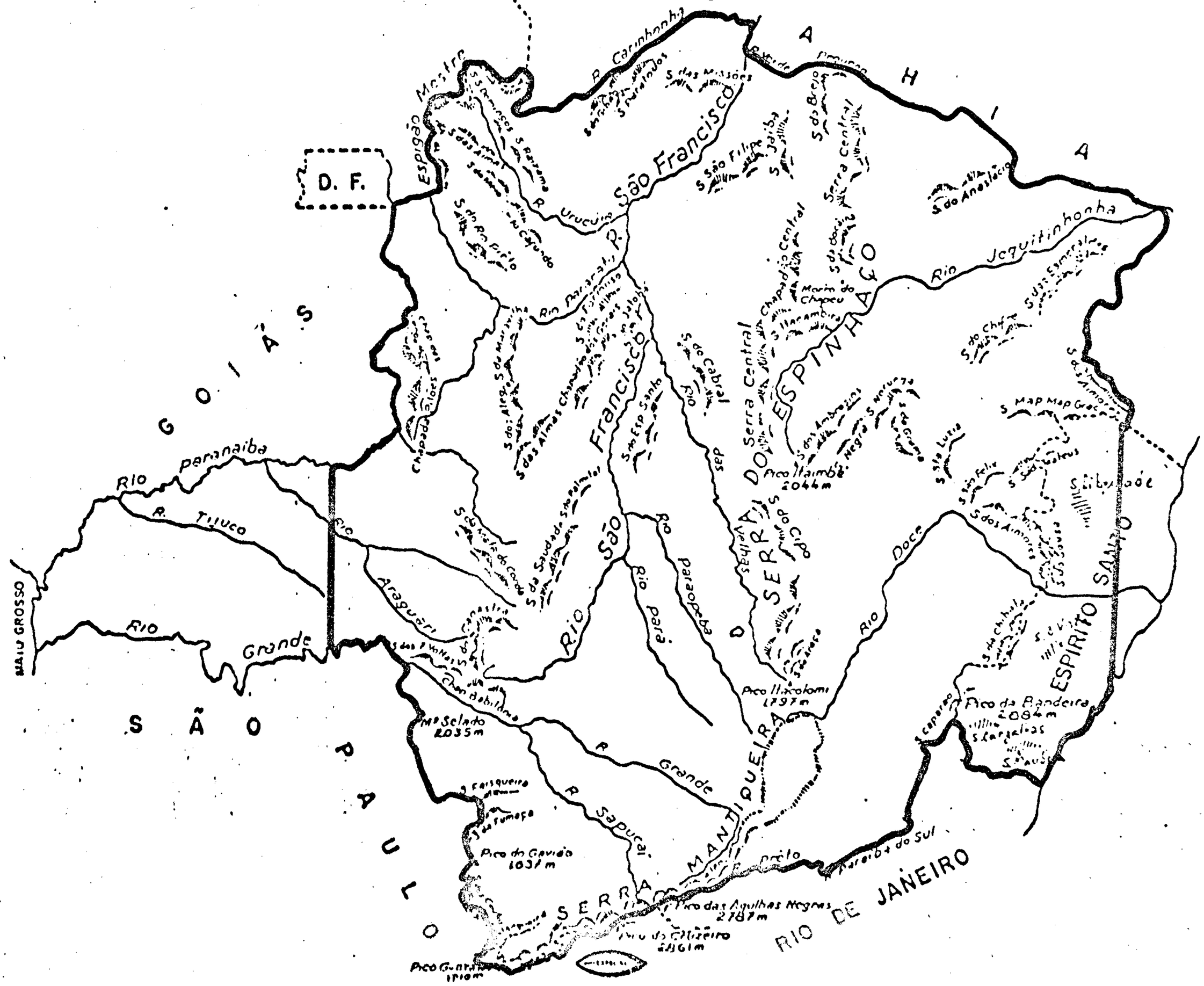
Practically, the whole area taken by the "Convênio" includes high plateaus and hills; only in the eastside of the region there are stretchs of flat land.

The hills are branches from the Mantiqueira hill, which is its denomination in the south of the region.

1) In the south, between the States of Minas Gerais and Rio de Janeiro, the Mantiqueira hill is known as Itatiaia hill, whose highest peak has the name of Agulhas Negras (2787 meters). Also in the south, toward the west, we have the Maciço de Poços de Caldas.

2) Toward the east, at the stateline between Mi-

8



nas Gerais and Espírito Santo, the Mantiqueira hill is divided in Caparaó hill, that continues up north with the names of Souza and Aimorés. Highest peak: Pico da Bandeira (2890 meters).

3) Up north, the Mantiqueira adds the Espinhaço hill, and has many local denominations: Itacolomi, Ouro Preto, Antônio Pereira, Caraça, Sêrro Frio, Itacambira, Grão Mogol, etc. Highest peaks: Itacolomi (1795 meters), Antônio Pereira (1358 meters), Monte Carapuça (1955 meters), Piedade (1778 meters), Grão Mogol (1200 meters).

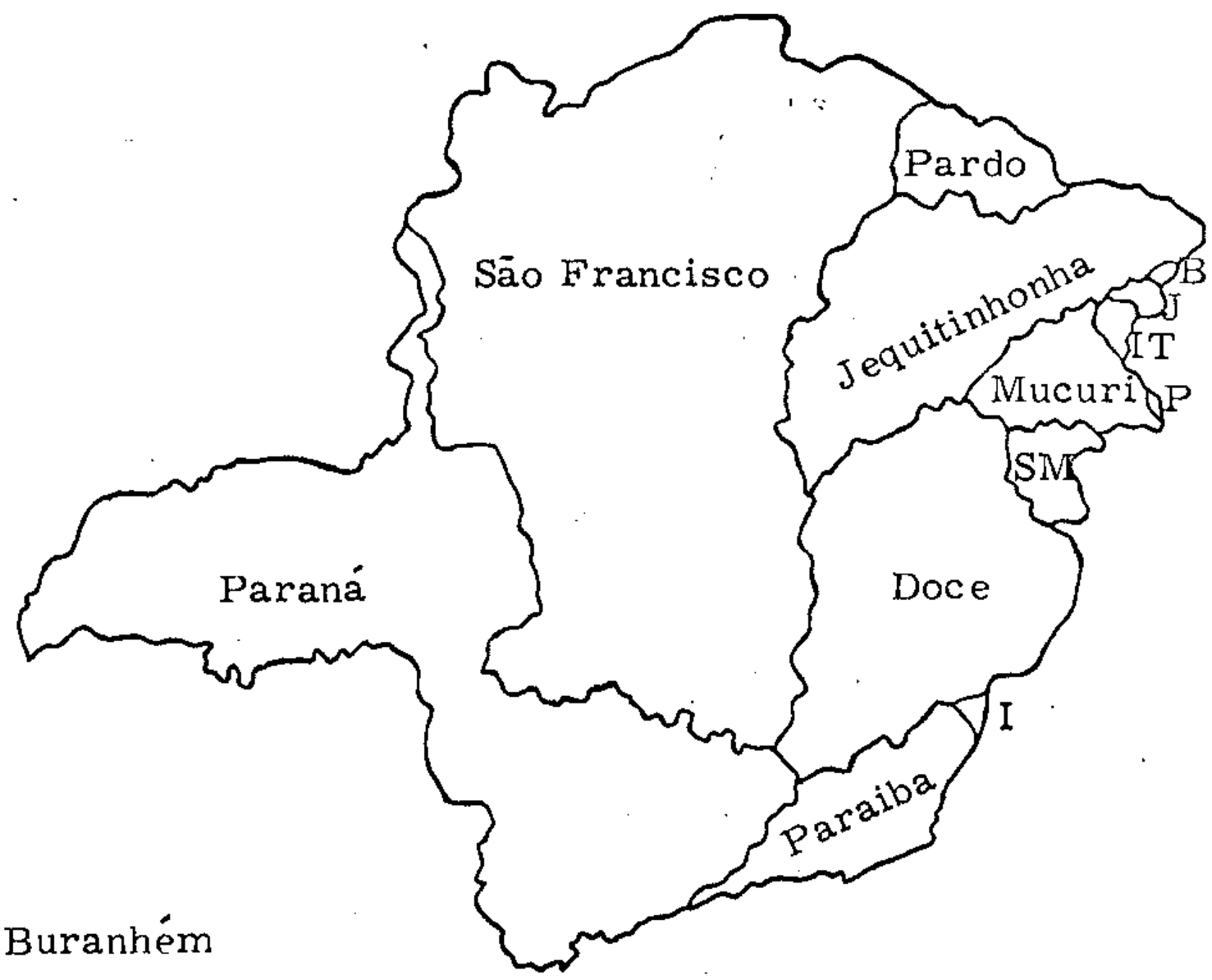
   At the westside of the Espinhaço hill, we have the hills: Montes Claros, Cabral, Espírito Santo, Central, Missões, Contendas, São Felipe, etc.

4) At west, between the rivers Grande and Paranaiba, the branches from Mantiqueira hill are denominated: Canastra and Mata da Corda.

   In the stateline between the States of Minas Gerais and Goiás, we have the hills: Pilões, São Domingos das Almas, Cangalha, Arrependidos, etc.

3.3 - HYDROGRAPHY

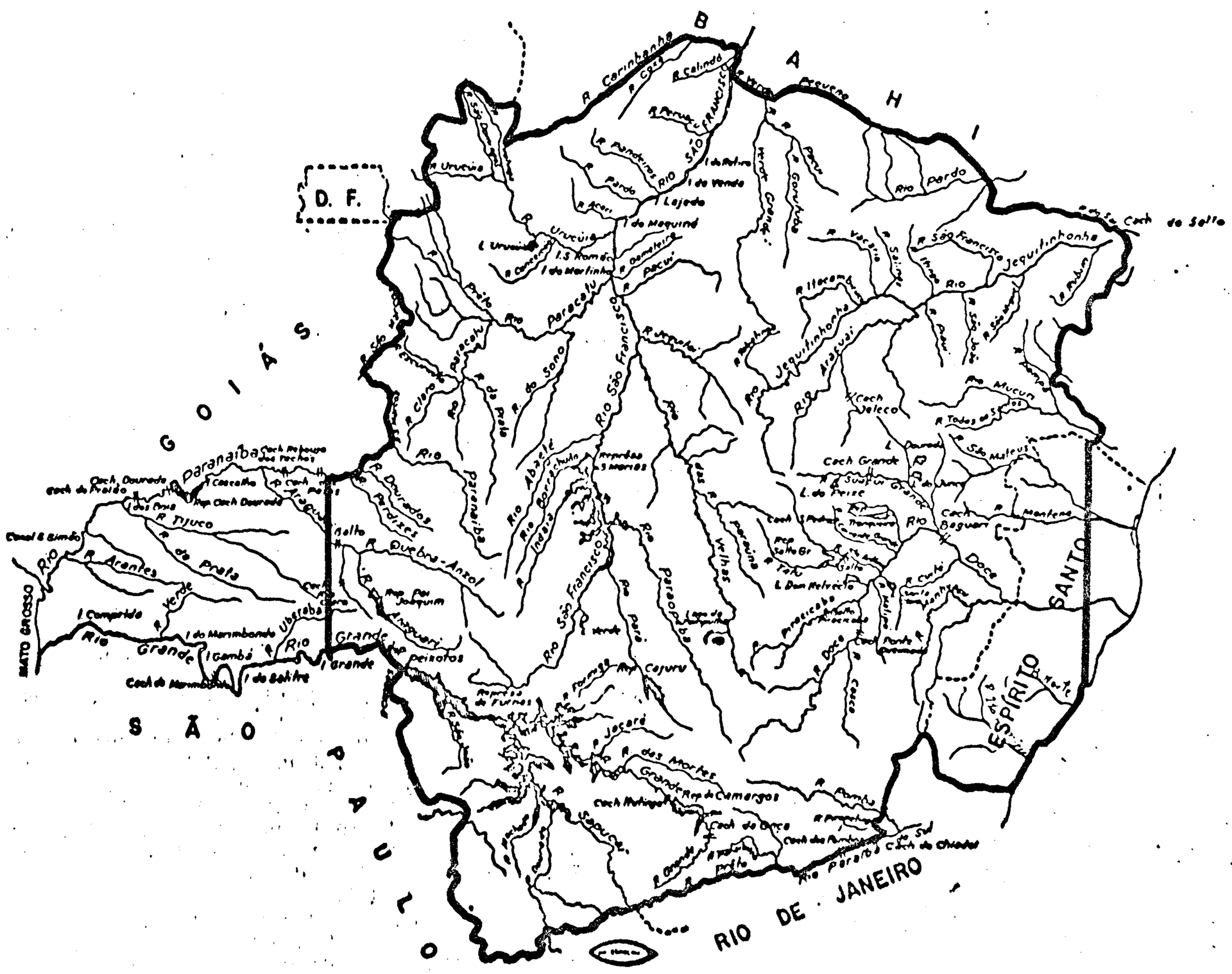
The map below shows us the main hydrographic basins, in the area that will be surveyed by "Convênio".



B - Buranhém
J - Jucuruçu
IT - Itanhém
P - Peruípe
SM- São Mateus
I - Itabapoana

HYDROGRAPHY

This map presents the whole hydrographic drainage of the region. Here we have high plateau rivers, with profiles divided into zones of rapids, currents and also water falls. These aspects are directly related to the morphology and the structures and also connected with the favorable climate condictions for occurence of perennial streams.



3.4 - CLIMATE

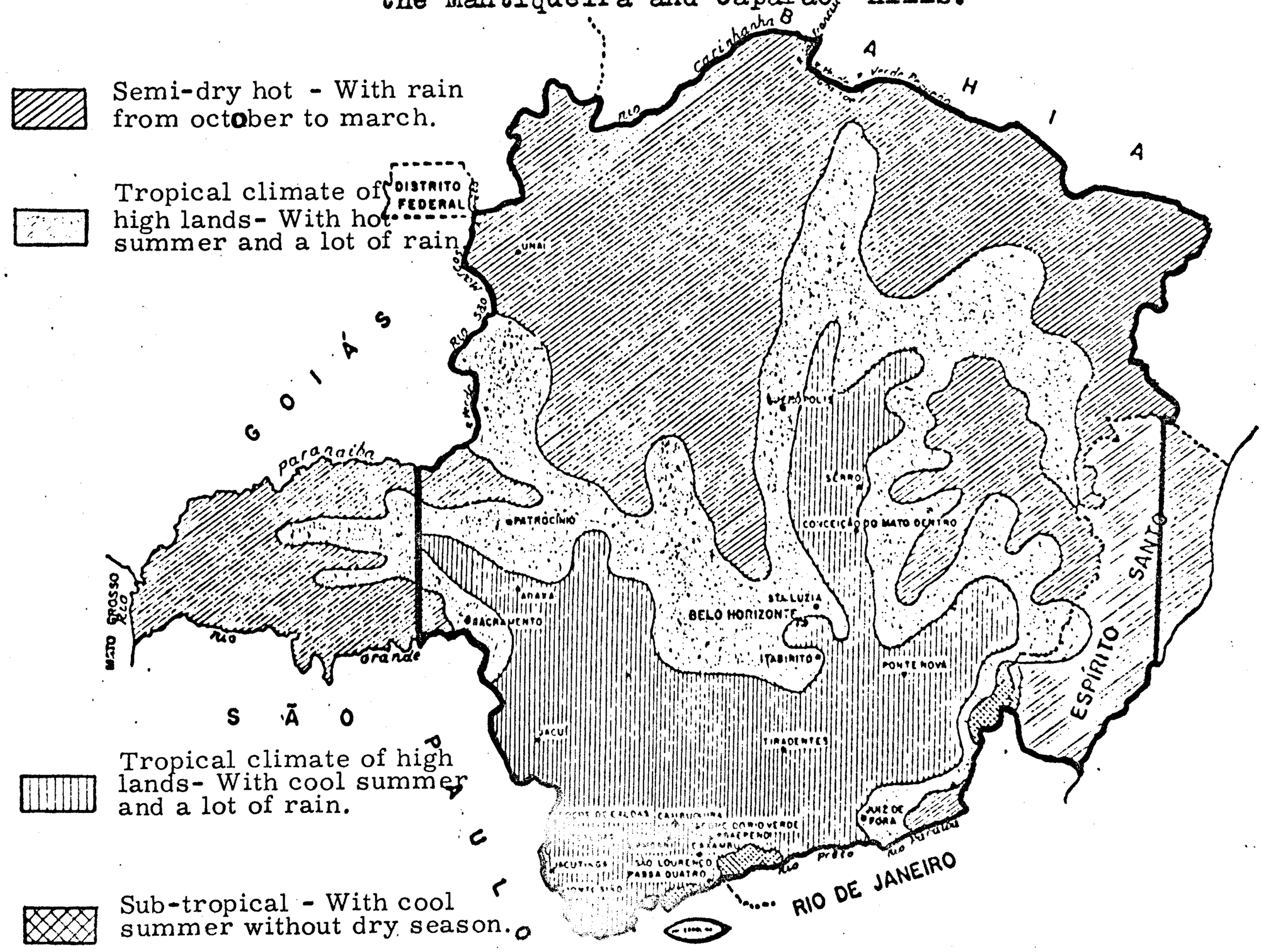
This area, under the influence of the relief, is characterized, chiefly, by a great variety of climate, which can be divided into 4 groups, as follows:

1) Tropical, hot and humide - With 2 definite seasons: rains from october to march and wild dryness in the central and northeastern, parts of the State;

2) Semi-dry hot - Characteristic of the frontier part between Minas Gerais and Bahia;

3) Tropical climate of high lands - Characterized by continuous changes, with hot summers and a lot of rain;

4) Sub-tropical - The summers are not so hot and the winters are agreable. It is a characterist of the south of Minas Gerais and of the highest points of the Mantiqueira and Caparaó hills.



3.5 - VEGETATION

The region is characterized by 4 fundamental kinds of vegetations:

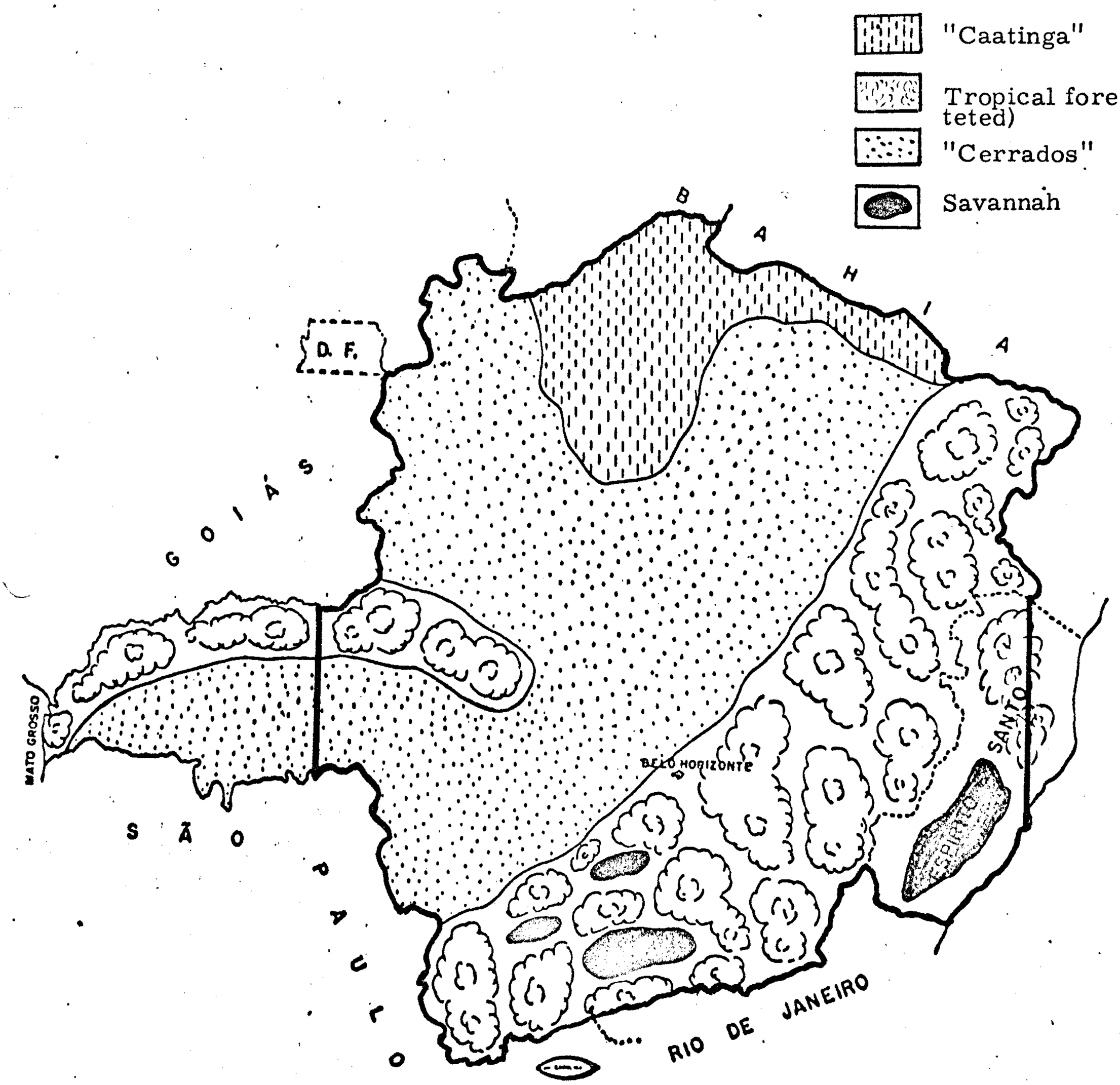
1) Tropical forest - It covers the east and the southside of the region, but today is almost completely devastated. The most common kinds are: the essences, the jacarandá, the cedar, the jequitibá, the pequiá, the pau-brasil, and other kinds of timber.

2) Cerrados - They cover the northern, northeastern central and southeastern parts of the State Minas Gerais. It is constituted by spaced small trees, with curved branches and a thick cover, that grow with the grass. Because of the relief of the land, we have some trees with a great dimension what gives an idea of forest, known as "cerradão".

3) Savannah - They cover a small area, at the south of the State of Minas Gerais, and the hills Espinhaço, Canastra and Mantiqueira. It is constituted by shrubs and herbage.

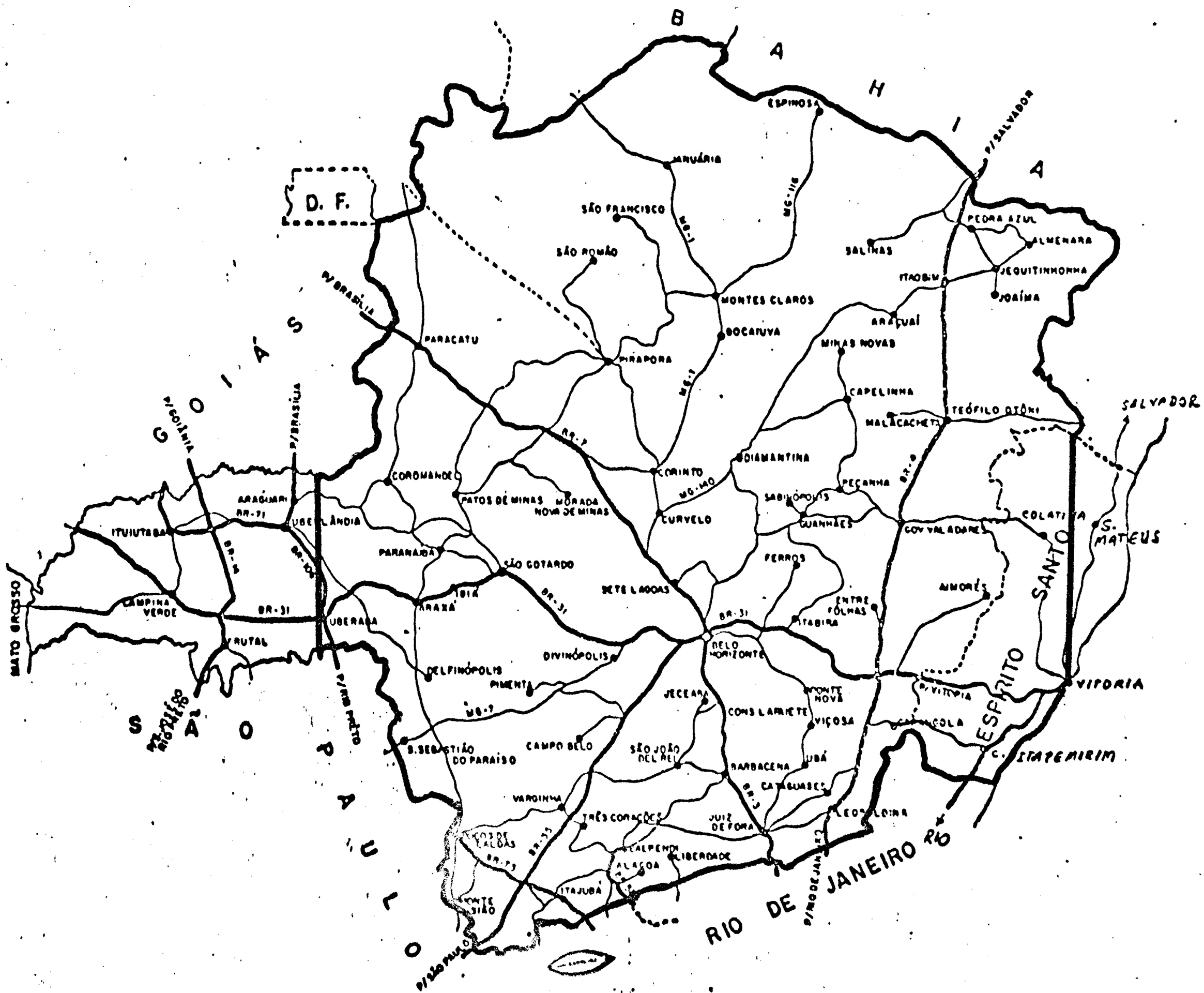
4) Caatinga - (semi-arid vegetation) - It covers the central and northern parts of the State of Minas Gerais. It is characterized by shrubs and wild cactus vegetation, which the most remarkable kinds are: "aroeira", "jurema", "catingueira", "faveleira", "umburana", "umbu","barriguda", "pau-ferro", "pereiro", "xique-xique" and "macambira".

VEGETATION


"Caatinga"
Tropical forest (devasteted)
"Cerrados"
Savannah
B A H I A
D. F.
GOIÁS
MATO GROSSO
SÃO PAULO
BELO HORIZONTE
ESPIRITO SANTO
RIO DE JANEIRO

3.6 - ROADS

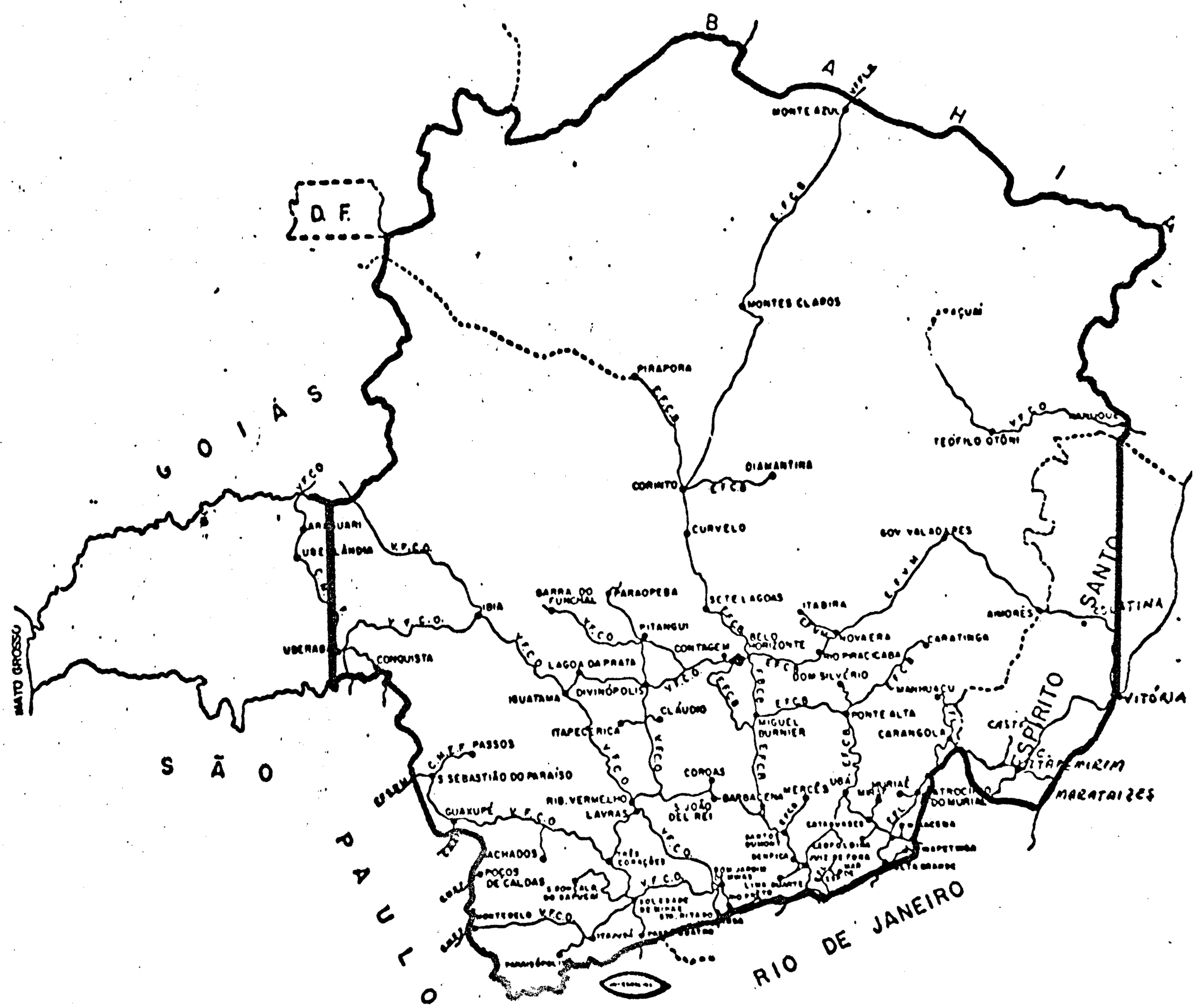
The map below shows us the main roads of this area. The reduced scale used prevents the representation of the municipal roads and other small not very important.



3.7 - RAILROADS

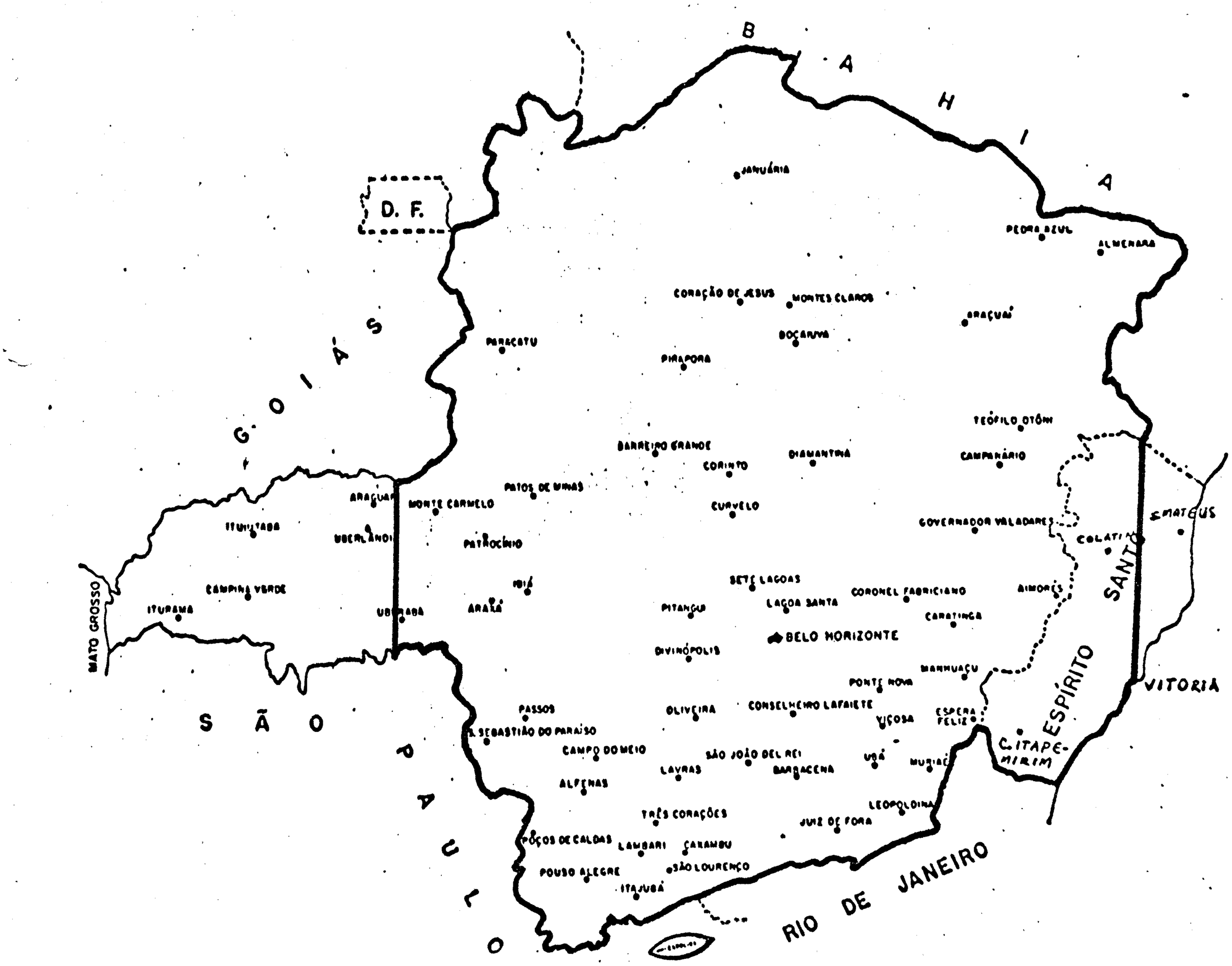
The map below shows the railways of this area. The signs mean:

E.F.V.M. - Estrada de Ferro Vitória a Minas;
E.F.C.B. - Estrada de Ferro Central do Brasil;
E.F.L. - Estrada de Ferro Leopoldina;
V.F.C.O. - Viação Férrea Centro-Oeste;
C.M.E.F. - Cia. Mogiana de Estrada de Ferro.



3.8 - AIRPORTS

The map below shows us the main cities with airports in the area that will be surveyed by the "Convênio Geofísica Brasil-Alemanha". To the planning period, we will have at disposal a map (scale 1:1,000,000) more complete, showing the characteristics of each airfield and the conditions of using of each one.



4 - SUMMARY OF MINAS GERAIS GEOLOGY

4 - SUMMARY OF MINAS GERAIS GEOLOGY

4.1 - Archeozoic Era

The archean in Brazil was designed by J.C.Branner as Brazilian complex; it is constituted by gneisses, shists, quartzite, dolomite, skarn, cata-itabirite, granites, diorites, gabros. Many basic rocks have been transformed into soapstones, serpentinites, etc. In some regions the archean formations have been cut by dike of volcanic rocks of Paleozoic and Mesozoic age. These formations constitute, practically, the whole substratum in Brazil.

LITHOLOGIC CHARACTERS - 1) The rocks are deeply metamorphosed; the most representative are the leucocratic gneisses; the mesocratic and melanocratic types are less frequent; 2) The granitization is very intense resulting in polingenetic granites of several features; 3) The archeozoic rocks are frequently cut by different types of igneous rocks.

TECTONIC - Features of orogeny are now difficult to be identified, because original structures have been masked or destructed by subsequent geological effects; the thick weathering intemperism which sometimes reaches more than 100 meters, perhaps constitute the main handicap to the field geologist. The reconstitution of the stages of the structural evolution of the Archeozoic Era becomes a problem, almost insoluble,for some areas where the erosion destructed all the characteristic formations of the epi-zone and even the moso-zone; the rocks that could offer aspects or structural characteristics are nomore founded and the lithologic groups, in the major part, are homogeneised into a general granitization.

CONTACT WITH THE SUBSEQUENT FORMATIONS - In many cases, it has been observed a direct and nitid contact between the archeozoic and proterozoic rocks, otherwise, the distinction is made by different grades of metamorphism and a better vision of the tectonic structures.

Besides gneisses, prototype of archean rocks with the same mineralogycal composition of granites, we have of this same age rocks such as: marbles, quartzites, gneiss orschist amphybolites and graphite schist which some times occurs interbeded in gneisses.

The archeozoic formations are frequently cut by many pegmatites and igneous rocks types. Many volcanic nucleus occur in granitic-gneiss areas as we can see in Poços de Caldas plateau and Passa Quatro municipality.

It is difficult to make clear the folding axis of archeozoic formations; meanwhile, we can say that the Brazilian archean formation is characterized by a mainly NNE direction and by a secondary one of NW, even in the gneissification direction joints and veins, as folding axis directions. These two rejuvenated directions appear since the Algonkian up to Jurassic. So, the joints of gondwanic sediments follow these directions such as the several dikes of retic diabase. That means the folding or deformation axis of beds superposed to archean formation have been affected by structural effects created by the pre-cambrian tectonic.

Lack of available data has been an obstacle to an approximated stratigraphy. We can say that the geologists just agree that the archean formation of ocean border is older than that of Serra da Mantiqueira.

4.2 - Proterozoic Era

Because of economical importance of Proterozoic formations, the States of Minas Gerais and Bahia have been deeply investigated by some generation of geologists since the beggining of XIX century up to now.

D.Guimarães divides the Proterozoic formations into three Series: Serie of Minas - discordantly superposed on archean formations, composed by quartzites, schists, iron formations, dolomites, phylites and volcanic rocks; all proterozoic area is gold-bearing. The chief area of Serie of Minas occurence is the Quadrilatero Ferrifero which offers

an special interest for its mineral resources. The geologists believe that the end of archeozoic period was marked by an marine transgression the "epicontinental" region of the Arqui-Brasil, with the subsequent sedimentation of sand and clay materials. The first sediments were followed by a subsidence of the plataform and basaltic intrusions. The volcanic rocks would have given origin to iron hydroxide and hydro-silicates which were after transformed into iron-bearing rocks by the regional metamorphism.

The first stage of Serie of Minas strata deformation, probably, would have happened about 1,065 millions years ago. The resulting relief coming up with this stage is still marked in our days by the "Serra do Espinhaço" aspects. It would be a ridge whose roots have actually the direction NE with a same direction axis of folding system. The second epeirogenic tectonic stage occasioned vertical displacement with repeate faulting before the marine transgression which created favorable conditions to neritic sedimentation of Serie Itacolomi. The volcanic rocks of this evente are found between both Series. The Serie of Minas, in places where erosion discovered catazone metamorphites, has three ages pegmatites: 1,065, 700/800 and 470/480 millions of years.

Serie Itacolomi - It is a neritic sedimentary series which lays discordantly on the Serie of Minas. F. Lacourt divides this Series into three horizons: inferior, conglomeratic, middle, characterized by phylites, and superior, constituted by quartzitic sandstons and quartzite.

Serie of Lavras - Before finishing the Penoquean diastrofism, the central-north region of Minas Gerais was already getting into the antartic polar circle while the last geotectonic phenomena were just completed the Espinhaço ridge rejuvenation of the Proterozoic, when the glaciation had been set in the altitudes. The Serie of Lavras was formed during this period and was composed by diamond conglomerates, tillites, quartzites and phylites. The Serie of Lavras is sub-divided into Sopa Formation, important by

the presence of diamonds in its tillites and Macaubas Formation.

4.3 - Paleozoic Era -

The paleozoic formations of Minas Gerais State, are composed by limestone, clay, siltites, conglomerates, arckose and slates. Serie Bambuí is the main paleozoic formation which occurs in Minas Gerais. The geologists believe that an intercratonic marine basin of slow subsidence, a mediterranean sea, was the ambiental sedimentation of these formations. From this era, there is a large belt of sediments that occurs in São Paulo, which becomes thin and abruptly ends near the boundary of the two states in the municipality of Monte Santo de Minas . The Serie Bambui is being carefully studied by some geologists.

4.4 - Mesozoic Era -

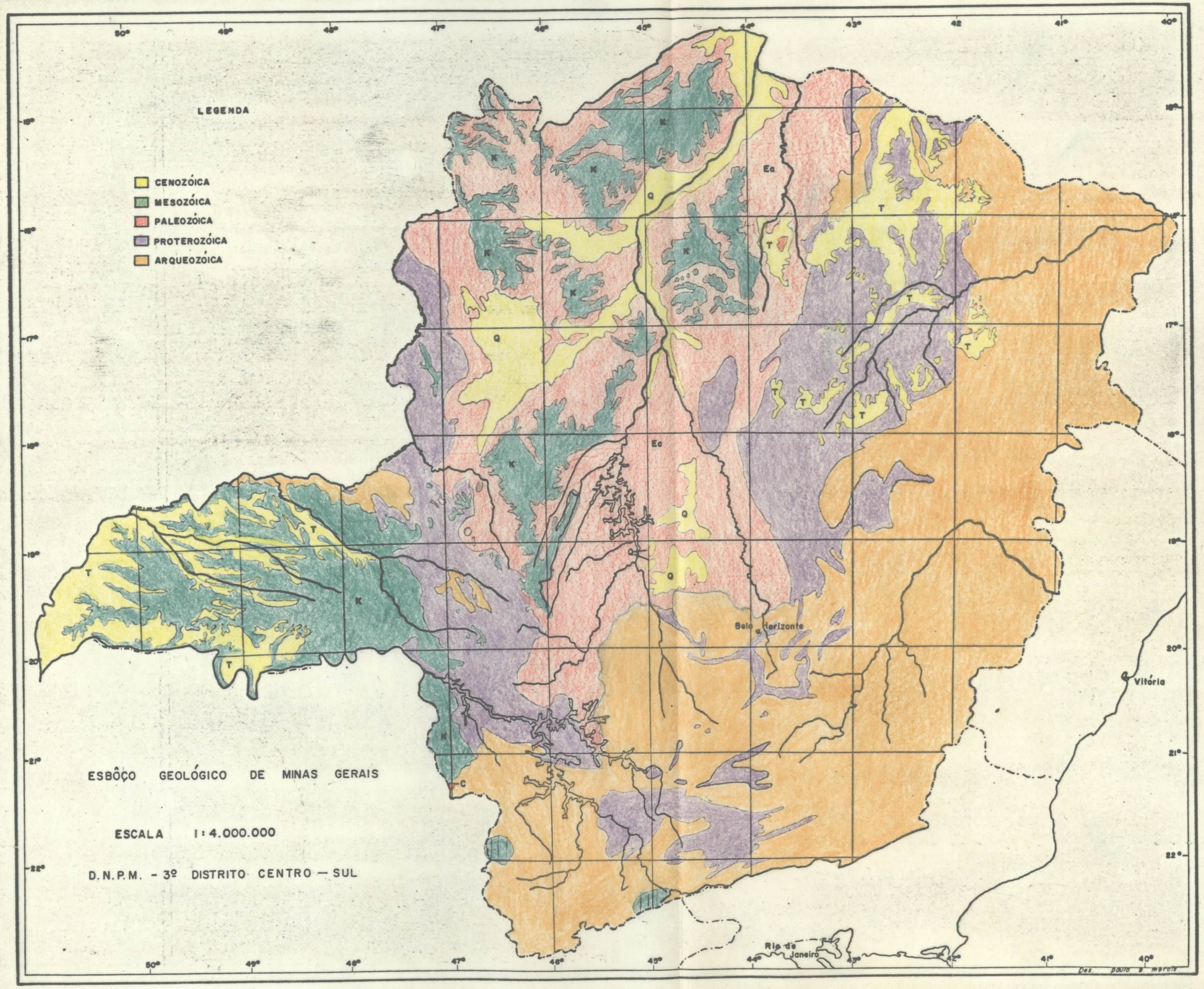
The mesozoic era was characterized by a world-wide diastrophism. During the Triassic, the desintegration of Gondwana took place and was followed up by basaltic magma flow in Brazil, Africa and India which widespread large parts of these continents. In Brazil, volcanism took place spasmodicaly throughout the Jurassic and Cretaceous with different characteristics.

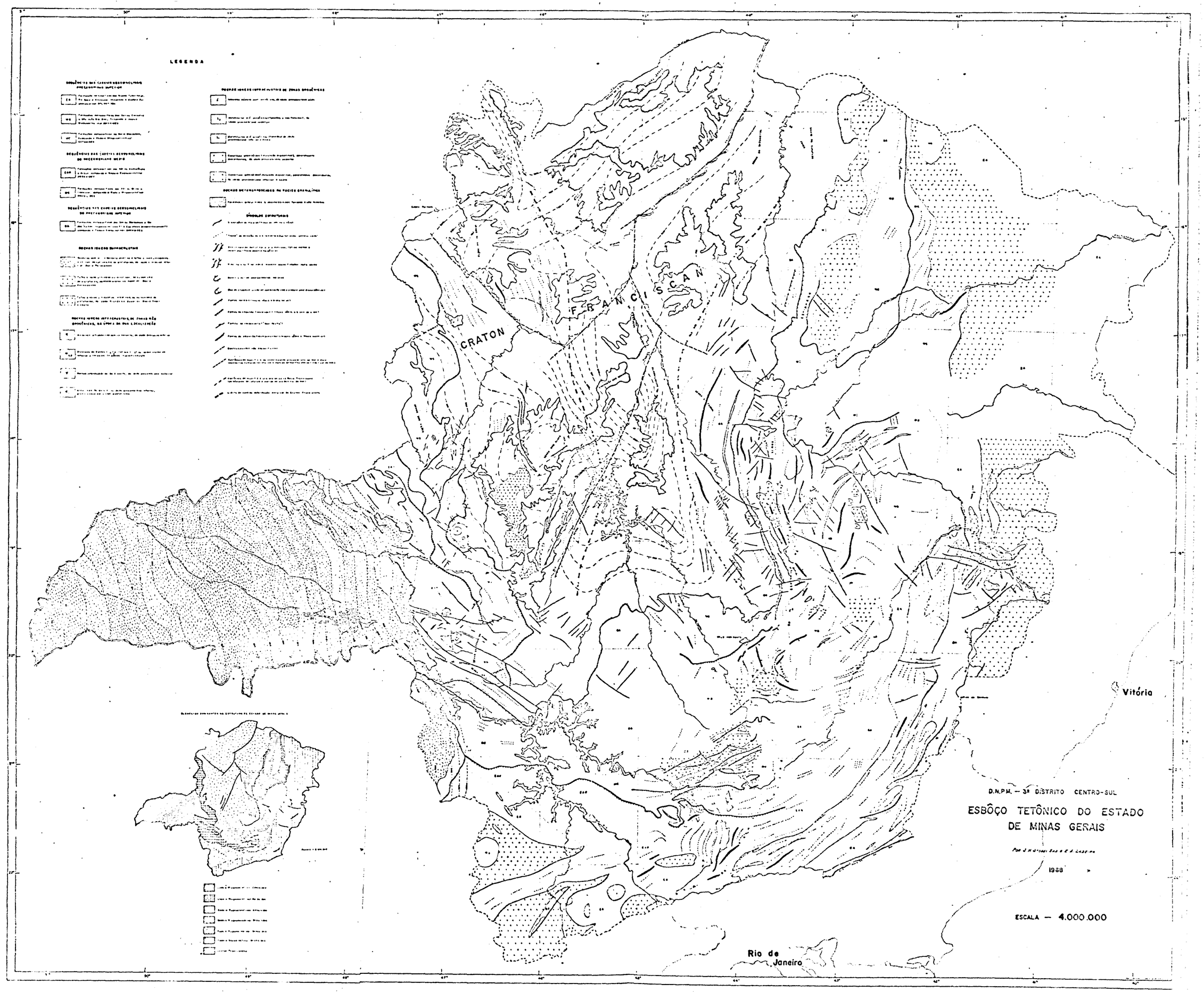
The displacement of new lands toward Equator, caused great climate modifications. Mesozoic formations in Minas Gerais are standed by Cretaceous. During lower Cretaceous the basaltic flows took place and at the same time sediments of eolic and fluvial ambient were being formed which resulted in the Botucatu Formation; thisFormation occurs in the west part of the State. During the upper Cretaceous the Bauru Group was formed with a continental lacustral origin and constituted by sandstones, limestones, conglomerates, siltites and claystones.

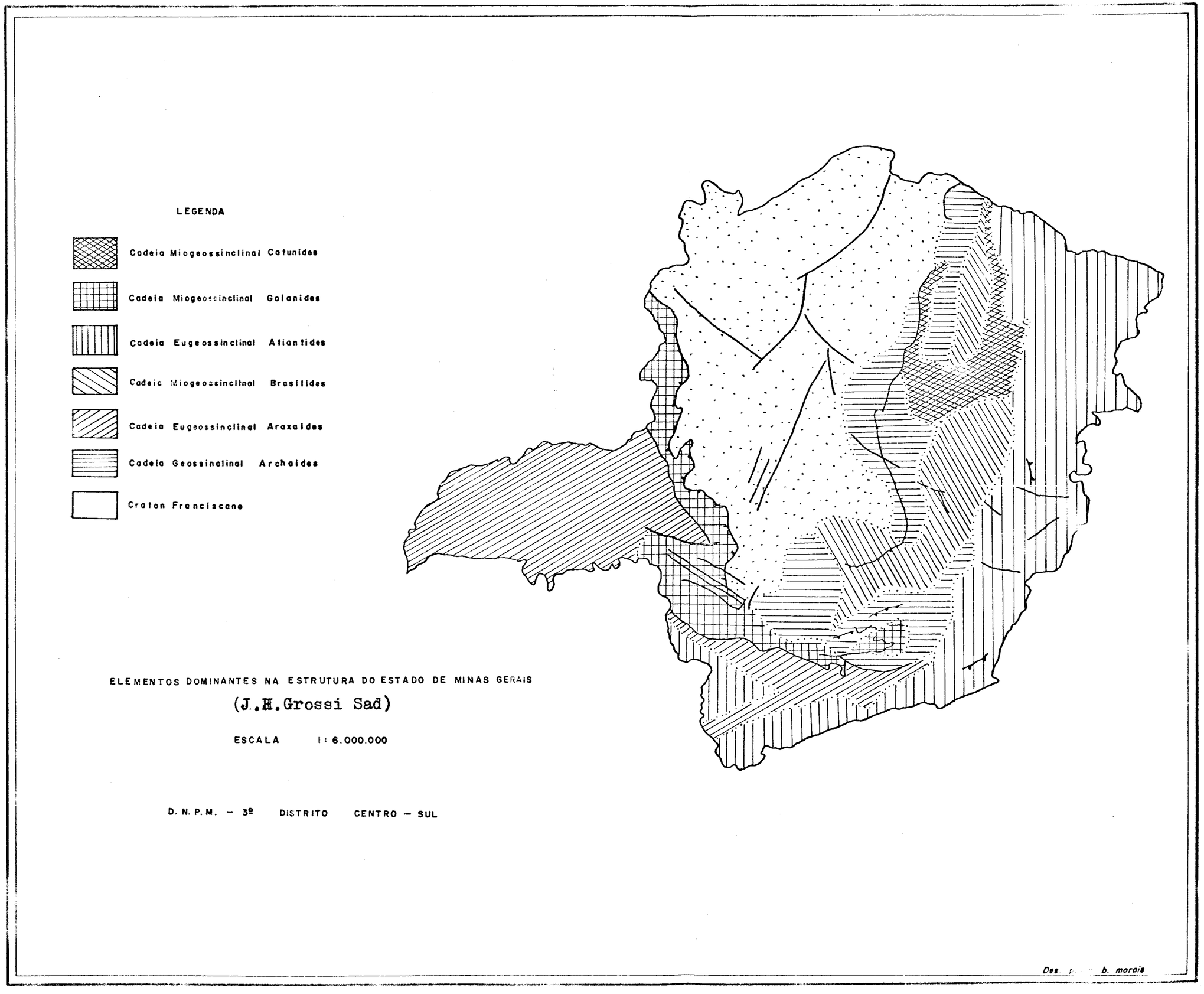
While the Group Bauru was being formed and the volcanic pipe activity was being processed, it took place the formation of pyroclastic sediments, which constitute the formations Areado and Mata da Corda.

4.5 - Cenozoic Era -

The plateaux placed in north of Minas Gerais are supposed to have been formed during the Tertiary. These formations are predominantly composed by sand and clay materials. Quaternary is standed by a large number of aluvional deposits in the beds of Minas Gerais rivers.


LEGENDA
CENOZÓICA
MESOZÓICA
PALEOZÓICA
PROTEROZÓICA
ARQUEOZÓICA
ESBÔÇO GEOLÓGICO DE MINAS GERAIS
ESCALA 1:4.000.000
D.N.P.M. - 3º DISTRITO CENTRO — SUL
Belo Horizonte
Vitória
Rio de Janeiro


LEGENDA
CRATON
FRANCISCAN
Vitória
Rio de Janeiro
D.N.P.M. — 3º DISTRITO CENTRO-SUL
ESBÔÇO TETÔNICO DO ESTADO DE MINAS GERAIS
1968
ESCALA — 4.000.000


LEGENDA
Cadeia Miogeossinclinal Catunides
Cadeia Miogeossinclinal Goianides
Cadeia Eugeossinclinal Atlantides
Cadeia Miogeossinclinal Brasilides
Cadeia Eugeossinclinal Araxaides
Cadeia Geossinclinal Archaides
Craton Franciscano
ELEMENTOS DOMINANTES NA ESTRUTURA DO ESTADO DE MINAS GERAIS
(J.H.Grossi Sad)
ESCALA 1: 6.000.000
D. N. P. M. – 3º DISTRITO CENTRO – SUL
Des : b. morais

5 - VIEW OF MINAS GERAIS MINERAL RESOURCES

5 - VIEW OF MINAS GERAIS MINERAL RESOURCES

Most important mineral layers of Minas Gerais State are concentrated in the Pre-Cambrian lands where Quadrilatero Ferrifero is settled down and by long of Espinhaço's Ridge as well. Other mineral resources are also found at West and South sites of Minas Gerais.

Ancient extraction of such resources has permitted that it could be created an important metalurgical park, one of the basis of its nowadays development.

Quadrilatero Ferrifero ocupies an extensive area in Minas Gerais where big bearings of iron ore, manganese, bauxite, dolomite and gold are found.

This great exuberance of mineral richness gave a particular behaviour to the region where the predominant activities are concerned with mineral business.

Iron ore - This is the most abundant ore in central zone of Minas Gerais. Almost all the totality of iron ore exploration in the Quadrilatero Ferrifero is based upon high degree hematite extraction; besides hematite, soft itabirite comes up easily concentrated by gravity. The exploration of iron ores in this region dates from the beginning of 19th Century. However, only at the comming of 1930 has Quadrilatero Ferrifero come to fill an important role in the iron economy. Nowadays, the exportation of iron ores extracted from this region is one of the main sources of Brasilian divice. The principal iron ore layers in Minas Gerais are situated in the following townships: Belo Horizonte, Itabirito, Congonhas do Campo, Brumadinho, Santa Barbara, Itabira, Rio Piracicaba, Barão de Cocais, etc.

Manganese - Manganese ore layers exploration in Minas Gerais dates from the 19th Century. Till today the cumulative production of all manganese ore mines situated inside the Quadrilatero Ferrifero is the biggest from south hemisphere,

thanks to the Morro da Mina's bearing exploration in Conselheiro Lafaiete. Outstanding manganese ore layers in Minas Gerais are situated at the townships of Conselheiro Lafaiete, Ouro Preto, Mariana, Rio Acima, Brumadinho, Mateus Leme, Nova Lima, Caeté, Santa Barbara, Dom Silverio, São Domingos do Prata, Santana do Pirapama, São João del-Rei, etc.

Gold - The gold exploration still holds an important place in the State's mining works. The Morro Velho mine in Nova Lima explores gold veins for more than one century. Another underground gold mine, in Passagem de Mariana, is being worked without a regular continuity. Gold is drug out from placers in rivers such as Rio das Velhas and Rio Jequitinhonha, while other small gold bearing placers throughout the country are also explored.

Silver - Silver, in the proportion of some hundreds of kilograms, is got as a subproduct in some gold mines. There are some outlooks of silver production from zinc ores in Vazante, Januaria and Itacambira townships.

Quartz - Besides Goias and Bahia, Minas Gerais is the most important State regarding quartz production. All its production comes from the works of quite small mines placed in the central part of the State, which extend from Pitangui throughout Diamantina and Montes Claros up to the northeast of Minas Gerais.

Cassiterite - Cassiterite is explored mainly in São João del-Rei and surrounding countries, such as São Tiago, Nazareno and Rezende Costa. Araçuaí and Itinga are other townships where cassiterite deposits occur. The deposits are either primary-pegmatites which besides quartz, feldspar and mica, contain spodumene, lipidolite, cassiterite, tourmaline, tantalite and columbite - or secondary in origin.

Mica - Mica comes from pegmatites exploration and Santa Maria do Suaçuí township is the principal productor; there are some important explorations in Espera Feliz, Bicas, Governador Valadares, São Sebastião do Maranhão, Coroaci, Conselheiro Pena and many others townships.

Beryl - Industrial beryl is extracted from the majority of the eastern mica bearing pegmatites. The main township where beryl production occurs are Santa Maria do Suaçui, Salinas, Galileia, Conselheiro Pena, etc.

Columbite - Columbite is mainly produced in Nazareno township, from cassiterite bearing pegmatites, althought some production comes from mica and gemstones bearing pegmatites situated in the east and northeast side of Minas Gerais.

Aluminium (bauxite) - Bauxite is explored in Ouro Preto, Belo Horizonte and Poços de Caldas townships.

Zirconium - Both baddleyte and caldasite are explored as zirconium ore in Poços de Caldas township.

Graphite - Graphite is extracted from gneiss rocks in Itapecerica. There is also graphite production in São Domingos do Prata.

Talc - The main talc mines in activity are situated in Carandaí, Ouro Branco and Ouro Preto townships.

Rutile - Rutile is produced in small amounts in São João del-Rei, Baependi and Bom Jardim de Minas townships.

Vermiculite - There are intermittent vermiculite productions in Rio Pomba township.

Phosphates - Minas Gerais has a great deal of phosphate deposits under the form of apatite in Araxá and Tapira, however, there is only one exploration in Araxá township.

Niobium - The pyrochlore exploration is taken on a small scale for the exploration of concentrate or ferro alloy.

Barite - Barite is produced in Araxá; it occurs in alkaline magma deposits related to those which originated the apatite mineralization.

Bentonite - Bentonite shales are explored in Sacramento, Uberaba and São Gonçalo do Abaeté.

Nickel - Garnierite is explored in the townships of Liberdade and Pratápolis, where the ore is used in performing iron-nickel alloys.

Asbestos - Asbestos, of the amphibole family, is mined out in Rio Pomba and Jacui. In Nova Lima there is a deposit of chrysotile.

Chromite - Because of its refractory character, chromite is used to make refractory bricks; it is also used to make iron-chromium alloys. The ore comes from deposits placed in Pium-í and Serro.

Limestone - There are extensive deposits in Pratápolis, Barroso, Pedro Leopoldo, Carandai, Uberaba, Arcos, etc., which are exploited in large scale for cement production.

Dolomite - Dolomite explorations are chiefly placed in Ouro Preto and Belo Horizonte.

Marble - Marble is explored in deposits placed in Sete Lagoas, Ouro Preto, Mar de Espanha, etc.

Kaolin - Kaolin is extracted from decomposed pegmatites situated in Bicas, Juiz de Fora, Leopoldina, Chiador, Lima Duarte, Espera Feliz, Carangola, Ubá, etc.

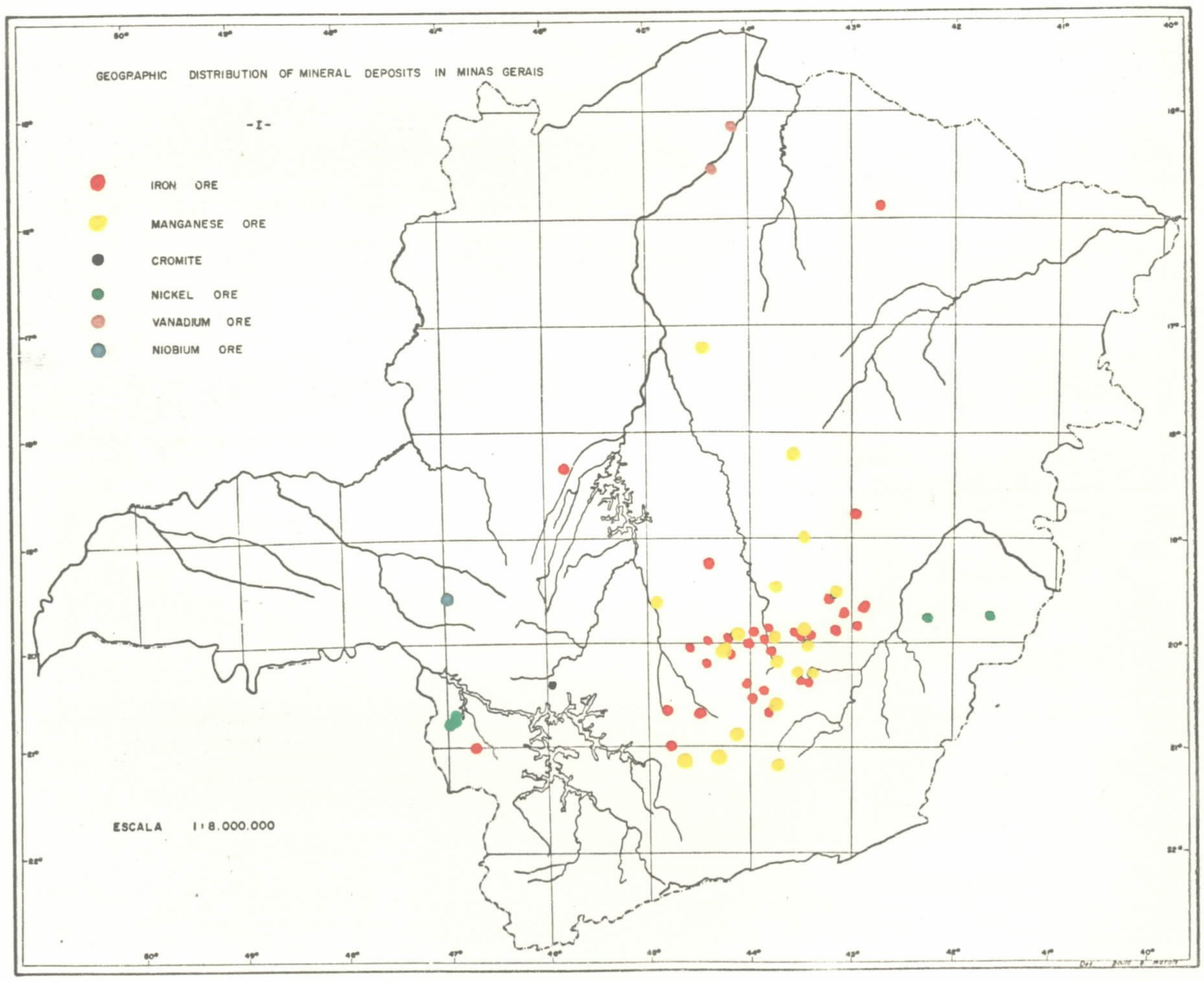
Feldspar - Feldspar is got as a subproduct of mica and gemstones bearing pegmatites.

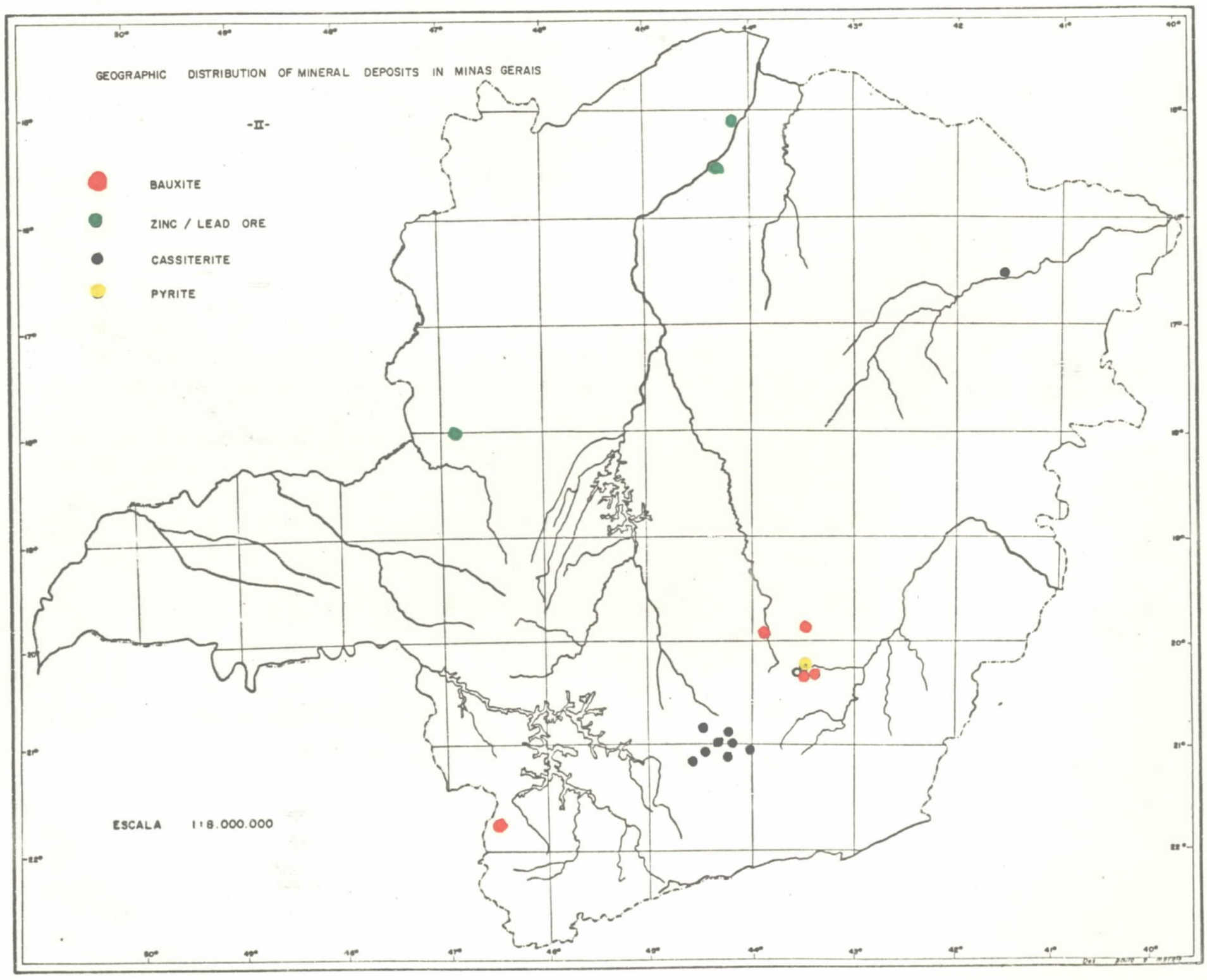
Diamond - Diamond bearing placers are explored in Diamantina, Serro and Grão Mogol areas, and Araguari, Monte Carmelo, Coromandel, Estrela do Sul, Patos de Minas, etc.

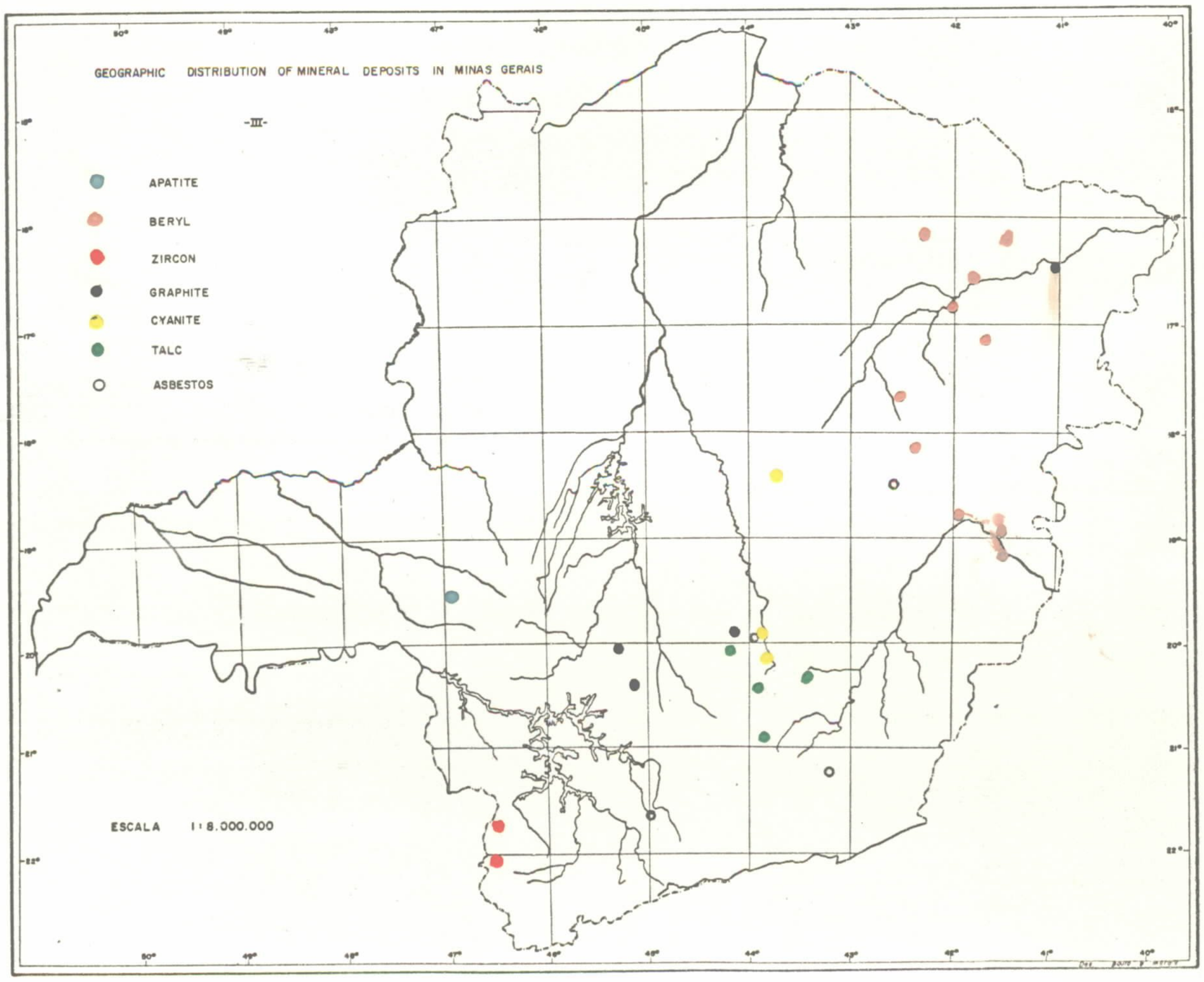
Gemstones - Gemstones are extracted either from pegmatites in the eastern and northeastern sides of Minas Gerais and also from eluvial deposits derived from such pegmatites. The main gemstone producting townships are Salinas, Teofilo Otoni, Governador Valadares, Conselheiro Pena, Araçuai, Medina, Pedra Azul, etc. Chief gemstonesof this area are aquamarine, tourmalines, emeralds, kunzits, topaz, etc. Ouro Preto's topaz is fomous for its colour and has been explored since the colonial age.

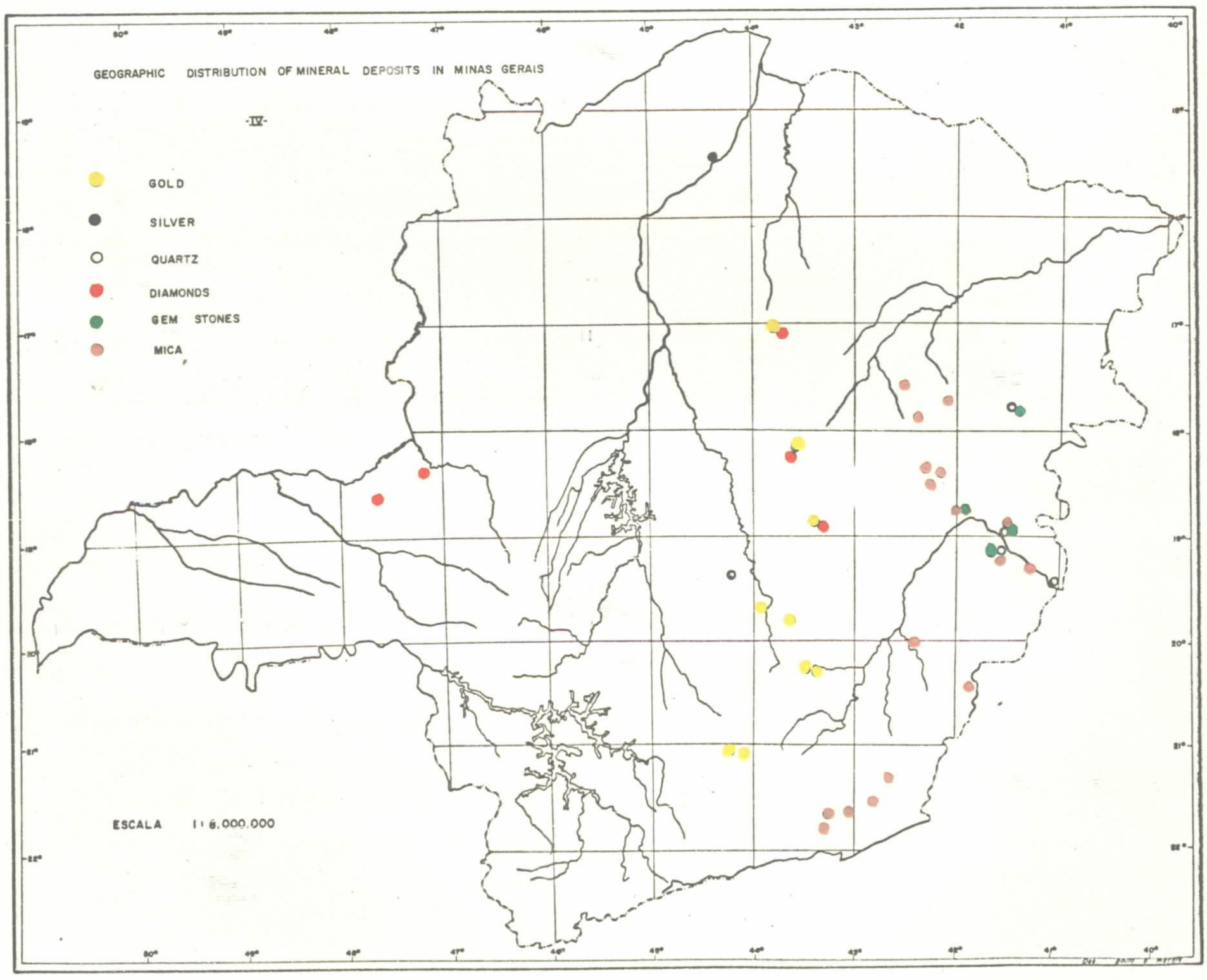
Pyrite - Pyrite has been explored in Ouro Preto's phylites. It is used by sulfuric acid plants in Piquete, São Paulo.

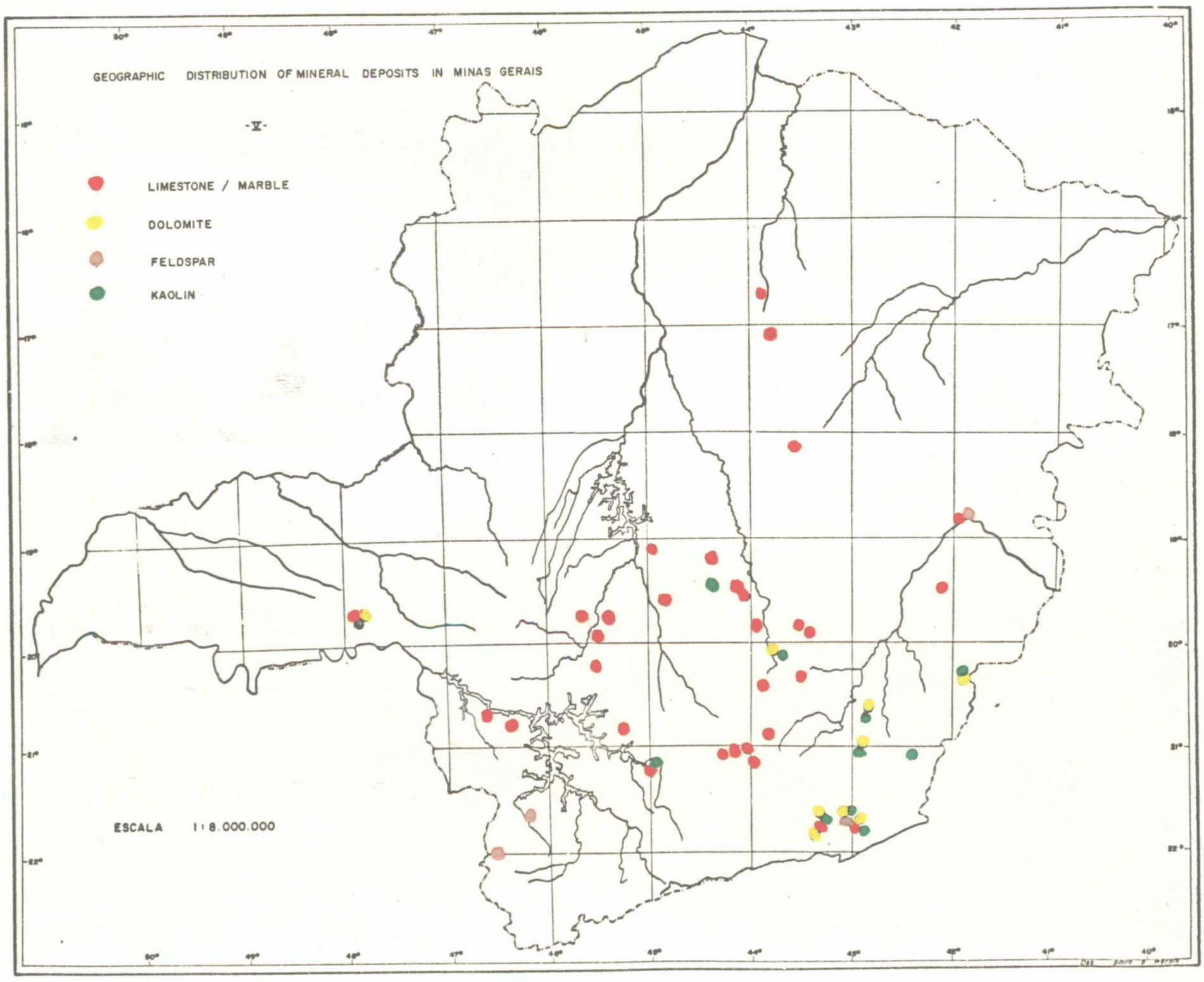
Cyanite - Cyanite has been explored in small amount in Nova Lima, Barão do Guaicui and Jequitinhonha river.


GEOGRAPHIC DISTRIBUTION OF MINERAL DEPOSITS IN MINAS GERAIS
-I-
IRON ORE
MANGANESE ORE
CROMITE
NICKEL ORE
VANADIUM ORE
NIOBIUM ORE
ESCALA 1:8.000.000


GEOGRAPHIC DISTRIBUTION OF MINERAL DEPOSITS IN MINAS GERAIS
-II-
BAUXITE
ZINC / LEAD ORE
CASSITERITE
PYRITE
ESCALA 1:8.000.000


GEOGRAPHIC DISTRIBUTION OF MINERAL DEPOSITS IN MINAS GERAIS
-III-
APATITE
BERYL
ZIRCON
GRAPHITE
CYANITE
TALC
ASBESTOS
ESCALA 1:8.000.000


GEOGRAPHIC DISTRIBUTION OF MINERAL DEPOSITS IN MINAS GERAIS
-IV-
GOLD
SILVER
QUARTZ
DIAMONDS
GEM STONES
MICA
ESCALA 1:6.000.000


GEOGRAPHIC DISTRIBUTION OF MINERAL DEPOSITS IN MINAS GERAIS
-V-
LIMESTONE / MARBLE
DOLOMITE
FELDSPAR
KAOLIN
ESCALA 1:8.000.000

6 - ADDITIONAL INFORMATIONS

6.1 - DATA COMPUTATION

There are in Belo Horizonte the following electronic computers in activity:

1) In the IBM - A IBM/360, mod. 40, 64 K;
2) In the ETRA- A IBM/360, mod. 30, 64 K;
3) In the ENGEPEL - A IBM/1130;
4) In the ENGEDATA - A IBM/1130;
5) In the ELETRODADOS - A IBM/360, mod. 30, 32 K;
6) In the Escola de Engenharia da UFMG - A IBM/1130;
7) In the CEMIG - A IBM/360, mod. 25, 32 K;
8) In the Banco de Crédito Real - A IBM/360, mod. 25,32K;

The first 6 enterprises mentioned above have a specialized department, in order to attend data computation works by order.

6.2 - DATA OF MAGNETIC STATIONS

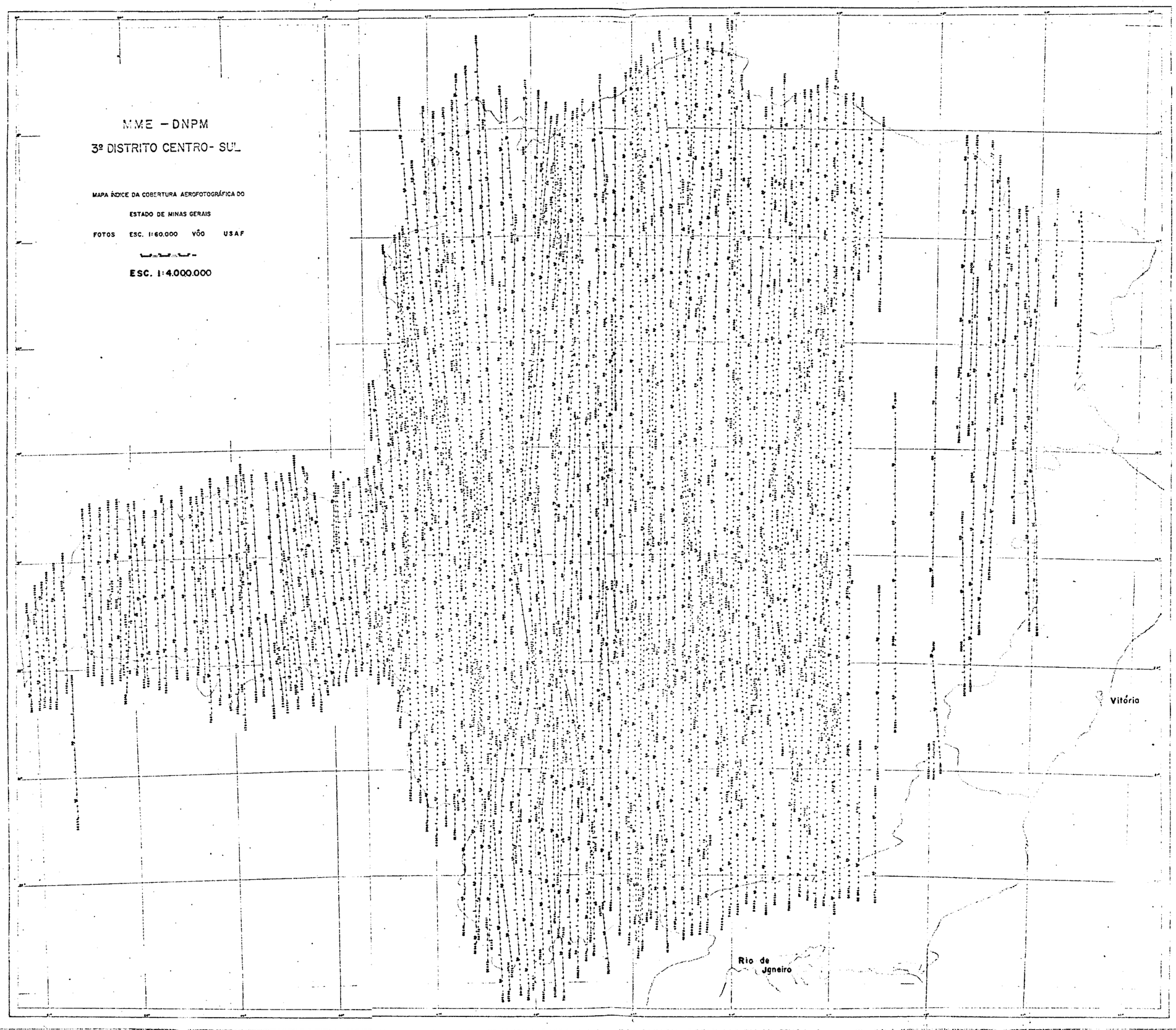
We added the following maps showing the magnetic field of Brazil and its secular change for the epoch 1965: 1) Map of lines of equal inclination; 2) Map of curves of equal variation of the inclination; 3) Map of lines of equal horizontal component; 4) Map of curves of equal annual variation of the horizontal component.

These maps were done by the "Observatório Nacional", a department of the "Ministério da Educação e Cultura". The curves that they represent are taken from the data at 85 magnetic stations located in several parts of the whole country. In the area of the "Convênio Geofísica Brasil-Alemanha" there are 22 of these stations.

6.3 - CARTOGRAPHY AND AEROPHOTOGRAPHY

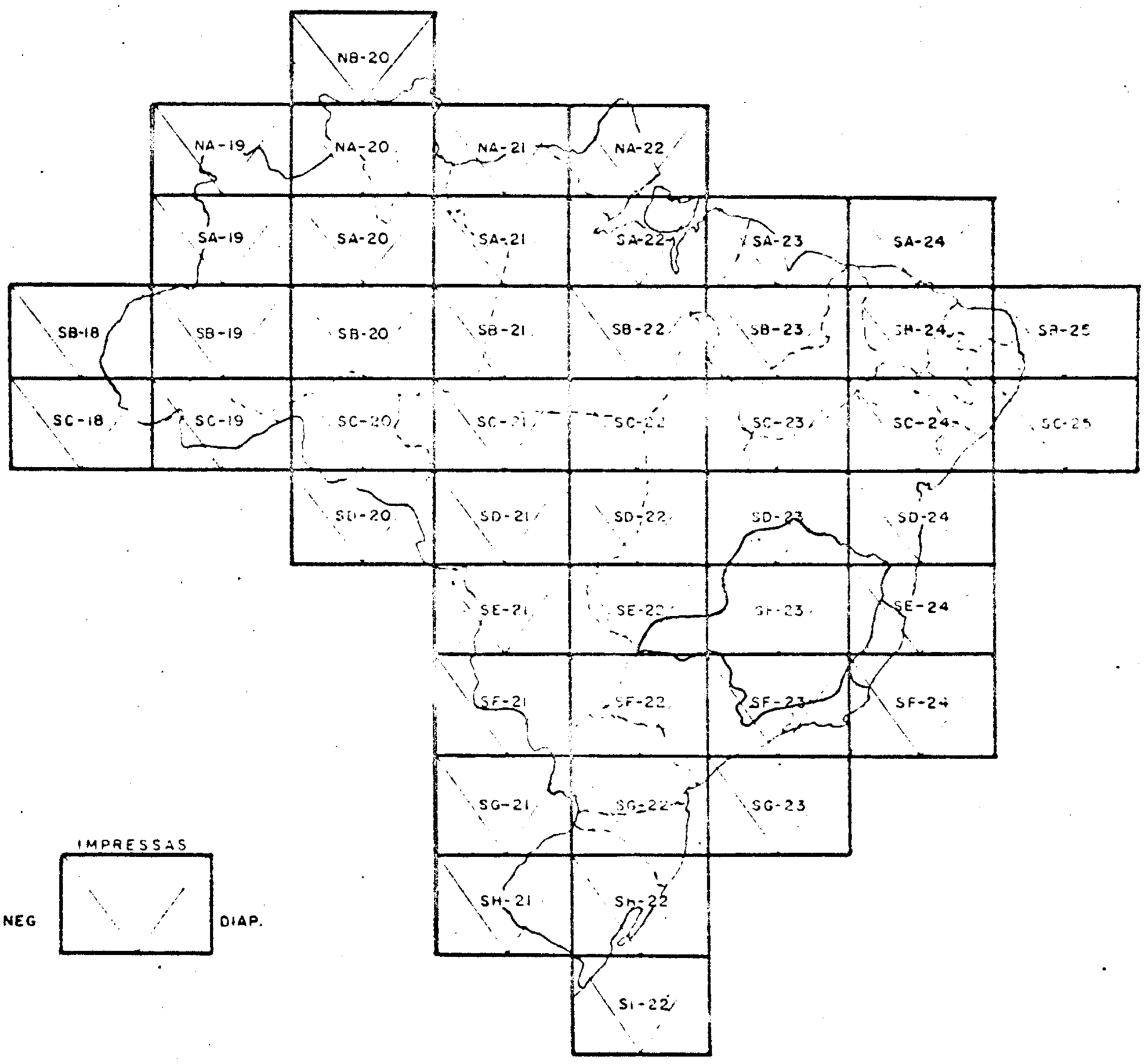
In addition, are presented the index-maps of the cartography of the area that will be surveyed, in the respective scales.

We add also an index-map of the aero-photogrametric covering of the State of Minas Gerais (scale 1:60,000), the single survey sistematically elaborated in the area. Other photogrametric surveys, in many scales, have been done in some parts of this area, whose index-maps will be showed during the development of the work.


MME - DNPM
3º DISTRITO CENTRO- SUL
MAPA ÍNDICE DA COBERTURA AEROFOTOGRÁFICA DO
ESTADO DE MINAS GERAIS
FOTOS ESC. 1:60.000 VÔO USAF
ESC. 1:4.000.000
Vitória
Rio de Janeiro

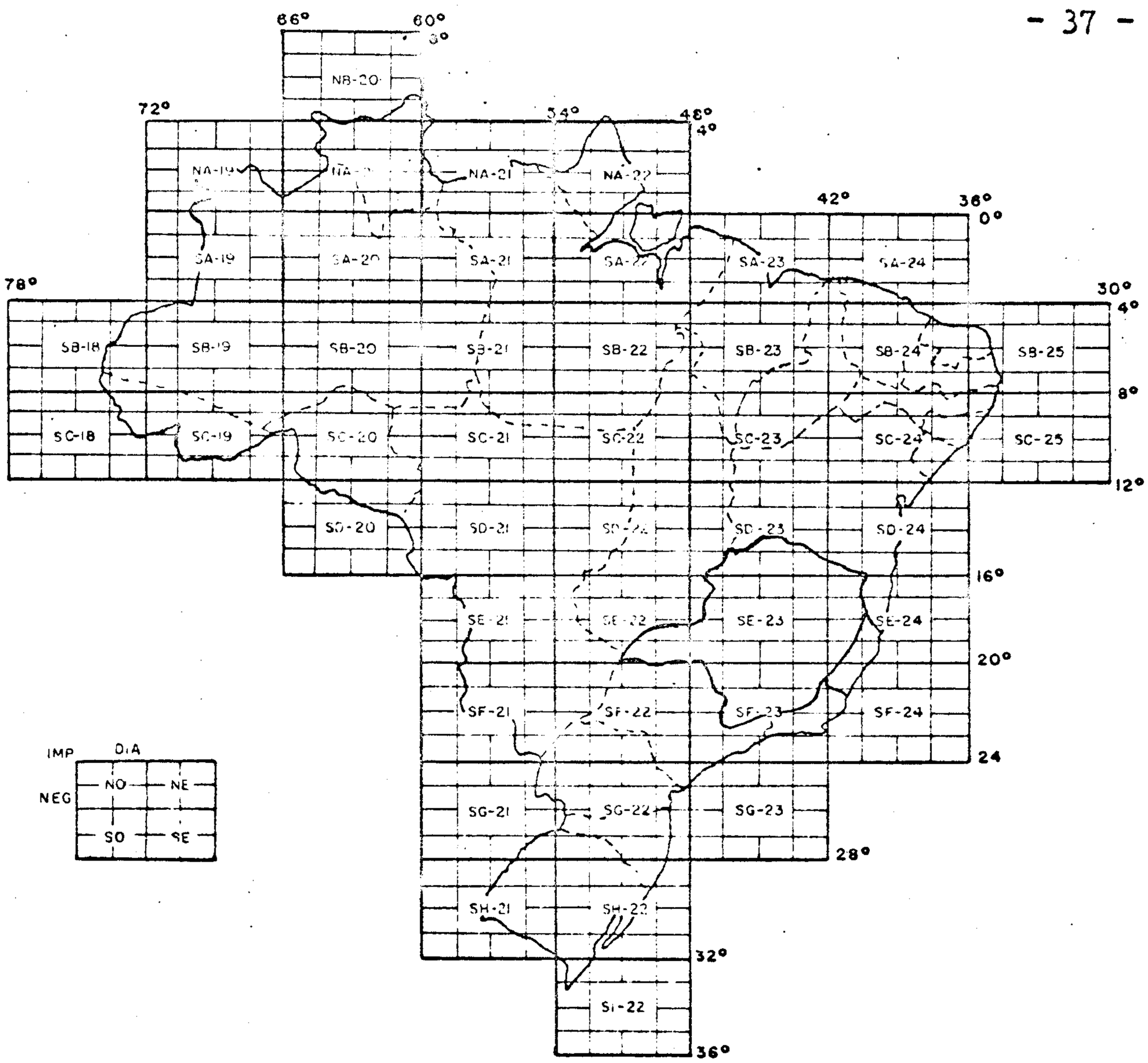
FÔLHAS 6° x 4°	
ESCALA 1:1000 000	IBGE — IBG

CARTOGRAPHY IN THE SCALE 1:1,000,000



FÔLHAS 3° x 2°	
ESCALA 1:500 000	IBGE – IBG

CARTOGRAPHY IN THE SCALE 1: 500,000



SÃO LUIZ – NO- 50
NE- 50
SO- 50
SE- 52

FORTALEZA- SO- 50,67
SE- 51,67

TERESINA- NO- 50,
NE- 47,
SO- 46
SE- 46,64

JAGUARIBE- NO- 51
NE- 46
SO- 47
SE- 51

PARAÍBA- NO- 51
SO- 50,65

R. S. FRANCISCO- NO- 51,65
NE- 51
SO- 54
SE- 51

ARAGARJU- NO- 52,65
NE- 55,65
SO- 55,65
SE- 54

RECIFE – NO- 55,67

BRASILIA – NO- 51, 65
NE- 55,66
SO- 52,
SE- 54,65

BAHIA – NO- 57
NE- 56
SO- 59

B. HORIZONTE- NO- 52
NE- 54
SO- 52
SE- 55

RIO DOCE- NO- 61
SO- 61

GOIÂNIA – NO- 55,65
NE- 57,66
SO- 50,65
SE- 52,66

PARANAPANEMA- NO- 48,66
NE- 50,
SO- 49,66
SE- 50

RIO DE JANEIRO- NO- 51
NE- 58
SO- 59
SE- 58

VITÓRIA – NO- 59
SO- 50,64

ASSUNCION- NE- 47,65
SE- 47,64

CURITIBA- NO- 48,67
NE-
SO- 47,67
SE- 67

IGUAPE- NO- 49,64

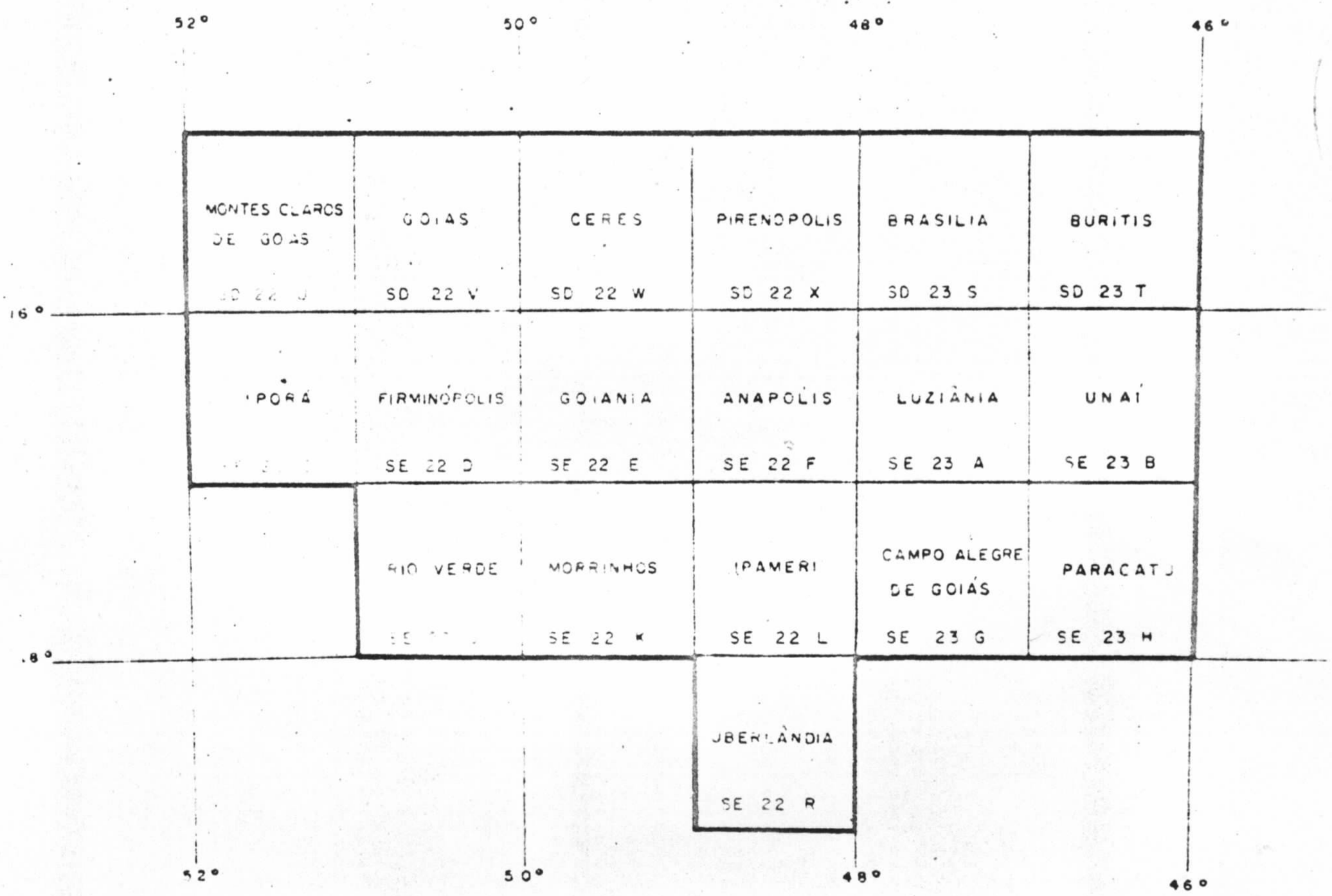
URUGUAIANA- NO- 47,64
NE- 46,65
SO- 46,65
SE- 47,66

P. ALEGRE- NO- 50,67
NE- 50,66
SO- 46,66
SE- 47,64

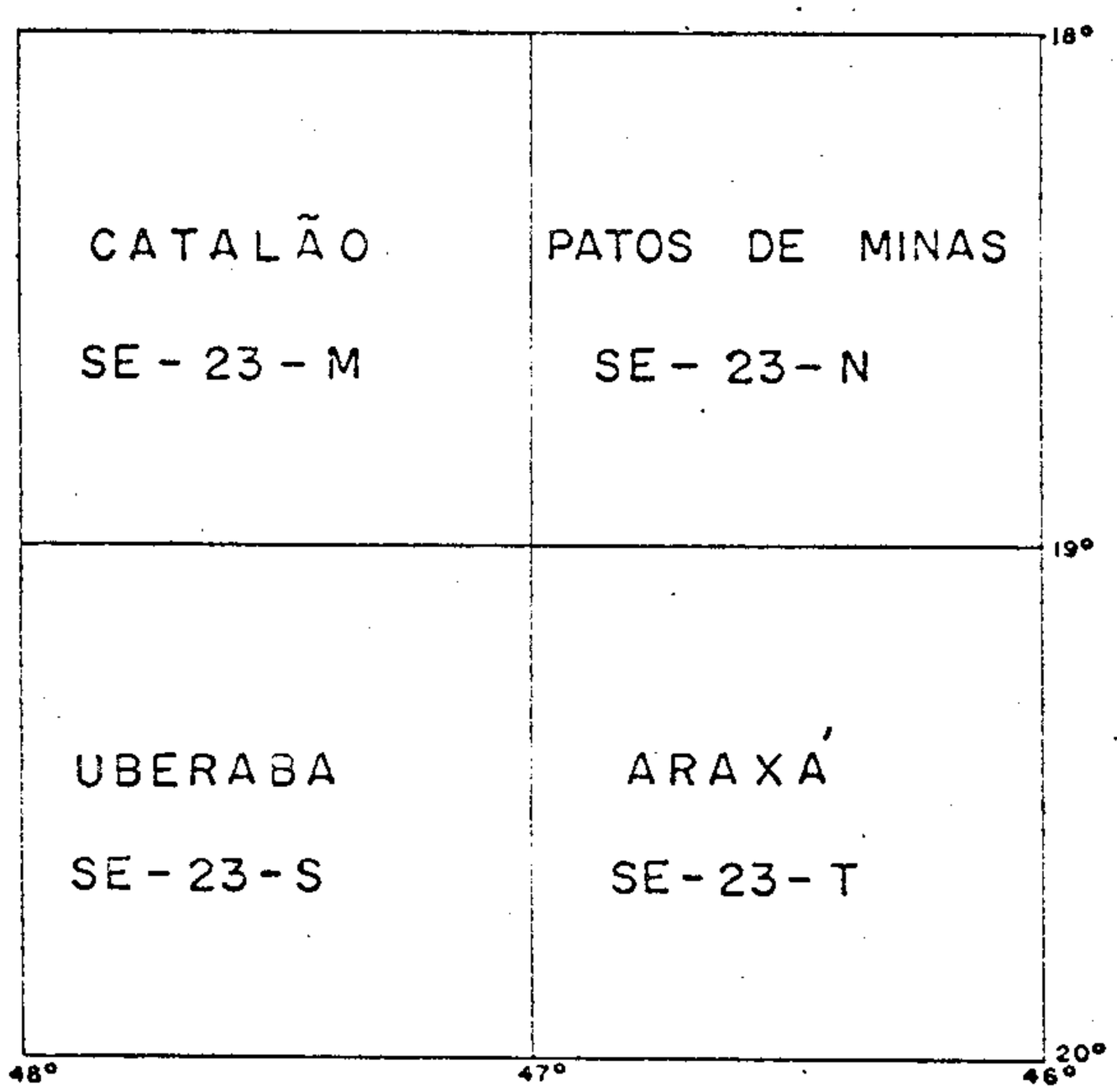
L. MIRIM – NO- 45,64

Seção de Cart. Rotta Geo...
/67

CARTOGRAPHY IN THE SCALE 1 : 250,000



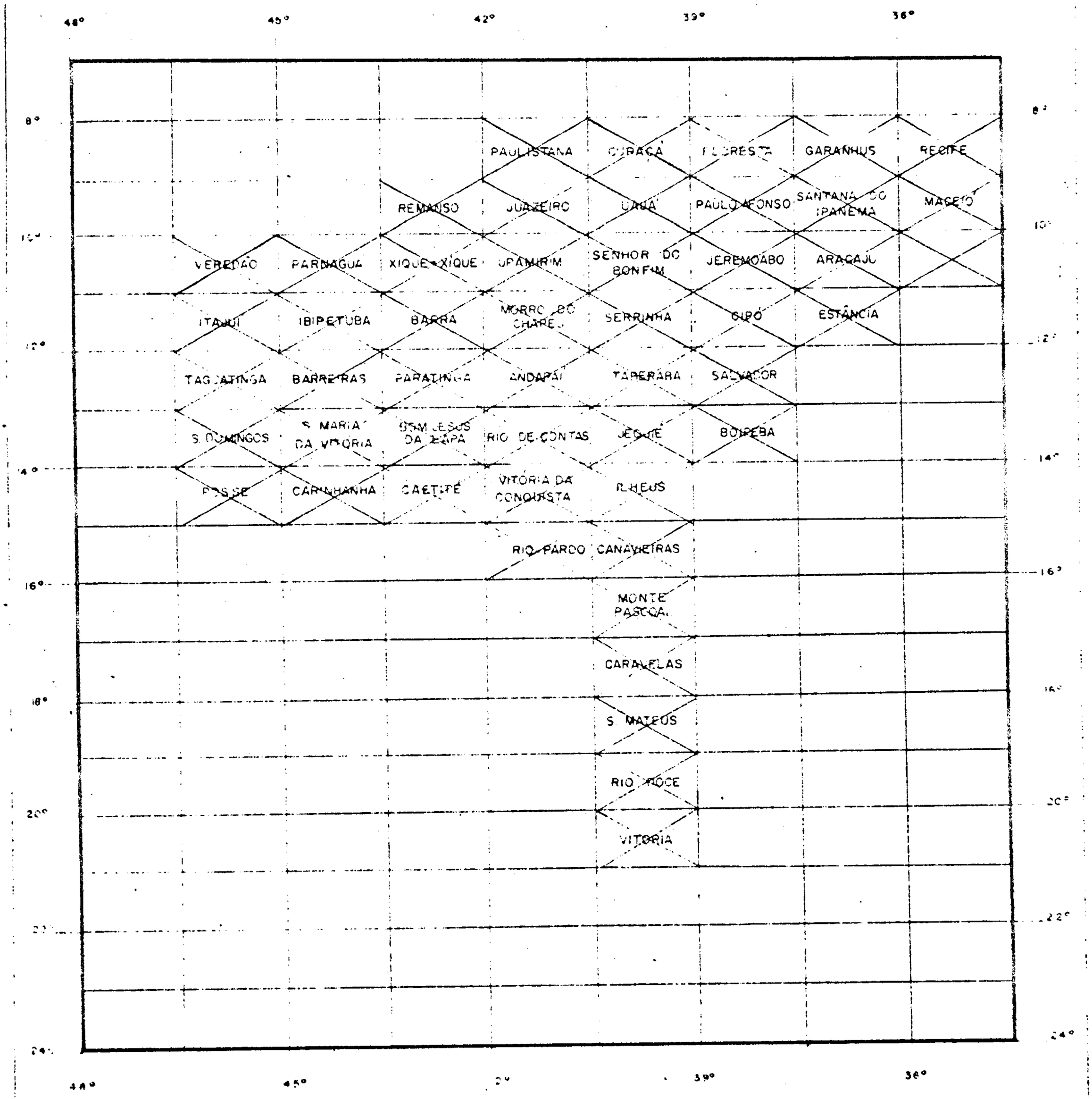
CARTOGRAPHY IN THE SCALE 1 : 250,000

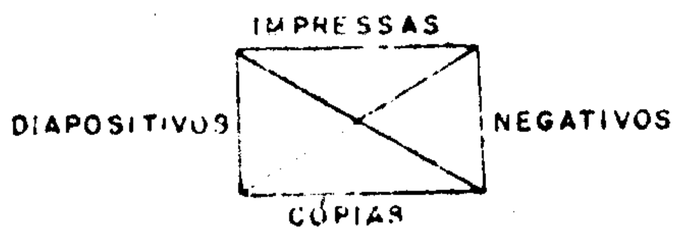


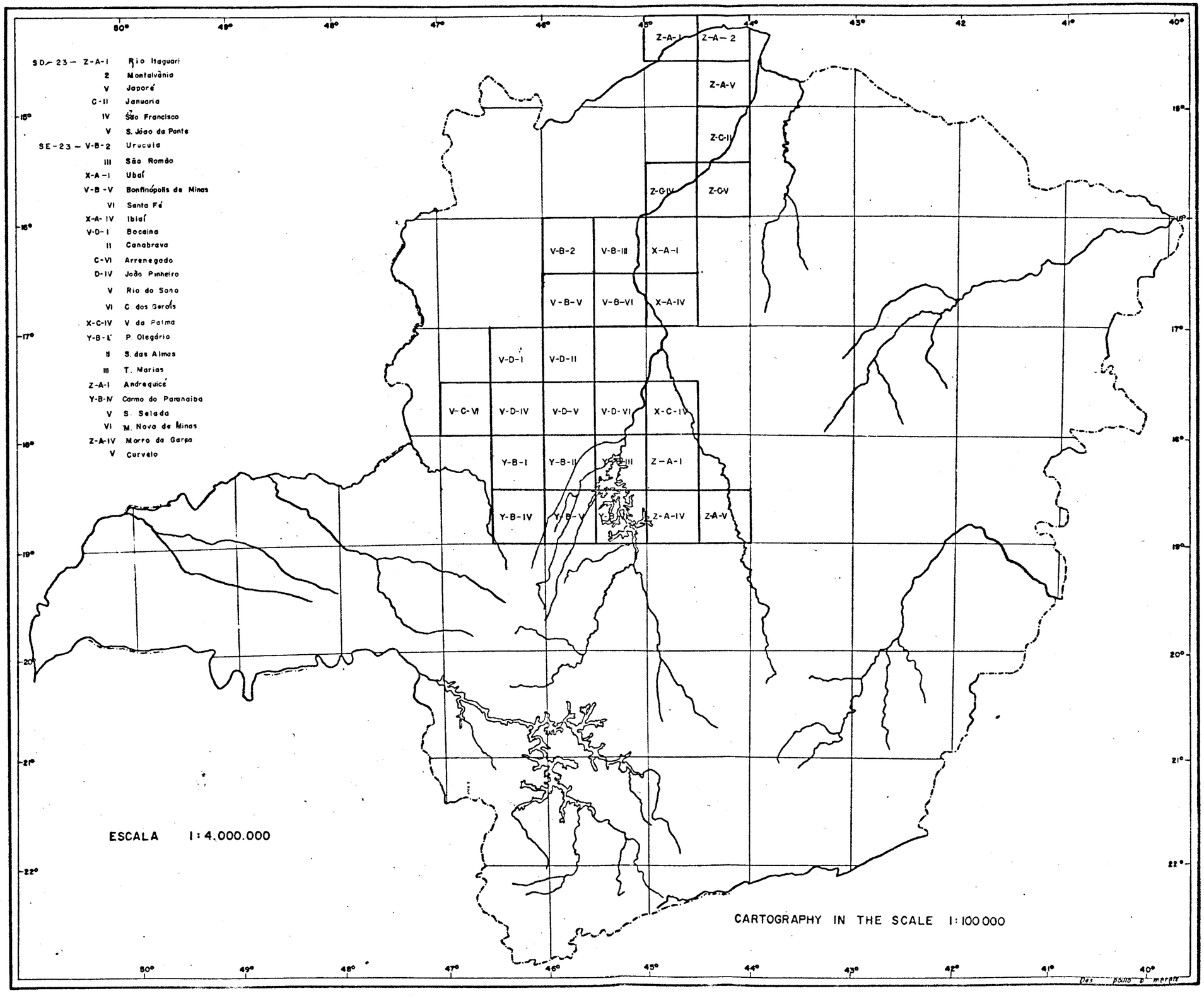
IBG	1:250 000

CARTOGRAPHY IN THE SCALE 1:250,000

SC-23 SC-24 SC-25
SD-23 SD-24
SE-24
SF-24

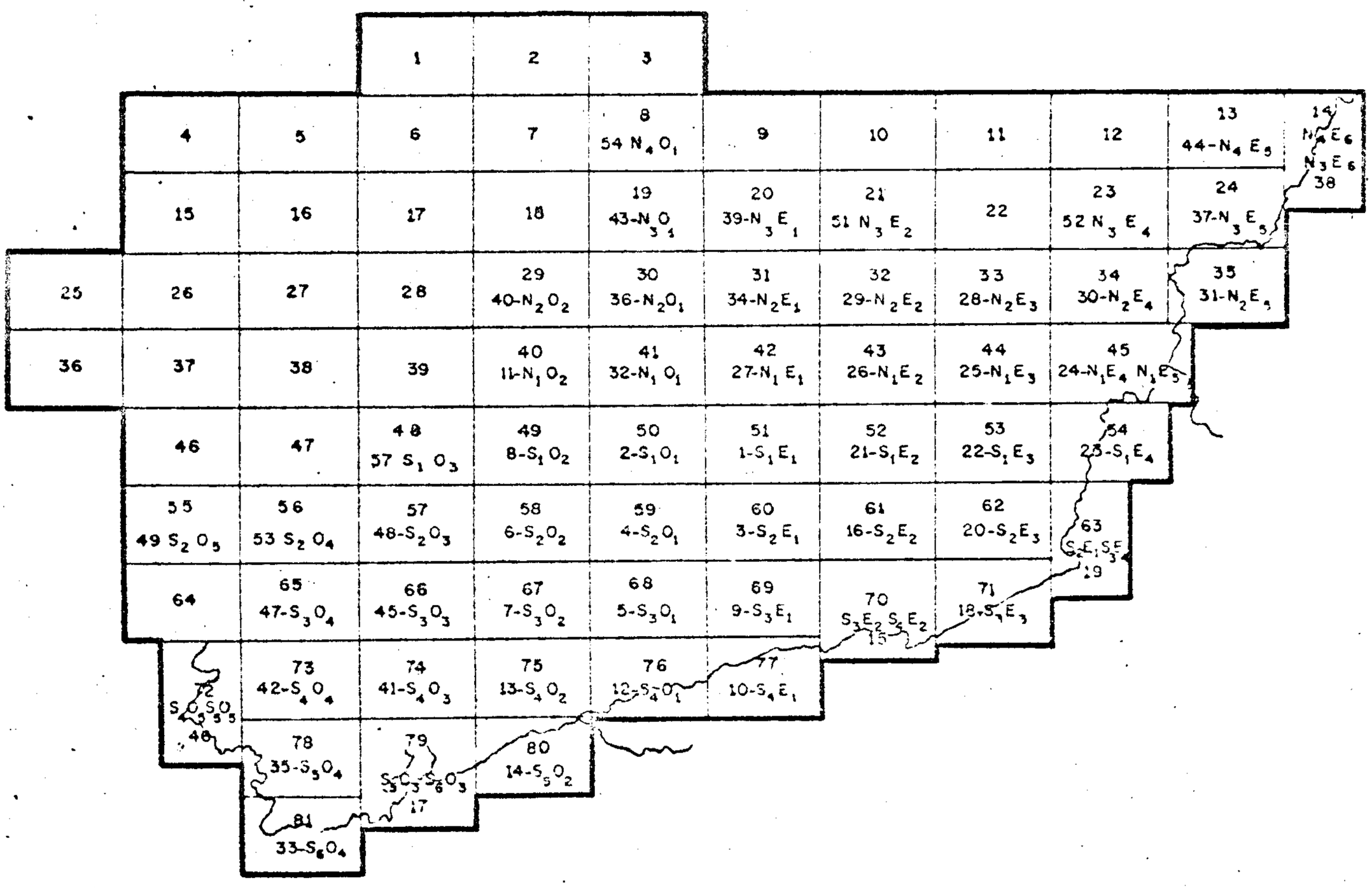




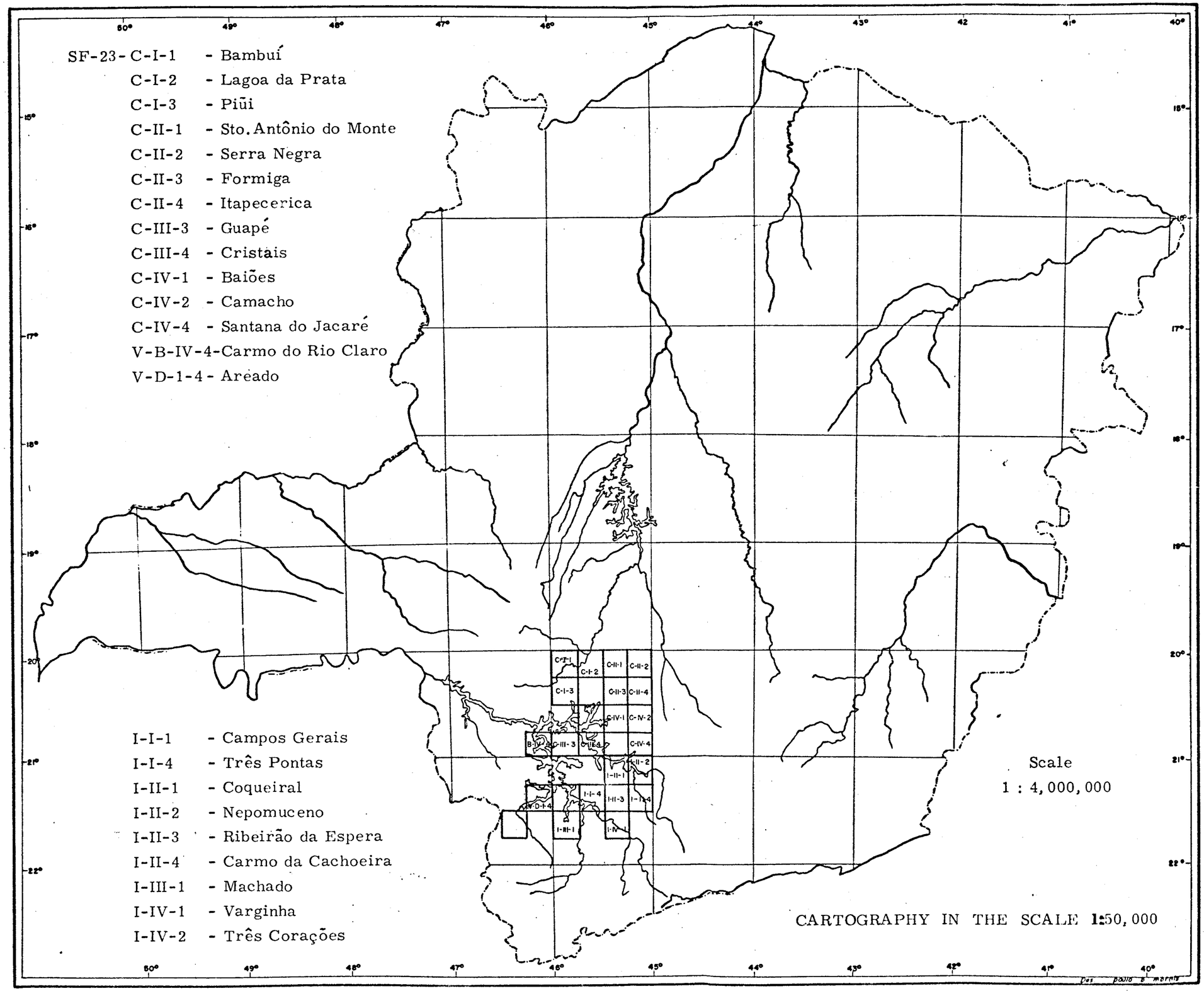

SD-23 - Z-A-I Rio Itaguari
2 Montalvânia
V Japoré
C-II Januaria
IV São Francisco
V S. João da Ponte
SE-23 - V-B-2 Urucuia
III São Romão
X-A-I Ubaí
V-B-V Bonfinópolis de Minas
VI Santa Fé
X-A-IV Ibiaí
V-D-I Bocaina
II Canabrava
C-VI Arrenegado
D-IV João Pinheiro
V Rio do Sono
VI C. dos Gerais
X-C-IV V. da Palma
Y-B-I P. Olegário
II S. das Almas
III T. Marias
Z-A-I Andrequicé
Y-B-IV Carmo do Paranaiba
V S. Selada
VI M. Nova de Minas
Z-A-IV Morro da Garça
V Curvelo
Z-A-I
Z-A-2
Z-A-V
Z-C-II
Z-C-IV
Z-C-V
V-B-2
V-B-III
X-A-I
V-B-V
V-B-VI
X-A-IV
V-D-I
V-D-II
V-C-VI
V-D-IV
V-D-V
V-D-VI
X-C-IV
Y-B-I
Y-B-II
Y-B-III
Z-A-I
Y-B-IV
Y-B-V
Y-B-VI
Z-A-IV
Z-A-V
ESCALA 1:4.000.000
CARTOGRAPHY IN THE SCALE 1:100 000

CARTA TOPOGRÁFICA DO EST. DE MINAS GERAIS	
SGMG	1:100 000

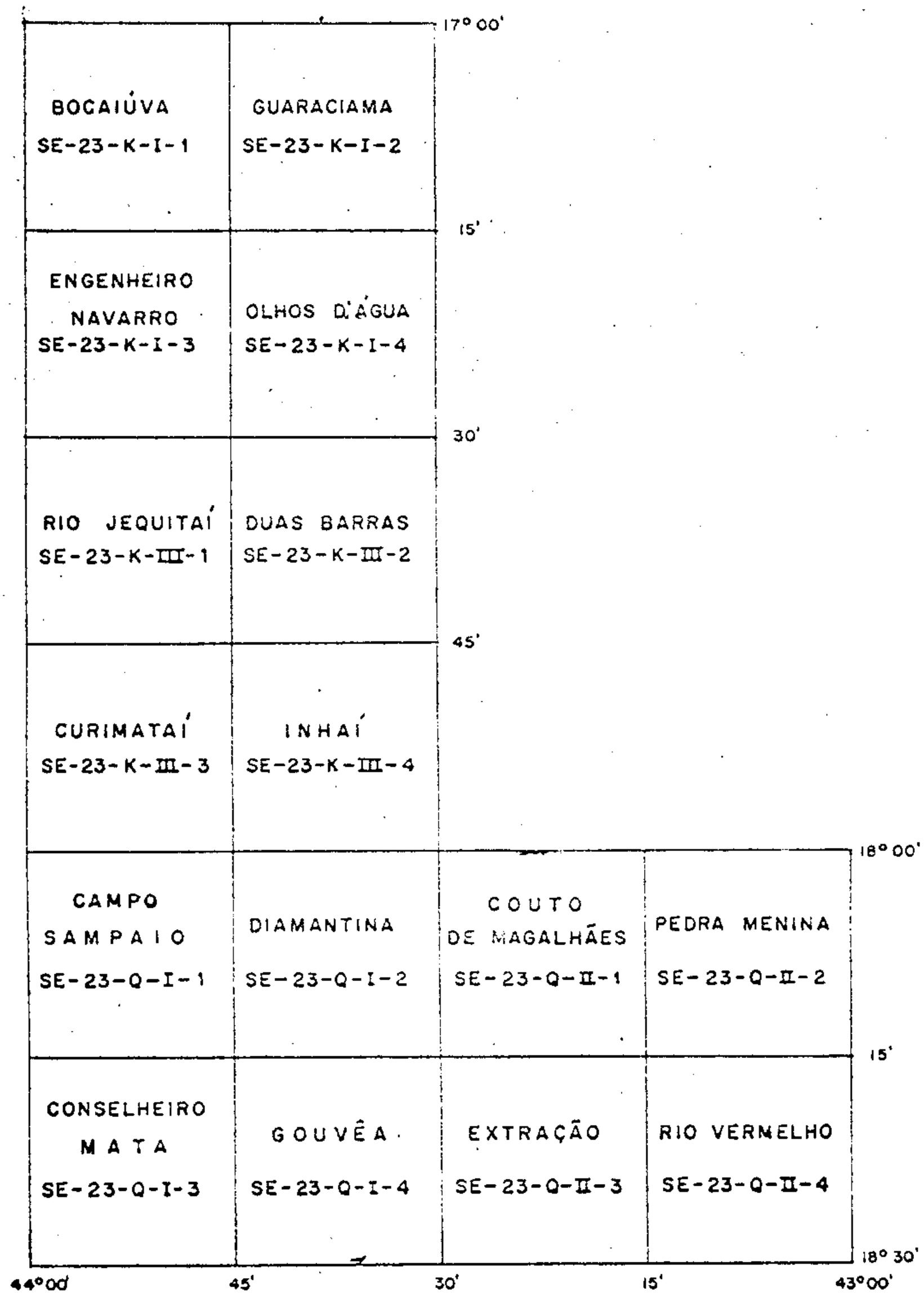
CARTOGRAPHY IN THE SCALE 1 : 100,000



1- DORES DE INDAYÁ
2- POMPÉO
3- SETE LAGÔAS
4- ARAXÁ
5- CAMPOS ALTOS
6- LUZ
7- PITANGUY
8- PARÁ
9- RIO DAS VELHAS
10- ITABIRA
11- ANTÔNIO DIAS
12- CARATINGA
13- IPANEMA
14- AYMORÉS
15- TAPIRA
16- BAMBUHY
17- LAGOA DA PRATA
18- DIVINÓPOLIS
19- ITAÚNA
20- BELO HORIZONTE
21- S. BÁRBARA
22- SAÚDE
23- R. SOARES
24- LAGINHA
25- IBIRACY
26- DELPHINÓPOLIS
27- PIUMHY
28- FORMIGA
29- ITAPECERICA
30- BOMFIM
31- ITABIRITO
32- OURO PRÊTO
33- PONTE NOVA
34- MANHUASSÚ
35- CAPARAÓ
36- S. THOMÉ
37- PASSOS
38- GUAPÉ
39- CRISTAES
40- OLIVEIRA
41- S. THIAGO
42- L. DOURADA
43- PIRANGA
44- VIÇOSA
45- CARANGOLA
46- MONTE SANTO
47- CARMO DO RIO CLARO
48- B. ESPERANÇA
49- LAVRAS
50- S JOÃO D'EL REI
51- BARBACENA
52- REMEDIOS
53- UBÁ
54- MURIAHÉ
55- MUZAMBINHO
56- ALFENAS
57- VARGINHA
58- LUMINARIAS
59- CARRANCAS
60- IBERTIOGA
61- PALMIRA
62- CATAGUAZES
63- PALMA
64- POCOS DE CALDAS
65- CALDAS
66- CAMPANHA
67- BAEPENDY
68- AYURUOCA
69- LIMA DUARTE
70- JUIZ DE FORA
71- A. PARAHIBA
72- JACUTINGA
73- P. ALEGRE
74- S. RITA
75- POUSO ALTO
76- BOCAINA
77- RIO PRETO
78- CAMBUHY
79- ITAJUBÁ
80- SOLEDADE
81- EXTREMA

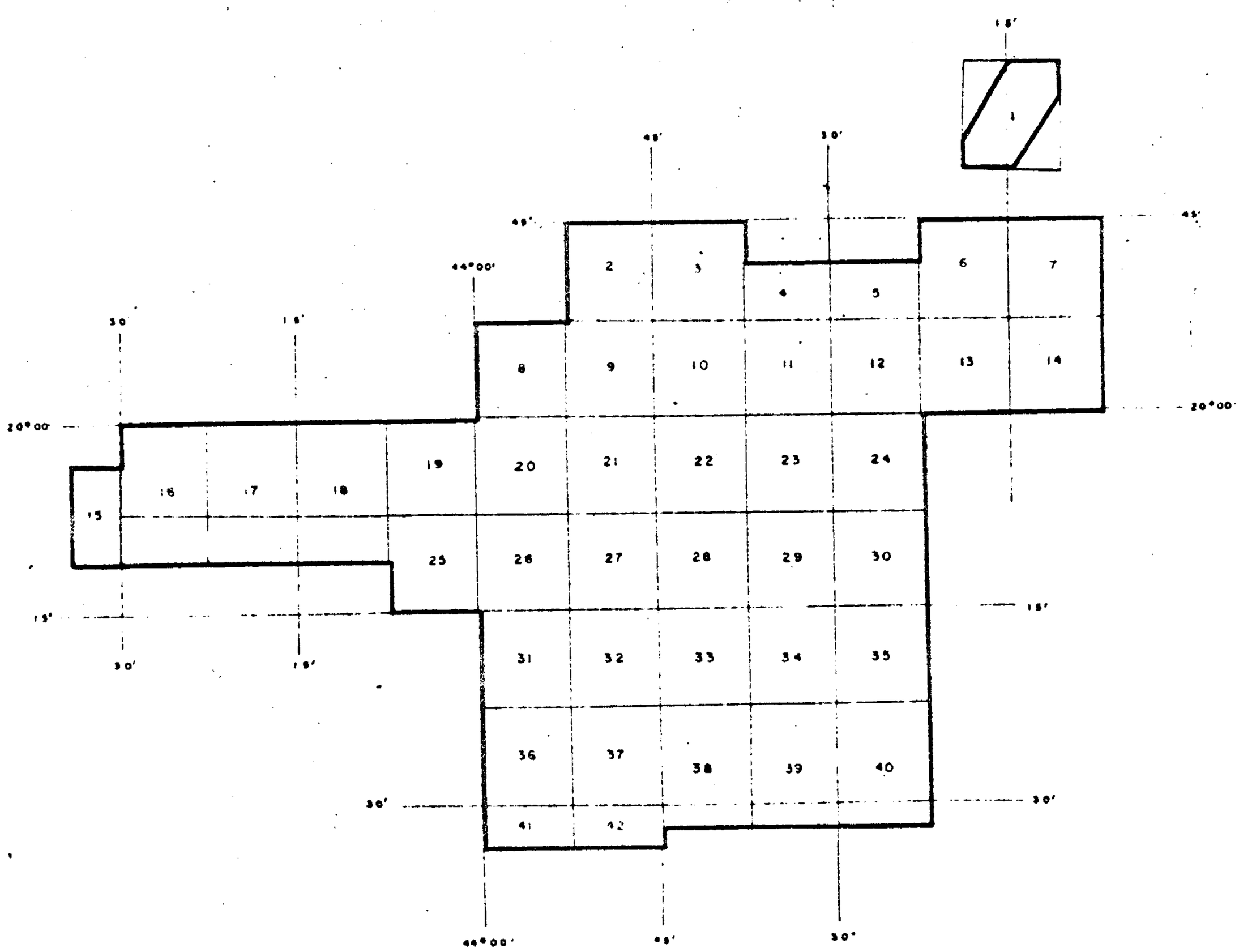

SF-23-C-I-1 - Bambuí
C-I-2 - Lagoa da Prata
C-I-3 - Piüi
C-II-1 - Sto. Antônio do Monte
C-II-2 - Serra Negra
C-II-3 - Formiga
C-II-4 - Itapecerica
C-III-3 - Guapé
C-III-4 - Cristais
C-IV-1 - Baiões
C-IV-2 - Camacho
C-IV-4 - Santana do Jacaré
V-B-IV-4-Carmo do Rio Claro
V-D-1-4 - Areado
I-I-1 - Campos Gerais
I-I-4 - Três Pontas
I-II-1 - Coqueiral
I-II-2 - Nepomuceno
I-II-3 - Ribeirão da Espera
I-II-4 - Carmo da Cachoeira
I-III-1 - Machado
I-IV-1 - Varginha
I-IV-2 - Três Corações
Scale
1 : 4,000,000
CARTOGRAPHY IN THE SCALE 1:50,000

CARGOGRAPHY IN THE SCALE 1 : 50,000



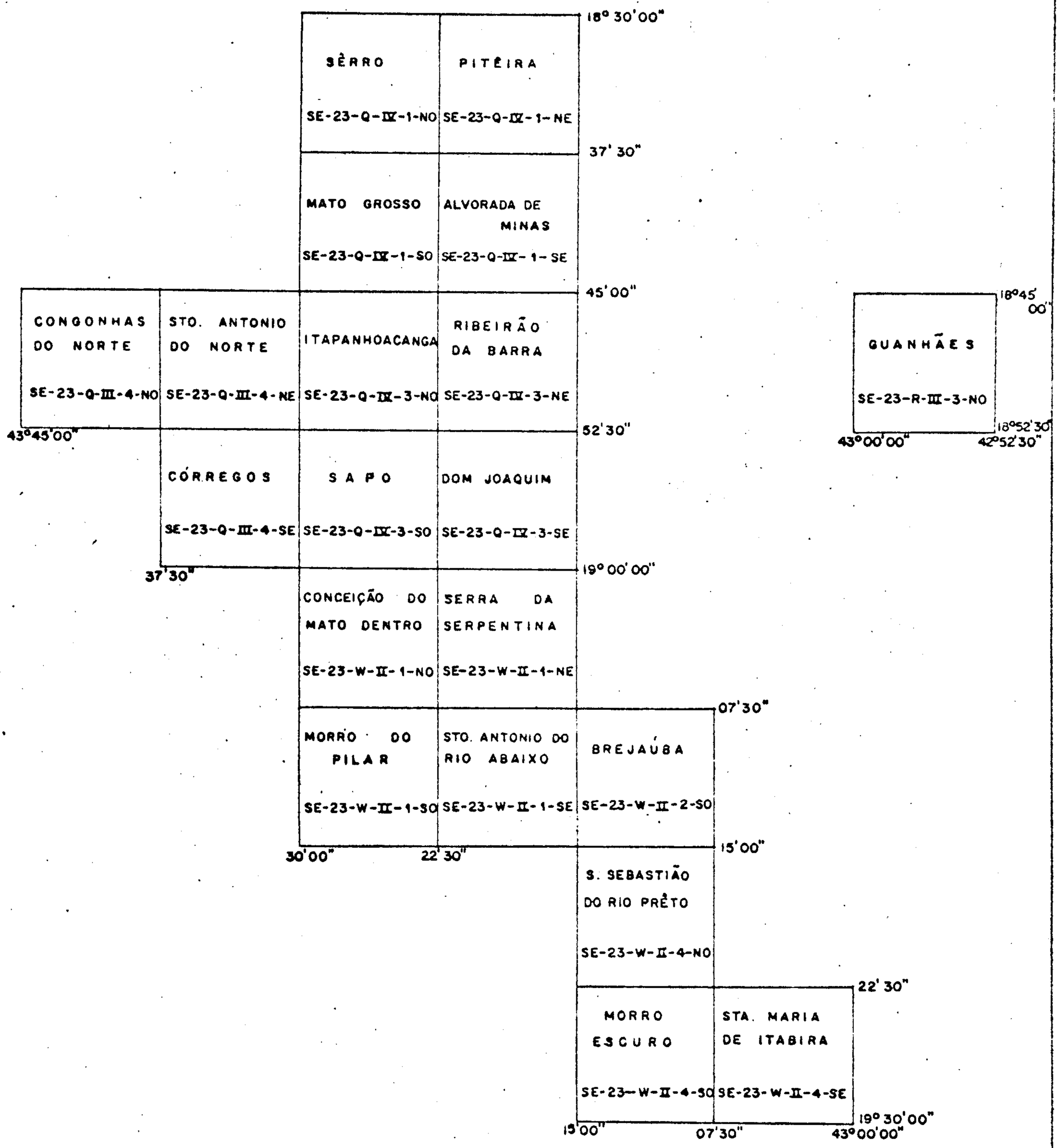
PROJ. QUADRILÁTERO FERRÍFERO - M.G.	
DNPM / USAID	1 : 25 000

CARTOGRAPHY IN THE SCALE 1 : 25,000



1 ITABIRA
2 SANTA LUZIA
3 SERRA DA PIEDADE
4 ANTÔNIO DOS SANTOS
5 COCAIS
6 SÃO GONÇALO
7 MONLEVADE
8 BELO HORIZONTE
9 NOVA LIMA
10 CAETÉ
11 GONGO SÔCO
12 SANTA BARBARA
13 FLORALIA
14 RIO PIRACICABA
15 ITAÚNA
16 SERRA AZUL ITATIAIUÇU
17 IGARAPÉ - SOUSAS
18 FECHO DO FUNIL - BRUMADINHO
19 IBIRITÉ
20 MACACOS
21 RIO ACIMA
22 GANDARELA
23 CONCEIÇÃO DO RIO ACIMA
24 CATAS ALTAS
25 PIEDADE DO PARAOPEBA
26 LAGOA GRANDE
27 ITABIRITO
28 RIO DE PEDRAS
29 CAPANEMA
30 SANTA RITA DURÃO
31 MARINHO DA SERRA
32 BAÇÃO
33 CACHOEIRA DO CAMPO
34 SÃO BARTOLOMEU
35 ANTÔNIO PEREIRA
36 CASA DE PEDRA
37 SÃO JULIÃO
38 DOM BOSCO - OURO BRANCO
39 OURO PRÊTO - SANTA RITA DO OURO PRÊTO
40 MARIANA - RIO DAS BANDEIRAS
41 JECEABA
42 CONGONHAS

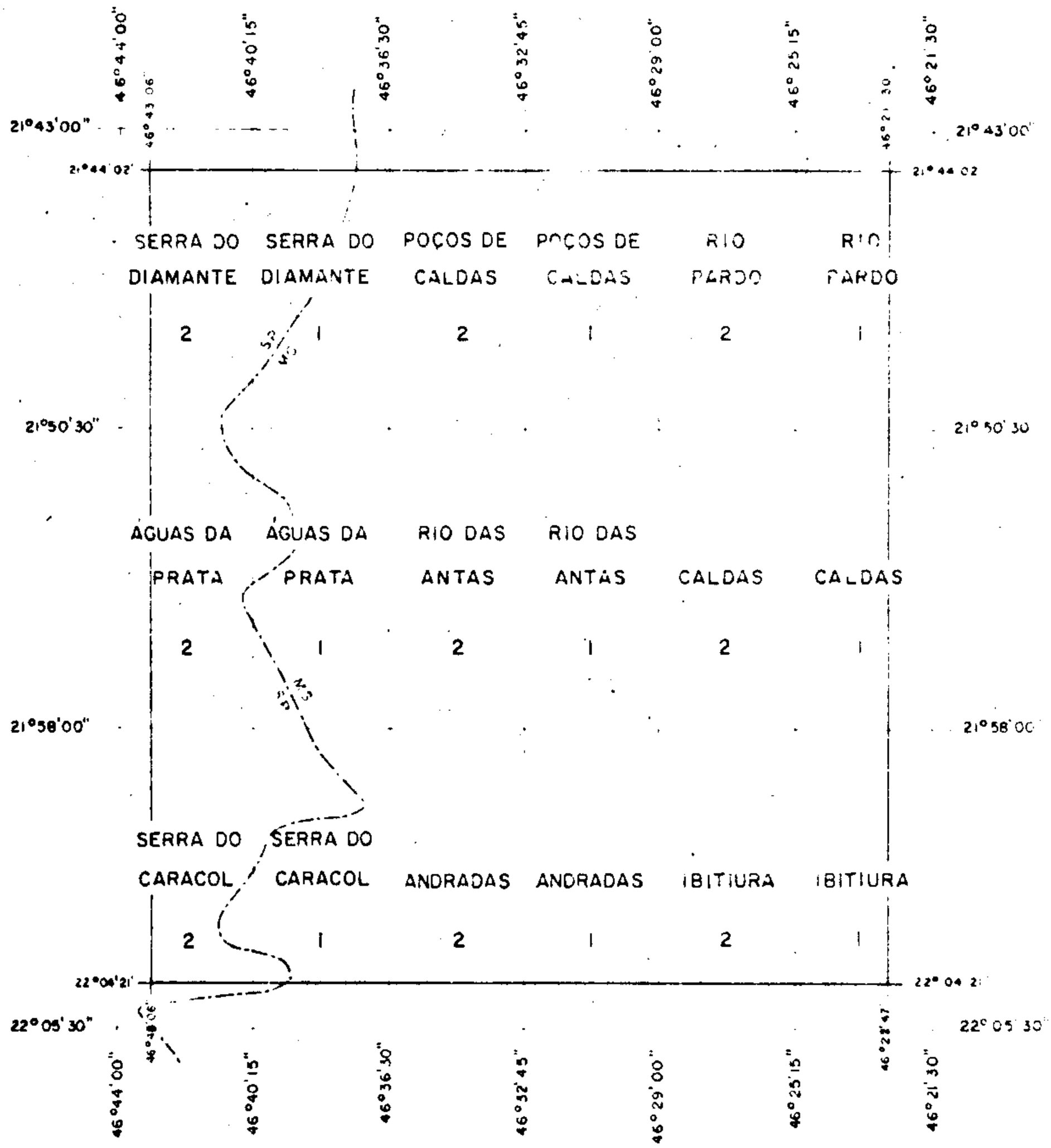
CARTOGRAPHY IN THE SCALE 1 : 25,000



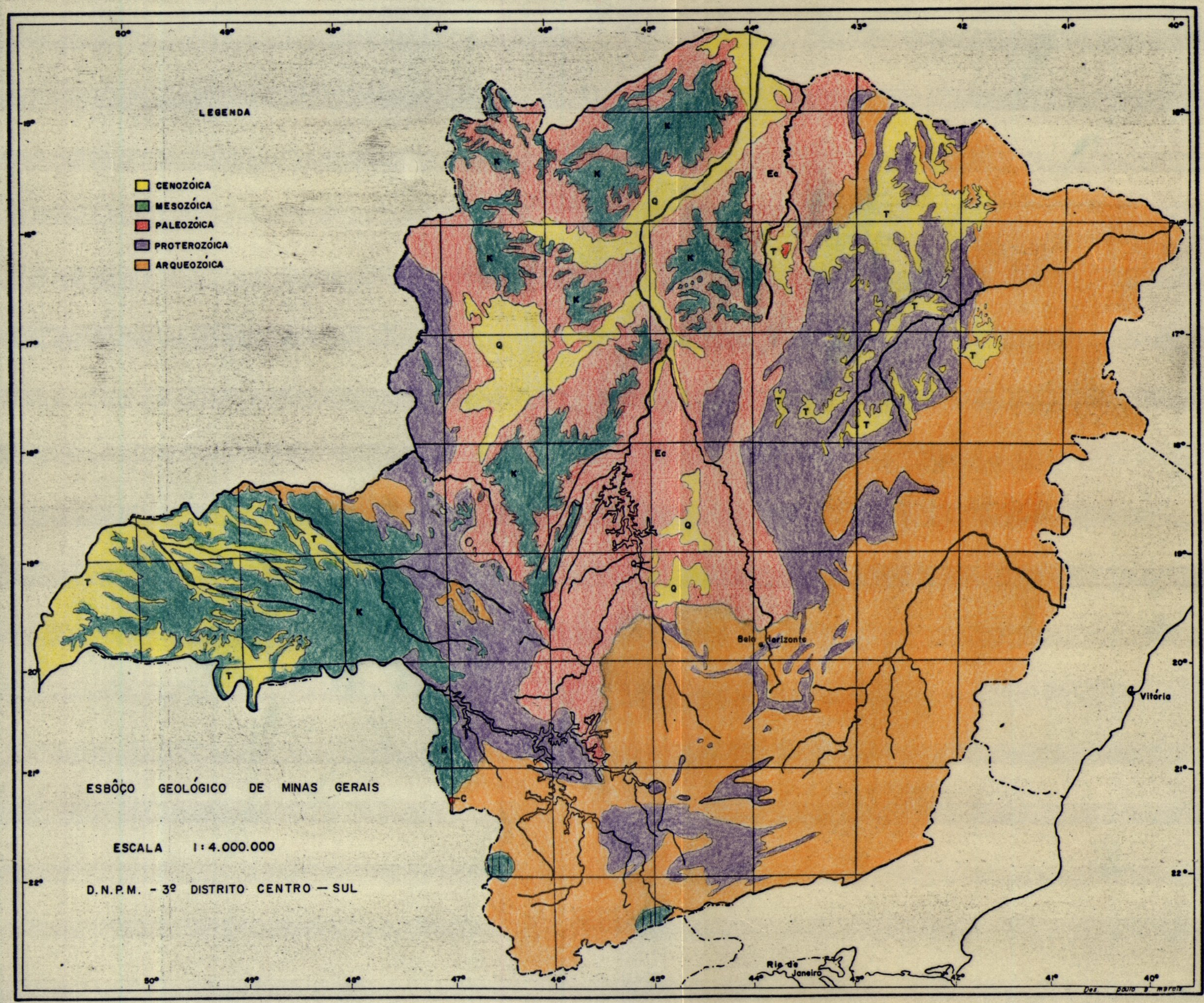
MAPA TOPOG DA REGIÃO DE POÇOS DE CALDAS
COM NAC DE ENERGIA NUCLEAR 1 : 10 000

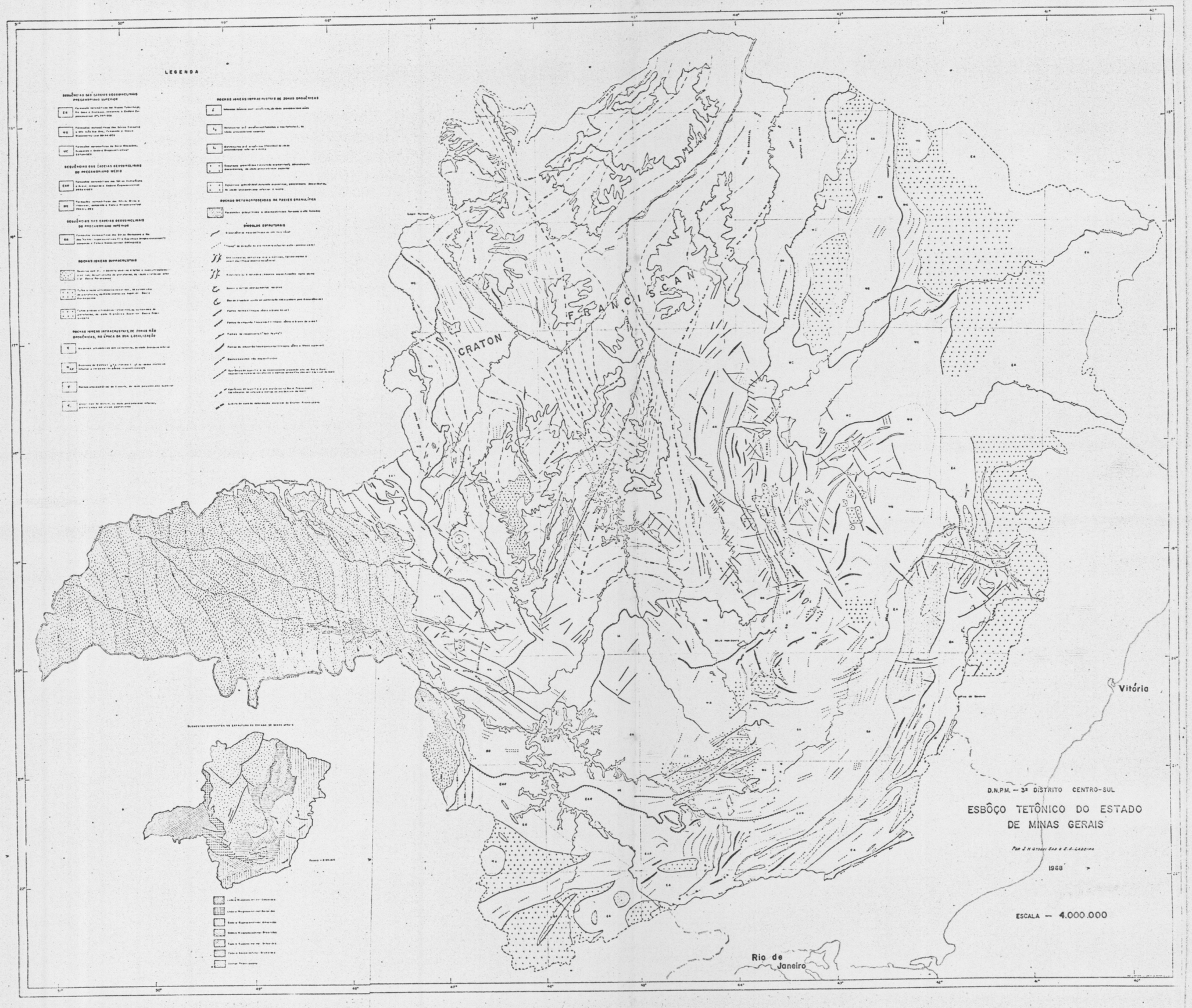
SF - 23

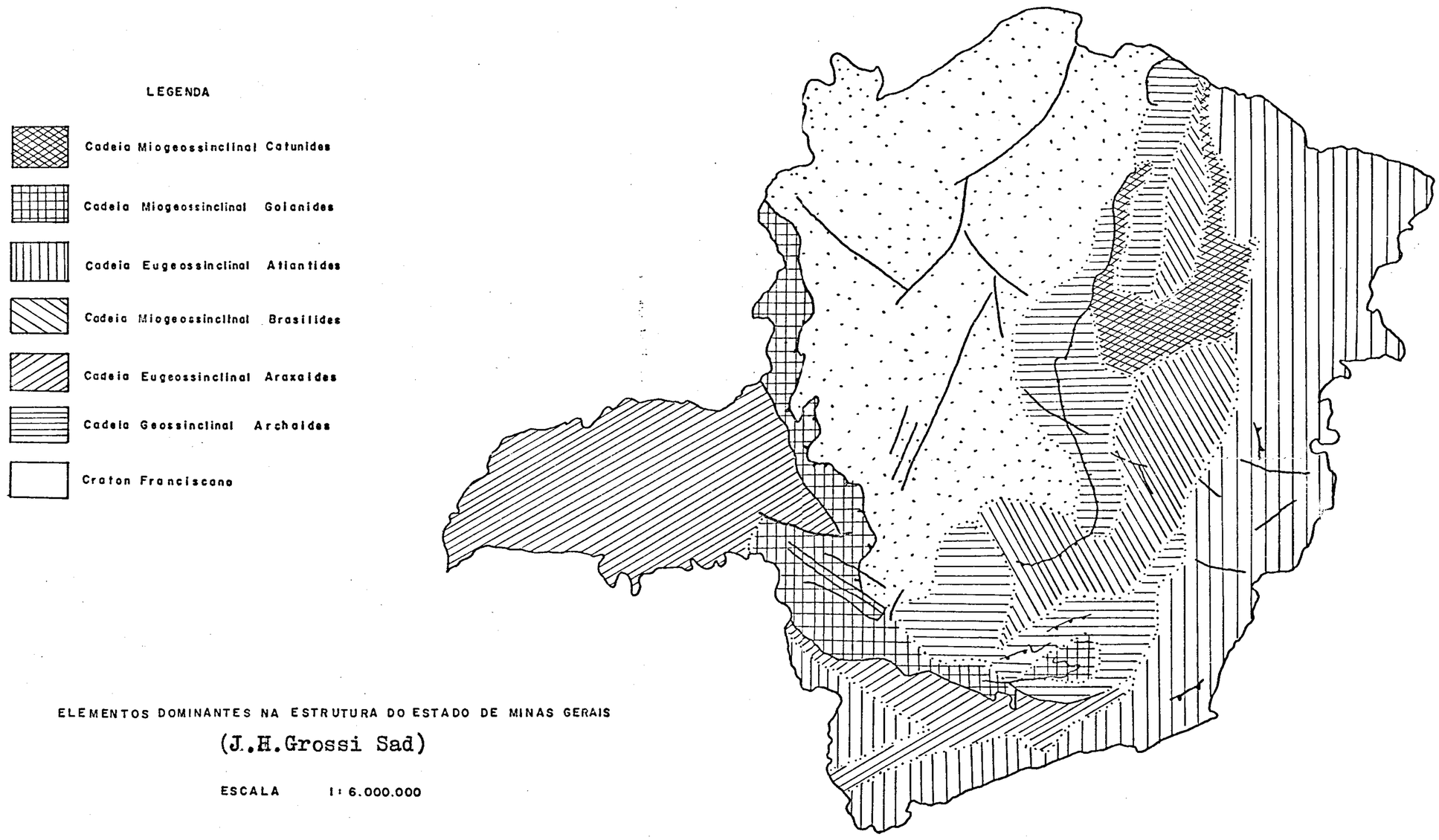
CARTOGRAPHY IN THE SCALE 1 : 10,000



ILLUSTRATIONS


LEGENDA
CENOZÓICA
MESOZÓICA
PALEOZÓICA
PROTEROZÓICA
ARQUEOZÓICA
ESBÔÇO GEOLÓGICO DE MINAS GERAIS
ESCALA 1:4.000.000
D.N.P.M. - 3º DISTRITO CENTRO — SUL
Belo Horizonte
Vitória
Rio de Janeiro


LEGENDA
CRATON
FRANCISCAN
Vitória
Rio de Janeiro
D.N.P.M. — 3ª DISTRITO CENTRO-SUL
ESBÔÇO TETÔNICO DO ESTADO DE MINAS GERAIS
1968
ESCALA — 4.000.000



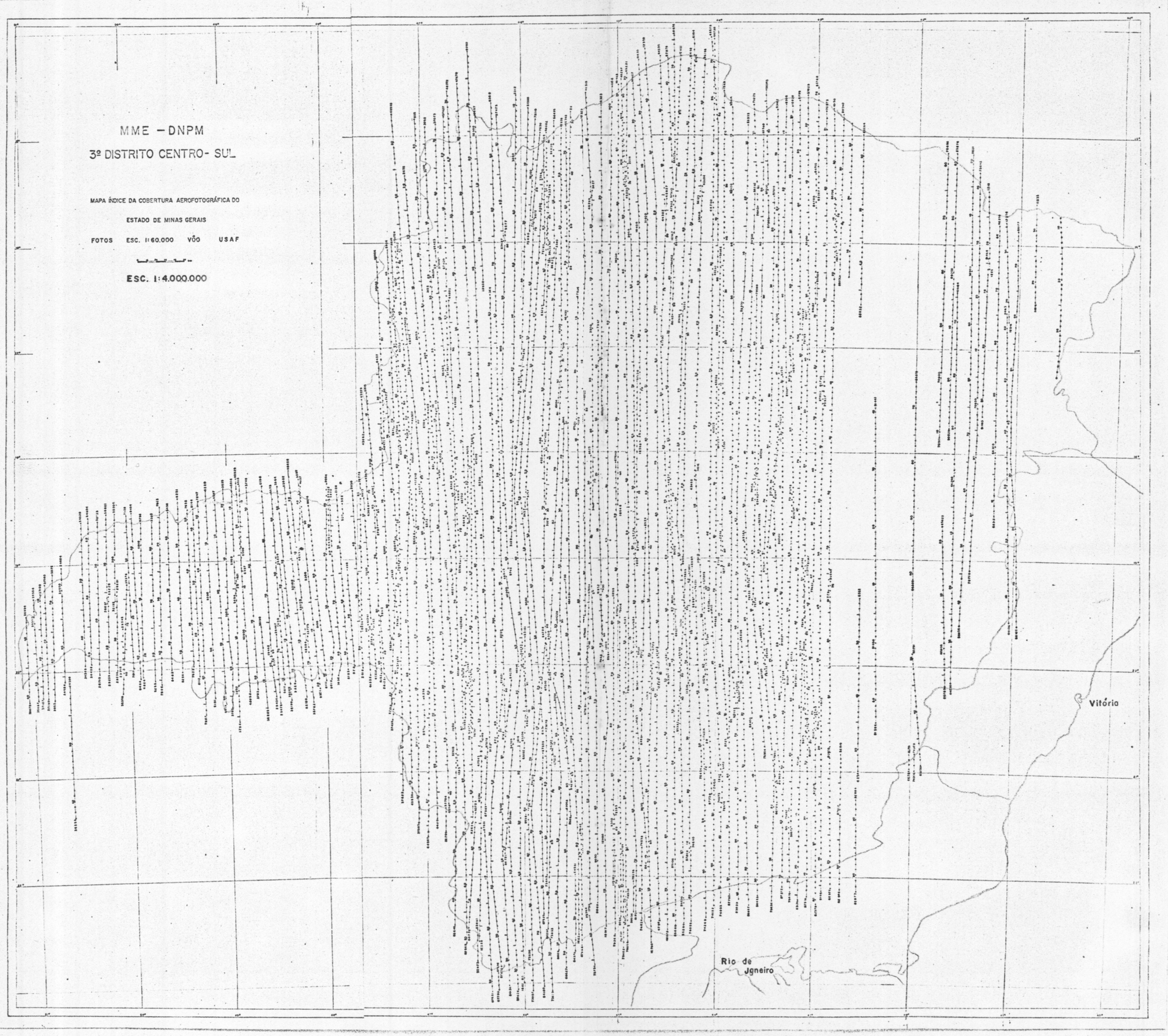
ELEMENTOS DOMINANTES NA ESTRUTURA DO ESTADO DE MINAS GERAIS

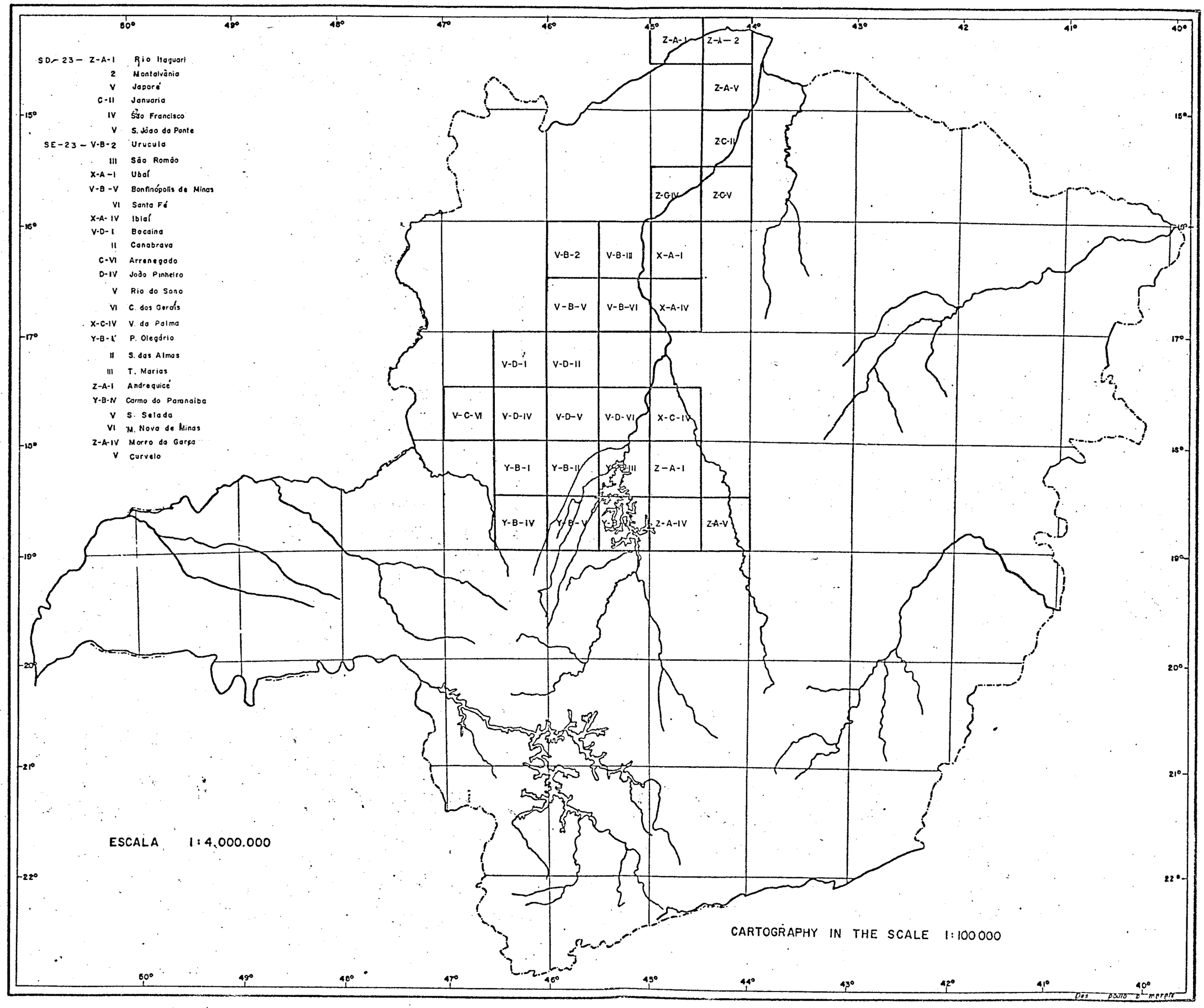
(J.H.Grossi Sad)

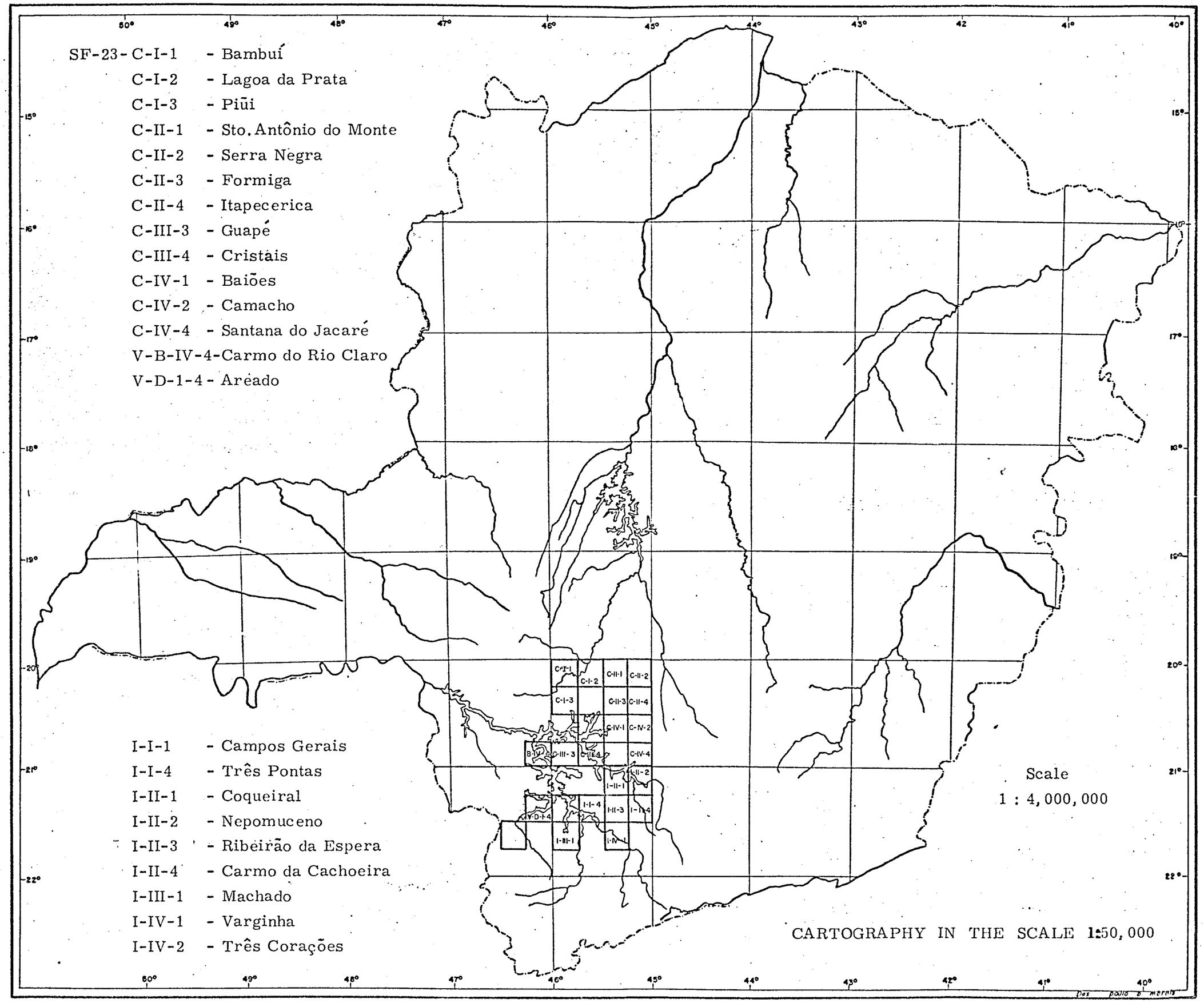
ESCALA 1: 6.000.000

D. N. P. M. – 3º DISTRITO CENTRO – SUL

Des. p. b. morais

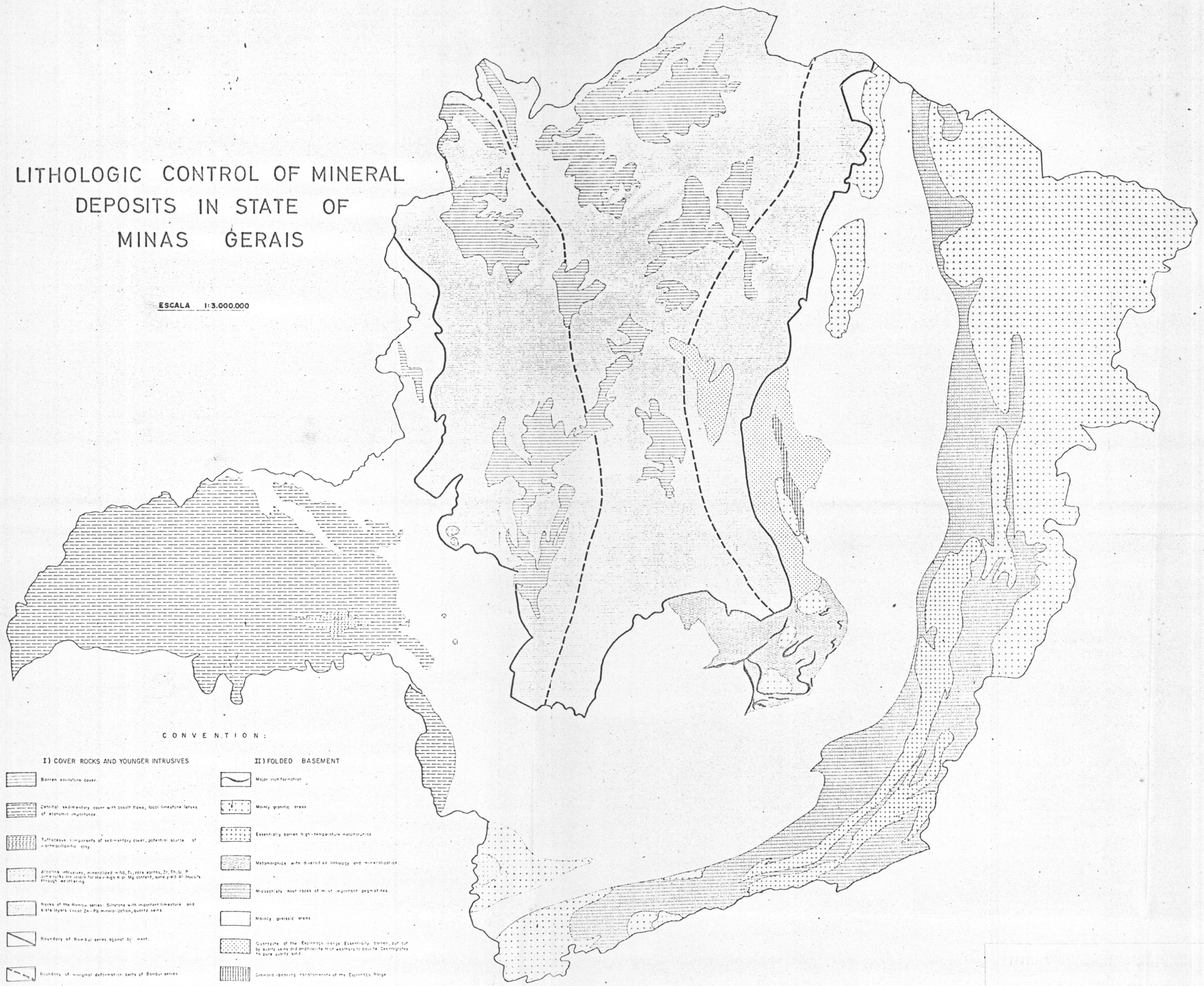

MME - DNPM
3º DISTRITO CENTRO- SUL
MAPA ÍNDICE DA COBERTURA AEROFOTOGRÁFICA DO
ESTADO DE MINAS GERAIS
FOTOS ESC. 1:60.000 VÔO USAF
ESC. 1:4.000.000
Vitória
Rio de Janeiro

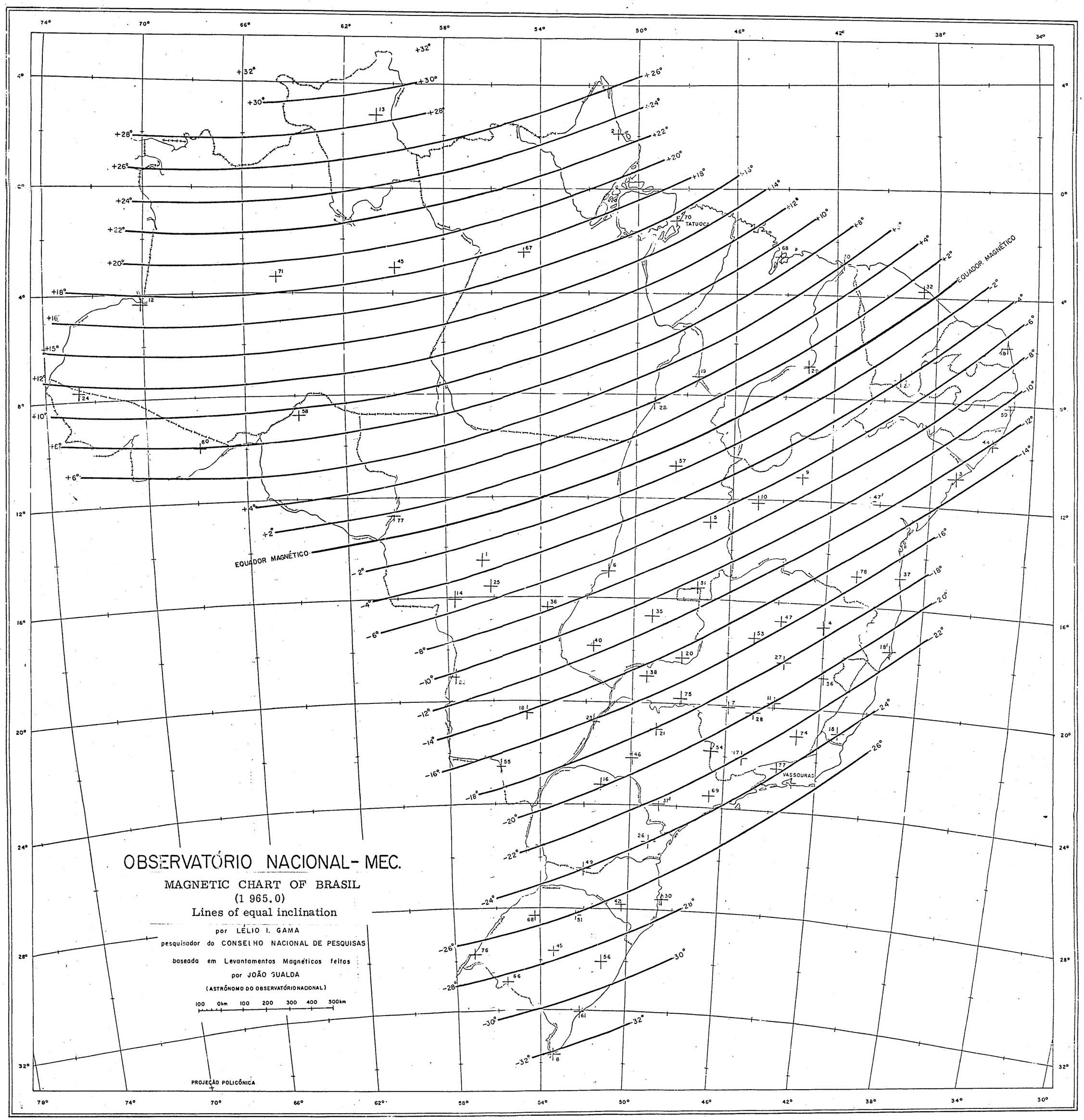

SD-23 — Z-A-I Rio Itaguari
2 Montalvânia
V Japoré
C-II Januaria
IV São Francisco
V S. João da Ponte
SE-23 — V-B-2 Urucuia
III São Romão
X-A-I Ubaí
V-B-V Bonfinópolis de Minas
VI Santa Fé
X-A-IV Ibiaí
V-D-I Bocaina
II Canabrava
C-VI Arrenegado
D-IV João Pinheiro
V Rio do Sono
VI C. dos Gerais
X-C-IV V. da Palma
Y-B-I P. Olegário
II S. das Almas
III T. Marias
Z-A-I Andrequicé
Y-B-IV Carmo do Paranaiba
V S. Selada
VI M. Nova de Minas
Z-A-IV Morro da Garça
V Curvelo
Z-A-I
Z-A-2
Z-A-V
Z-C-II
Z-C-IV
Z-C-V
V-B-2
V-B-III
X-A-I
V-B-V
V-B-VI
X-A-IV
V-D-I
V-D-II
V-C-VI
V-D-IV
V-D-V
V-D-VI
X-C-IV
Y-B-I
Y-B-II
Y-B-III
Z-A-I
Y-B-IV
Y-B-V
Z-A-IV
Z-A-V
ESCALA 1:4.000.000
CARTOGRAPHY IN THE SCALE 1:100 000

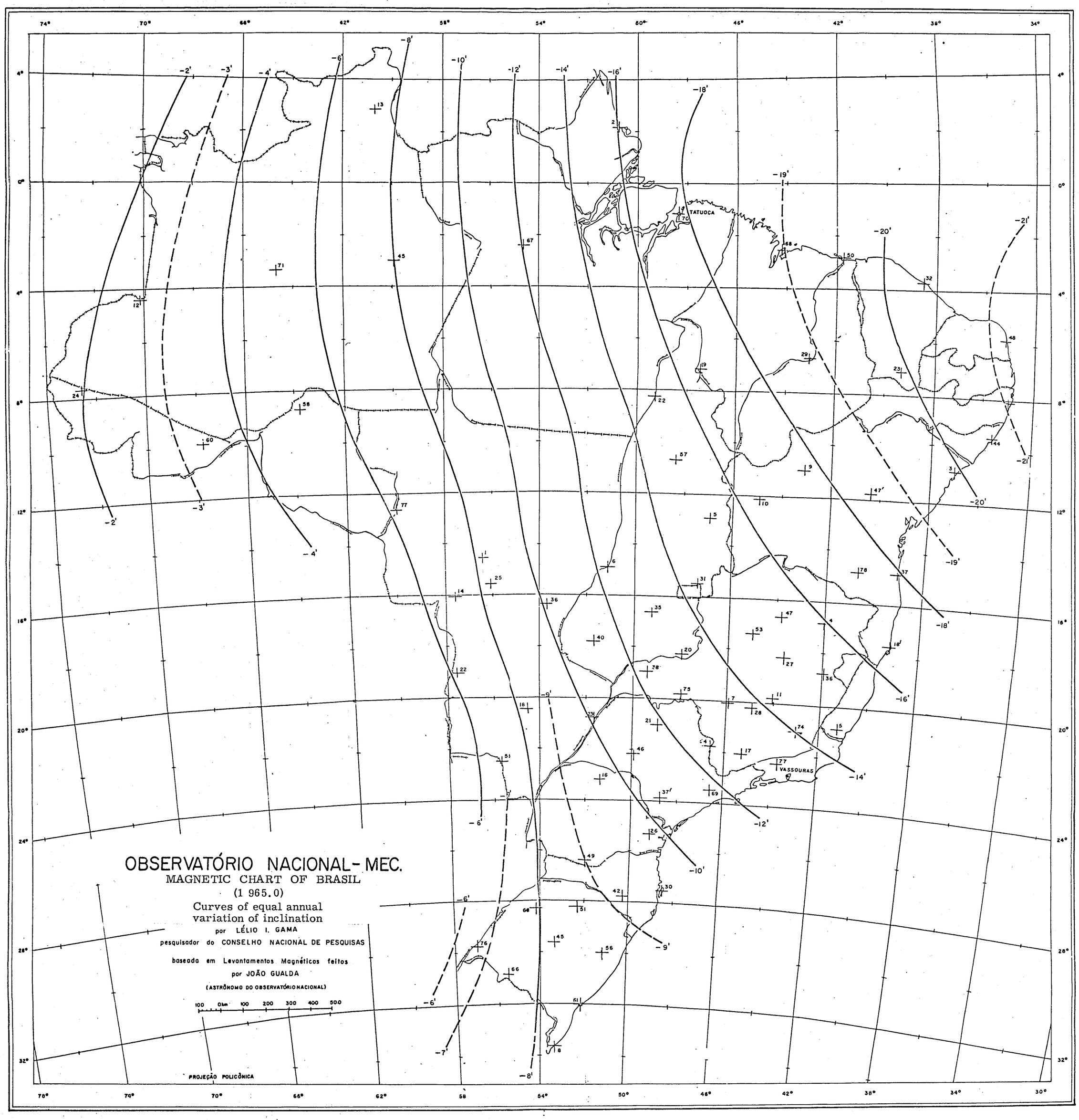

SF-23- C-I-1 - Bambuí
C-I-2 - Lagoa da Prata
C-I-3 - Piüi
C-II-1 - Sto. Antônio do Monte
C-II-2 - Serra Negra
C-II-3 - Formiga
C-II-4 - Itapecerica
C-III-3 - Guapé
C-III-4 - Cristais
C-IV-1 - Baiões
C-IV-2 - Camacho
C-IV-4 - Santana do Jacaré
V-B-IV-4-Carmo do Rio Claro
V-D-1-4 - Areado
I-I-1 - Campos Gerais
I-I-4 - Três Pontas
I-II-1 - Coqueiral
I-II-2 - Nepomuceno
I-II-3 - Ribeirão da Espera
I-II-4 - Carmo da Cachoeira
I-III-1 - Machado
I-IV-1 - Varginha
I-IV-2 - Três Corações
Scale
1 : 4,000,000
CARTOGRAPHY IN THE SCALE 1:50,000

LITHOLOGIC CONTROL OF MINERAL DEPOSITS IN STATE OF MINAS GERAIS

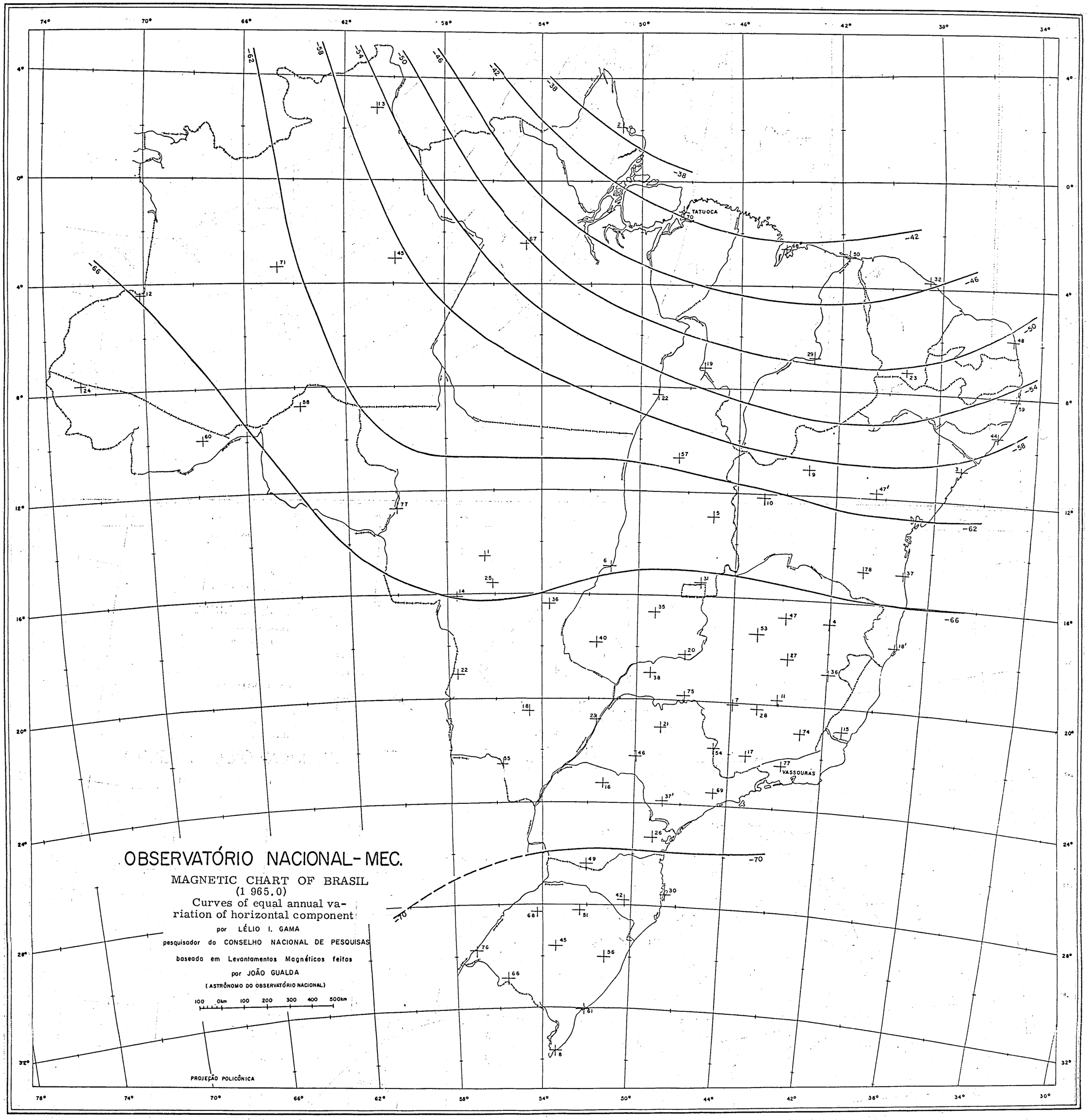
ESCALA 1:3.000.000




OBSERVATÓRIO NACIONAL - MEC.
MAGNETIC CHART OF BRASIL
(1 965.0)
Lines of equal inclination
por LÉLIO I. GAMA
pesquisador do CONSELHO NACIONAL DE PESQUISAS
baseada em Levantamentos Magnéticos feitos
por JOÃO GUALDA
(ASTRÔNOMO DO OBSERVATÓRIO NACIONAL)
100 0km 100 200 300 400 500km
PROJEÇÃO POLICÔNICA
EQUADOR MAGNÉTICO
TATUOCA
VASSOURAS


OBSERVATÓRIO NACIONAL - MEC.
MAGNETIC CHART OF BRASIL
(1 965.0)
Curves of equal annual
variation of inclination
por LÉLIO I. GAMA
pesquisador do CONSELHO NACIONAL DE PESQUISAS
baseada em Levantamentos Magnéticos feitos
por JOÃO GUALDA
(ASTRÔNOMO DO OBSERVATÓRIO NACIONAL)
100 0 km 100 200 300 400 500
PROJEÇÃO POLICÔNICA
TATUOCA
VASSOURAS

OBSERVATÓRIO NACIONAL-MEC.
MAGNETIC CHART OF BRASIL
(1 965.0)
Lines of equal horizontal component
por LÉLIO I. GAMA
pesquisador do CONSELHO NACIONAL DE PESQUISAS
baseada em Levantamentos Magnéticos feitos
por JOÃO GUALDA
(ASTRÔNOMO DO OBSERV. NAC.)
100 0km 100 200 300 400 500km
TATUOCA
VASSOURAS
29200
28950
28700
28450
28200
27950
27700
27450
27200
26950
26700
26450
26200
25950
25700
25450
25200
24950
24700
24450
24200
23950
23700
23450
23200
22950
22700
22450
22200
21950
21700
21450
21200
20950
20700


OBSERVATÓRIO NACIONAL - MEC.
MAGNETIC CHART OF BRASIL
(1 965.0)
Curves of equal annual variation of horizontal component
por LÉLIO I. GAMA
pesquisador do CONSELHO NACIONAL DE PESQUISAS
baseada em Levantamentos Magnéticos feitos
por JOÃO GUALDA
(ASTRÔNOMO DO OBSERVATÓRIO NACIONAL)
100 0km 100 200 300 400 500km
PROJEÇÃO POLICÔNICA
TATUOCA
VASSOURAS
-38
-42
-46
-50
-54
-58
-62
-66
-70