GEOLOGICAL POTENTIAL OF ANGOLA AND AVAILABLE SERVICES TO SUPORT MINING OPERATIONS

By: DOMINGOS CORDEIRO

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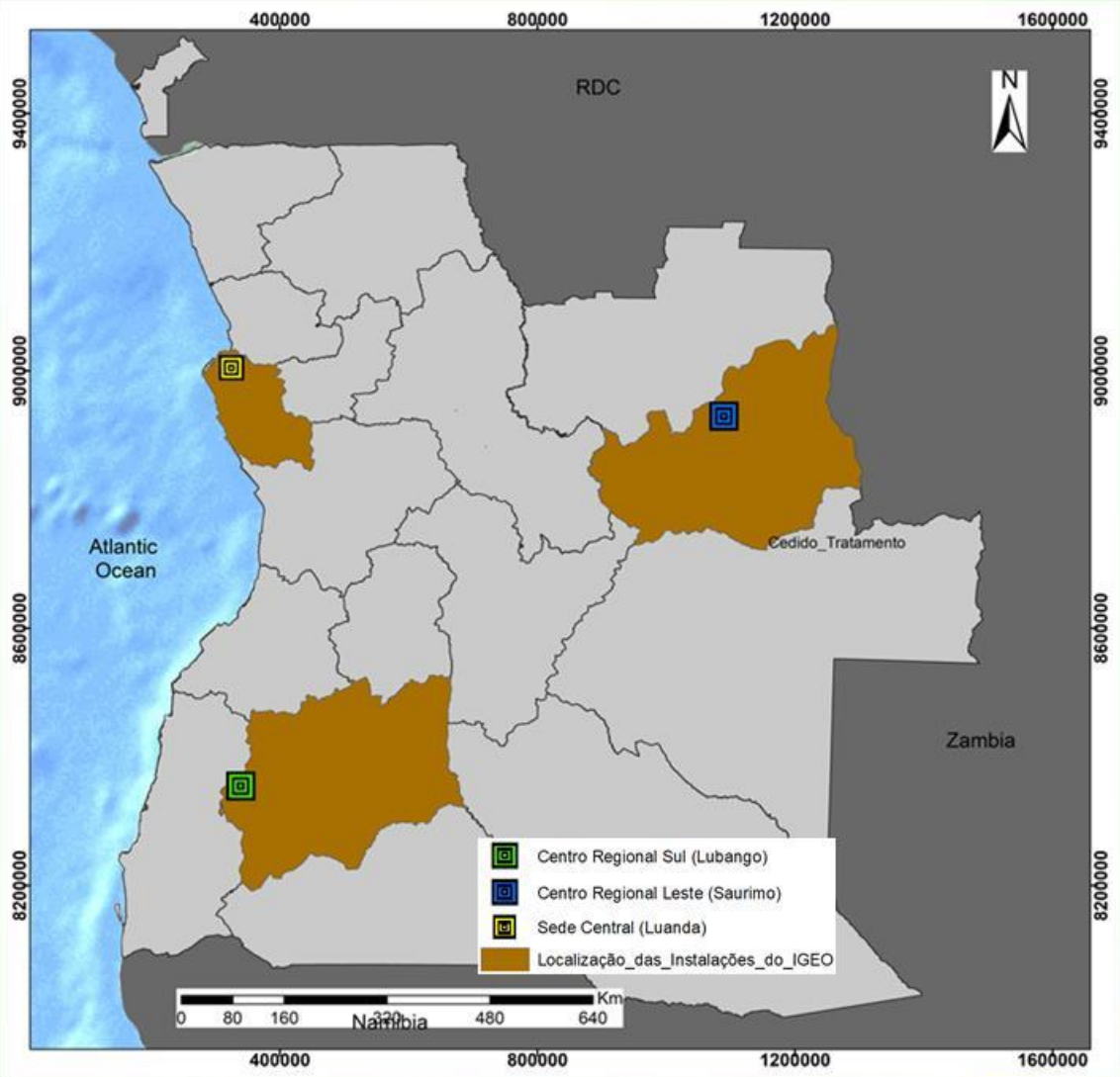
1.1. VISION AND MISSION OF GEOLOGICAL OF ANGOLA



- **Supervised by the Ministry of Mineral Resources, Petroleum and Gas (MREMPET)**

- **GEOLÓGICAL INSTITUTE OF ANGOLA (IGEO)**
  - ✓ Supervised by the Ministry of Mineral Resources, Petroleum and Gas (MREMPET)
- **VISION**
  - ✓ Our VISION is to assert ourselves as the largest reference of geoscientific research
  - ✓ In line with the sustainable development of country
- **MISSION**
  - ✓ Our Mission is to provide credible geological information to State authorities, investors and academies.

1. PRESENTATION OF GEOLOGICAL INSTITUTE OF ANGOLA

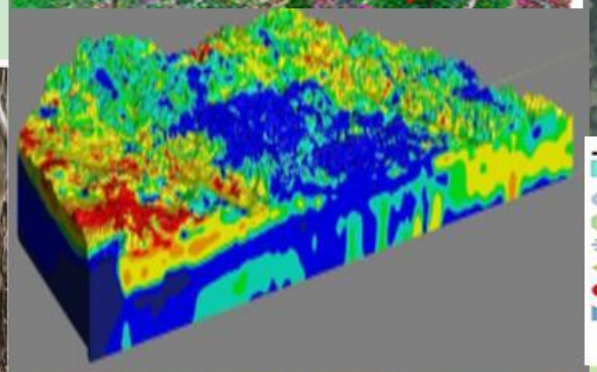
1.2. MAIN STATURORY ATTRIBUITIONS

The Geological Institute of Angola (IGEO) as the National Geological Survey is a public institution, which attributions are:

- Conducting geoscientific studies throughout the national territory;
- Metallogenetic characterization and managemente of the Mineral Resources inventary;
- Treatment, publication and dissemination of geological and minerals information.

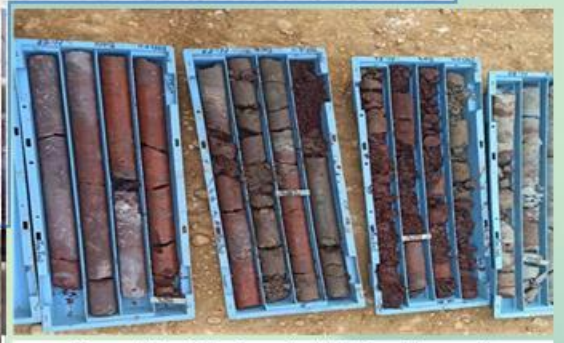
Field Work

GeophysicS & Remote Sensing



Geochemistry

Resources inventory



Hematite–Chalcocite (Native Copper)

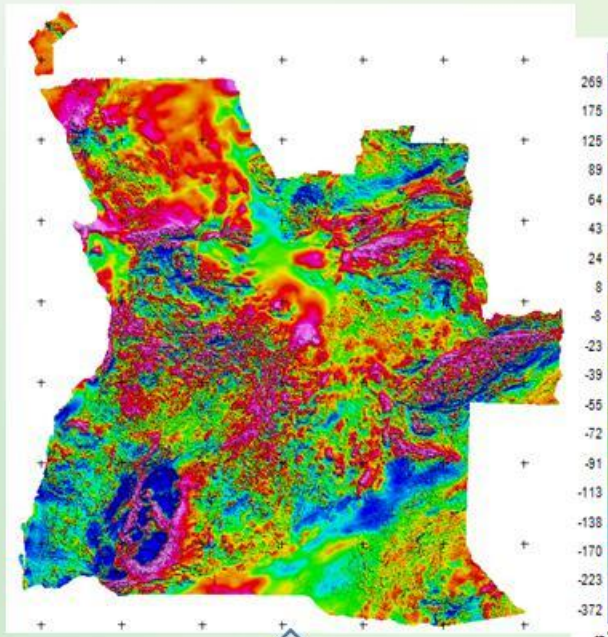
Hematite–Chalcocite (Native Copper)

Nióbio

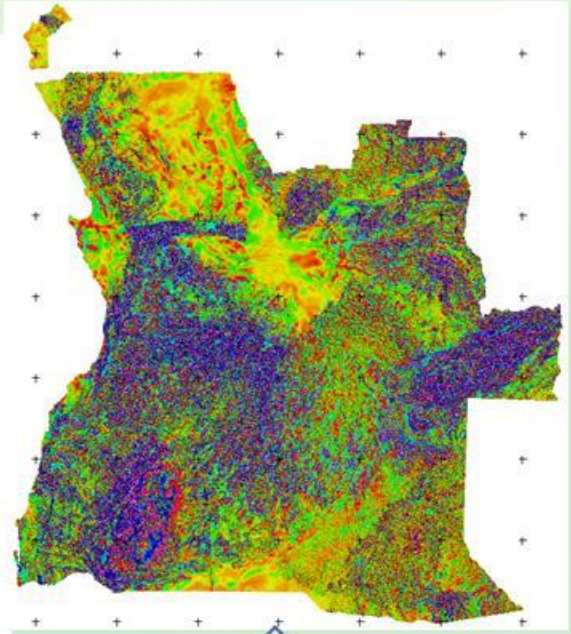
2. AVAILABLE GEOCIENTÍFIC INFORMATION

2.1. Geophysics Dataset PLANANAGEO)

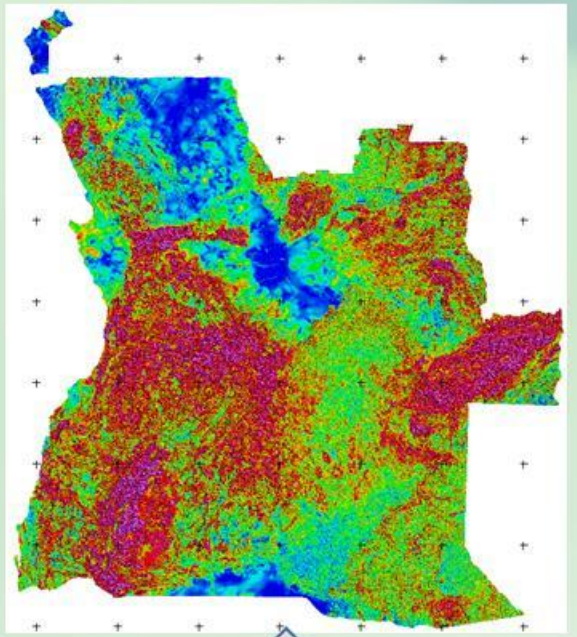
Magnetics :;



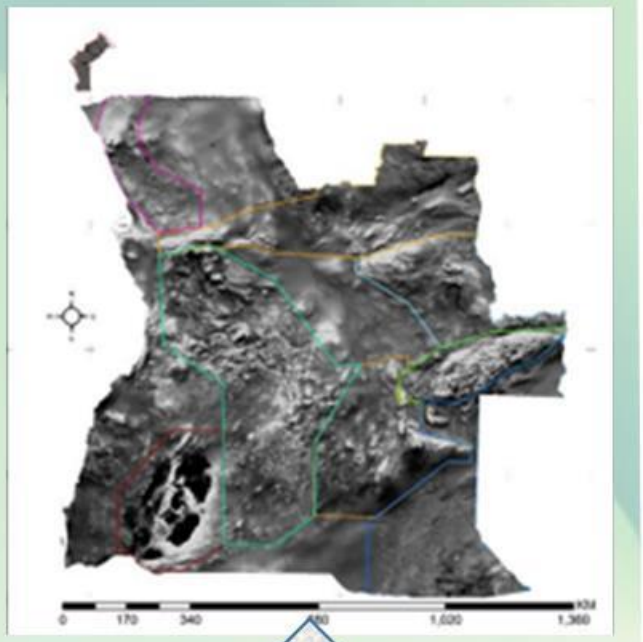
Total Magnetic field



First derivative



Analytical Signal



Grey scale magnético
Overlayde by ALIs

PARAMETERS

- ✓ Magnetometria: ***Survey parameters***
  Lines spacing 1000 meters;
- ✓ *Flight altitude 100 ±20meters;*
- ✓ *Flight speed : 230 Km/h*

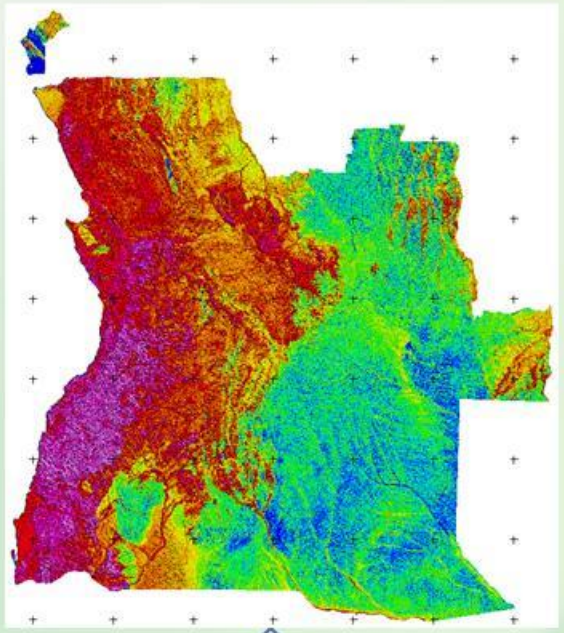
IMPORTANCE OF MAGNETIC DATA

- ✓ Geological mapping;
- ✓ Discovery of mineral and oil deposits;
- ✓ Arcaeology and engineering

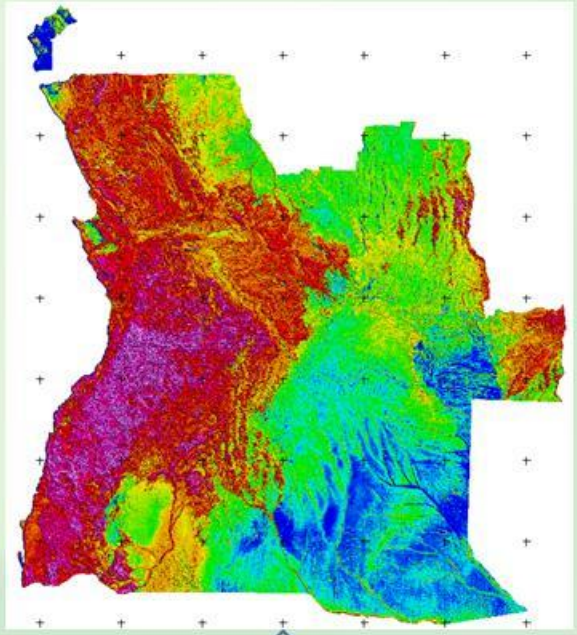
2. AVAILABLE GEOCIENTÍFIC INFORMATION

2.1. Geophysics Dataset PLANANAGEO)

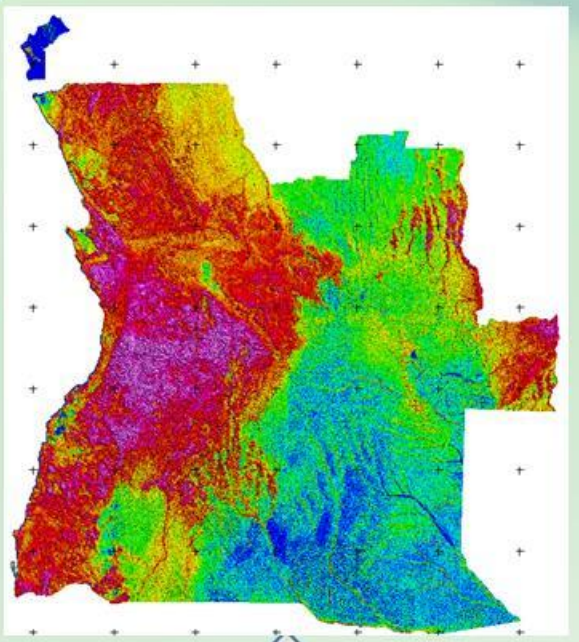
RADIOMETRY



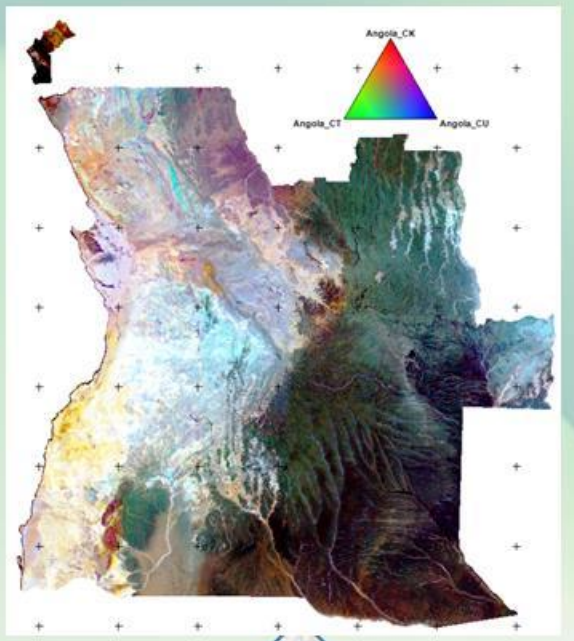
Map of Potassium



Map of thorium



Map of Uranium



Ternary Image

PARAMETERS

- ✓ Magnetometria: ***Survey parameters***
  Lines spacing 1000 meters;
- ✓ *Flight altitude 100 ±20meters;*
- ✓ *Flight speed : 230 Km/h*

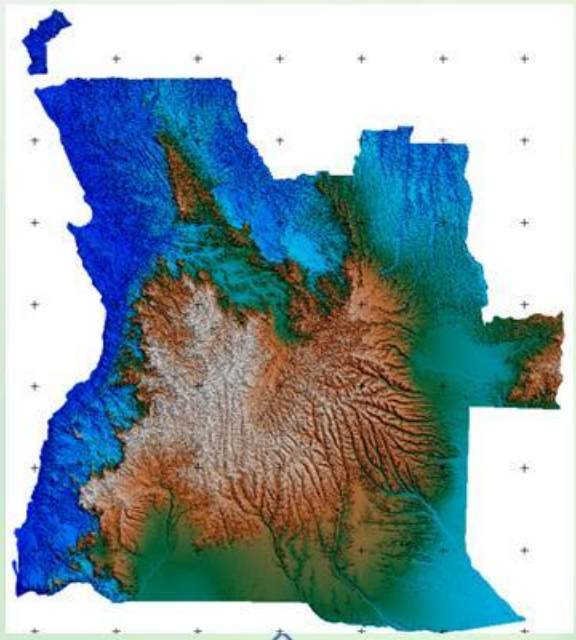
IMPORTANCE OF RADIOMETRICS DATAS

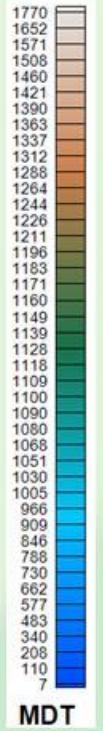
- ✓ Measures the natural gamma radiation of rocks and soils,
- ✓ Widely used in geological mapping ;
- ✓ Descovery of mineral deposits, Hydrothermal;
- ✓ Agriculture and environmental studies .

2. AVAILABLE GEOCIENTÍFIC INFORMATION

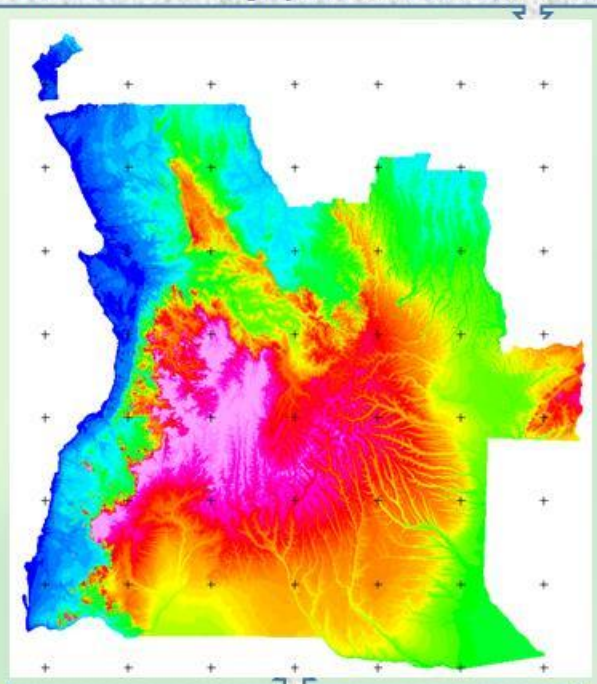
2.1. Geophysics Dataset PLANANAGEO)

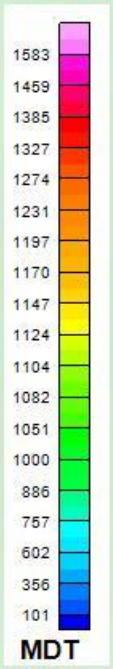
Dados altimetricos + blocos+ exemplo de dados de linha: *Espaçamento entre as linhas de voos: 1000 metros Altitude: 100 ± 20 metros Velocidade de Voo: 230 Km/h*



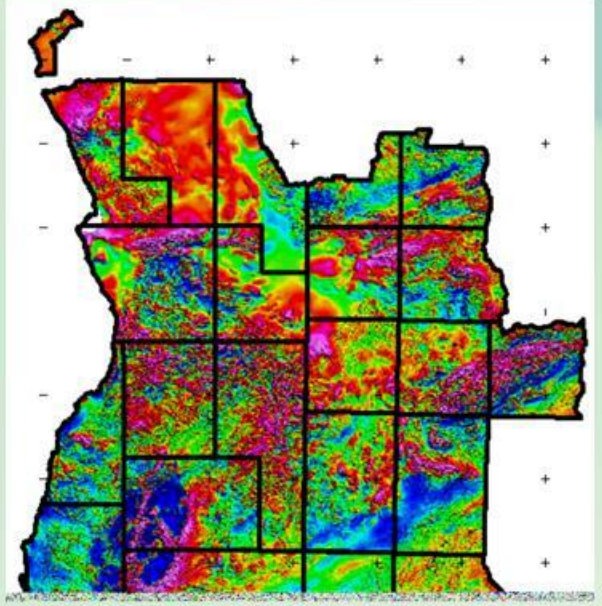


Digital Terrain Model





Digital Terrain Model



22 Blocs of geophysics datas Set Mag/Rad

X_m	Y_m	BASE	ROVER
308045	8995328	31270.8	31858.2
308049	8995326	31268.3	31855.1
308053	8995323	31264.6	31833.4
308057	8995320	31253.0	31854.0
308061	8995318	31254.1	31835.9
308065	8995315	31257.5	31877.3
308069	8995313	31249.8	31869.5
308074	8995311	31254.3	31866.1
308078	8995325	31246.8	31862.2
308073	8995327	31252.7	31853.5
308068	8995330	31237.5	31844.2
308065	8995332	31244.9	31853.9
308061	8995333	31249.4	31846.1
308057	8995337	31246.4	31858.3
308053	8995340	31248.3	31834.0
308047	8995342	31250.6	31846.3
308042	8995344	31250.4	31846.4
308049	8995359	31256.7	31863.0
308053	8995357	31247.0	31861.5

Exemplo de dados de linhas

PARAMETERS

- ✓ Magnetometria: ***Survey parameters***
  Lines spacing 1000 meters;
- ✓ *Flight altitude 100 ±20meters;*
- ✓ *Flight speed : 230 Km/h*

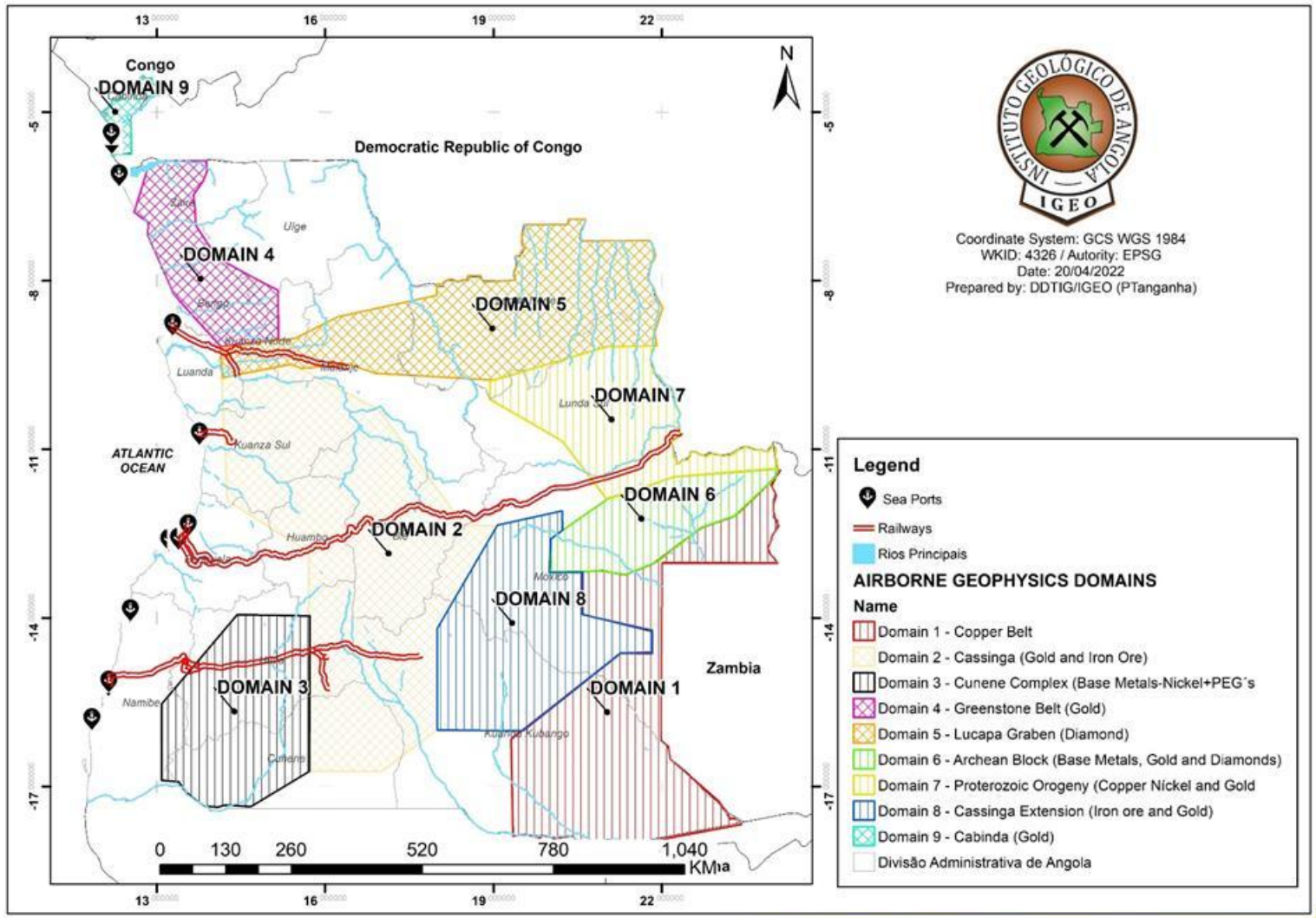
IMPORTANCE OF Digital Tarrain Model

- ✓ Urban planning and geotechnucs studies;
- ✓ Flood Risk mapping, Erosion and Environmental,
- ✓ Agriculture and Natural Resource Management.

2. AVAILABLE GEOCIENTÍFIC INFORMATION

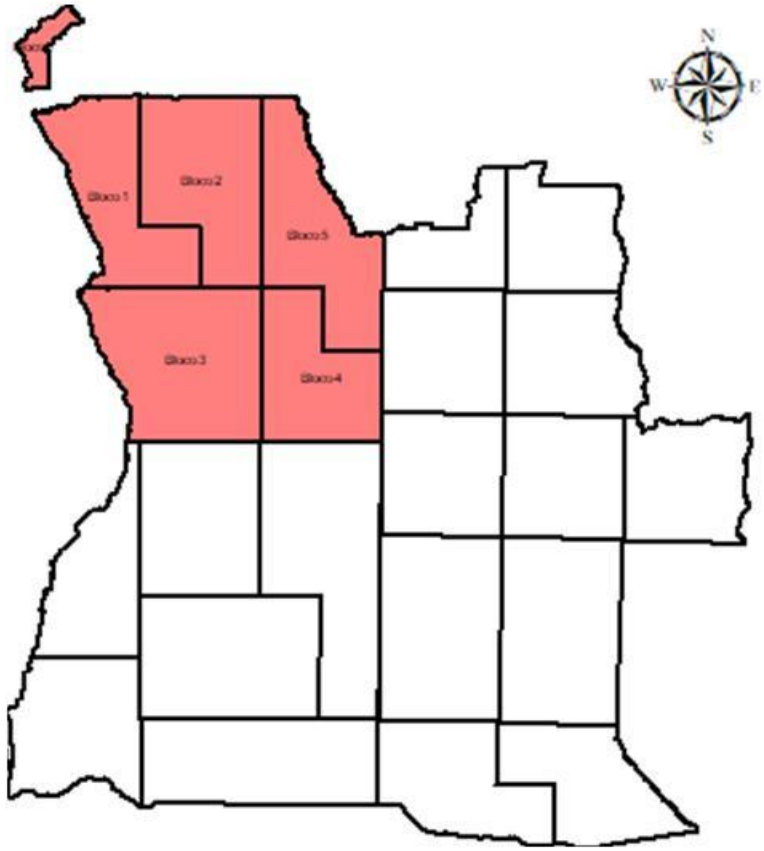
2.1 Result of National Geoloy Plan (PLANAGEO)

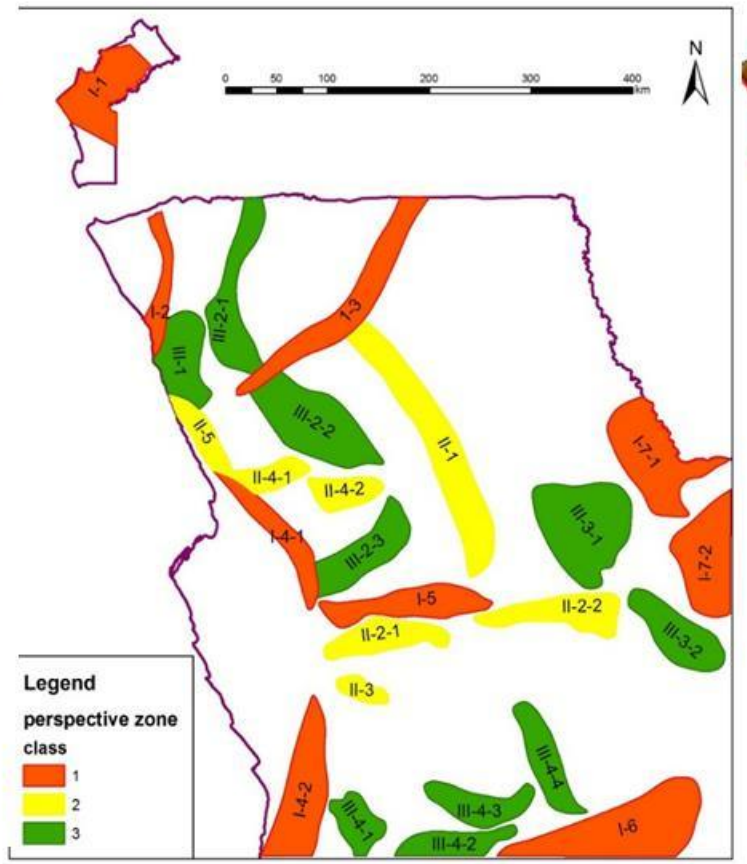
DOMAINS

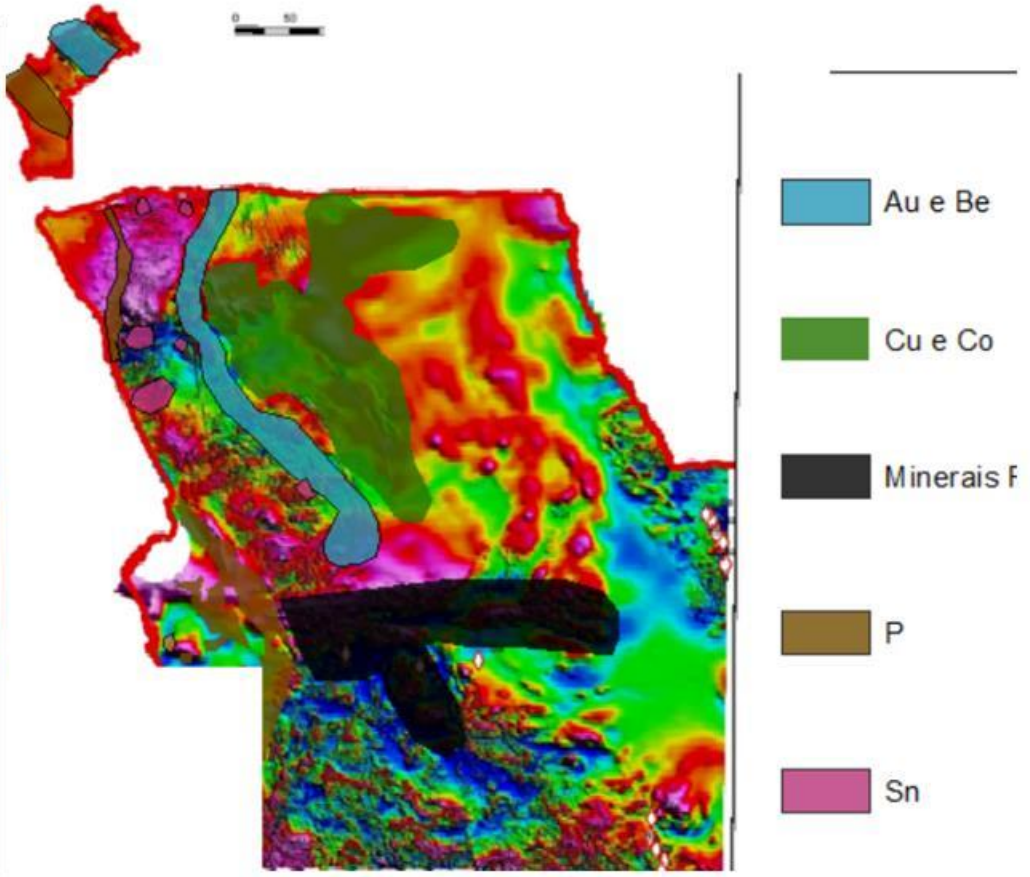


2. AVAILABLE GEOCIENTÍFIC INFORMATION

2.1 Zone 1. Result of National Geoloy Plan (PLANAGEO)





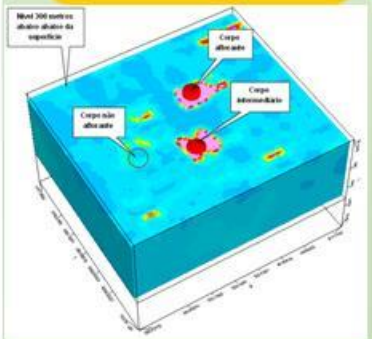


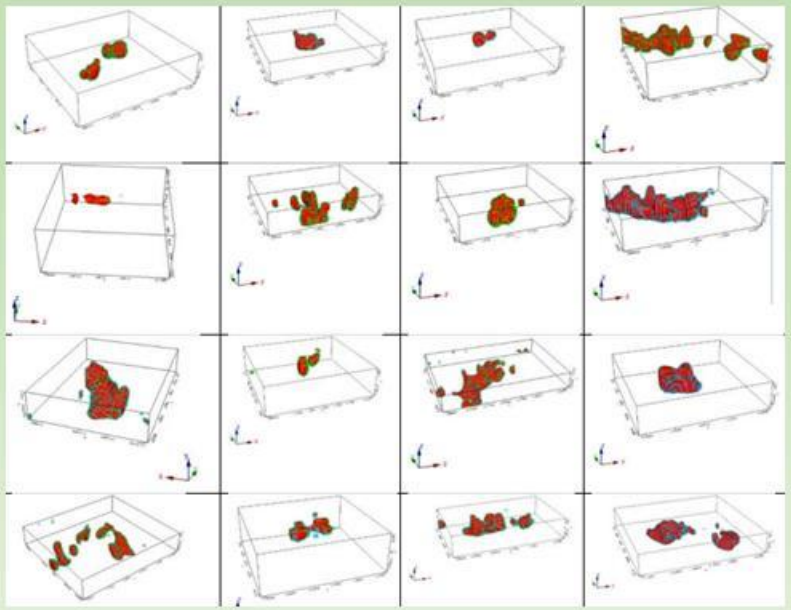
area of mineral interesse: Class I,7(9), Class II,5, Class III,4: I-1: **Gold, Phosphates; I-2: Phosphates, Uranium ; 1-3:** Copper, Zinc and Lead; I-4: Uranium and Copper; I-5: Iron, Mn, REE; I-6: Diiomond , metallic mineral; **I-7: Diomond; II-1: Copper, Zinc and Lead; II-2:** REE; III-1: Poly metallic; III-2: Ouro, Poly metallic; III-3 Relational element; III -4: Gold, REE

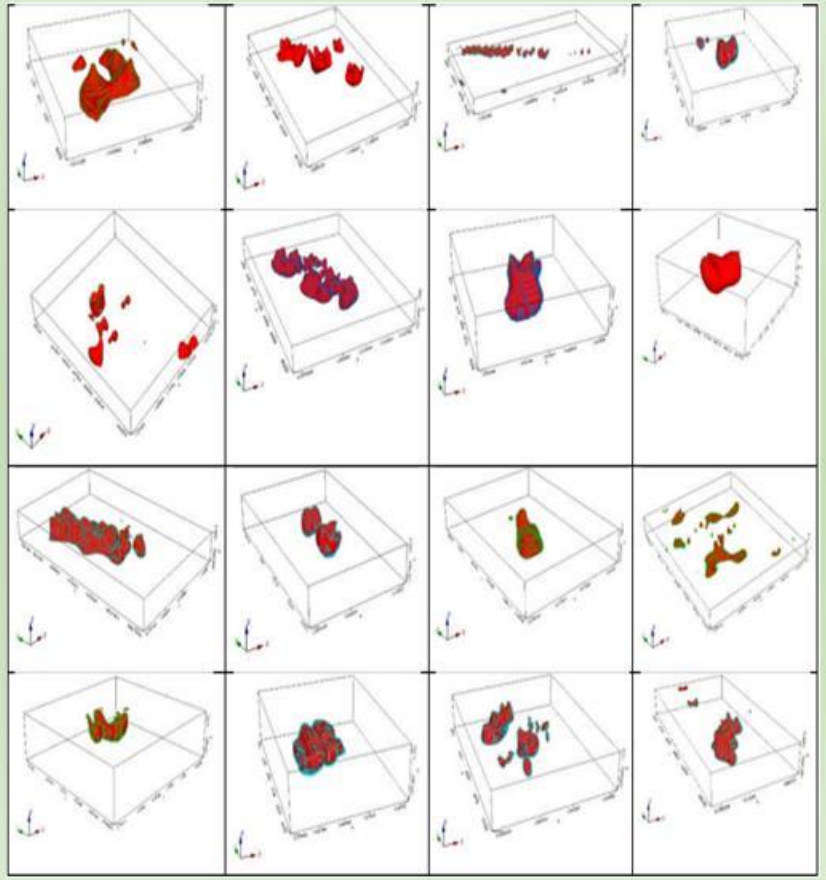
2. AVAILABLE GEOCIENTÍFIC INFORMATION

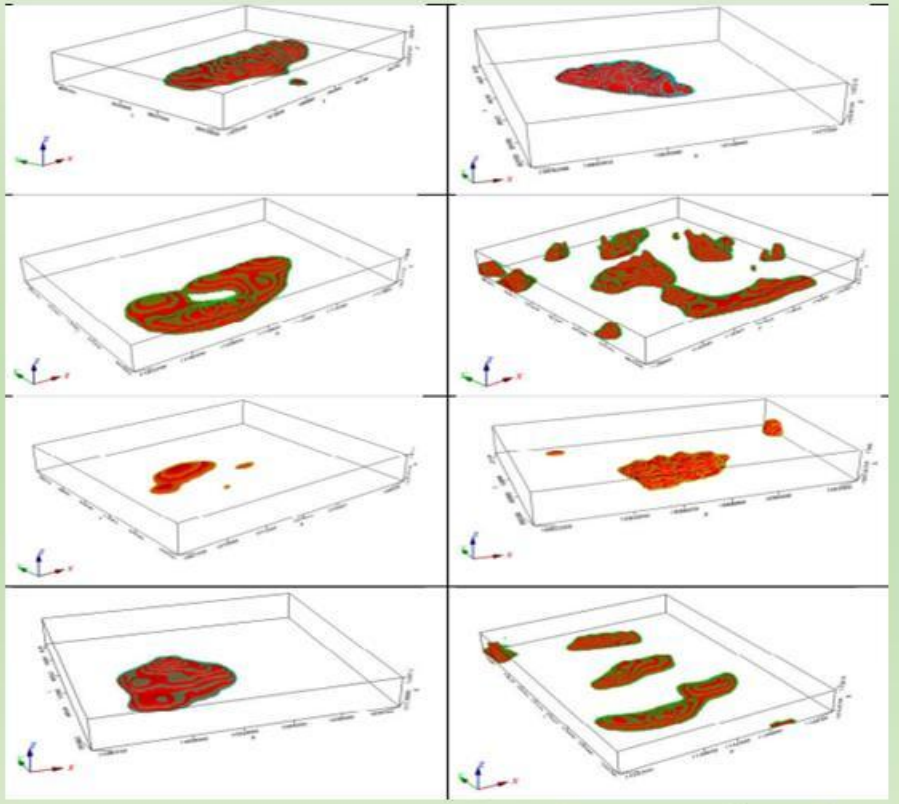
East part of Angola

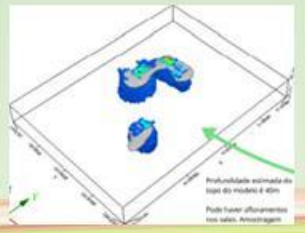
Zona 2

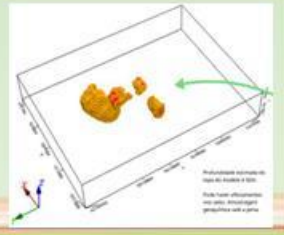










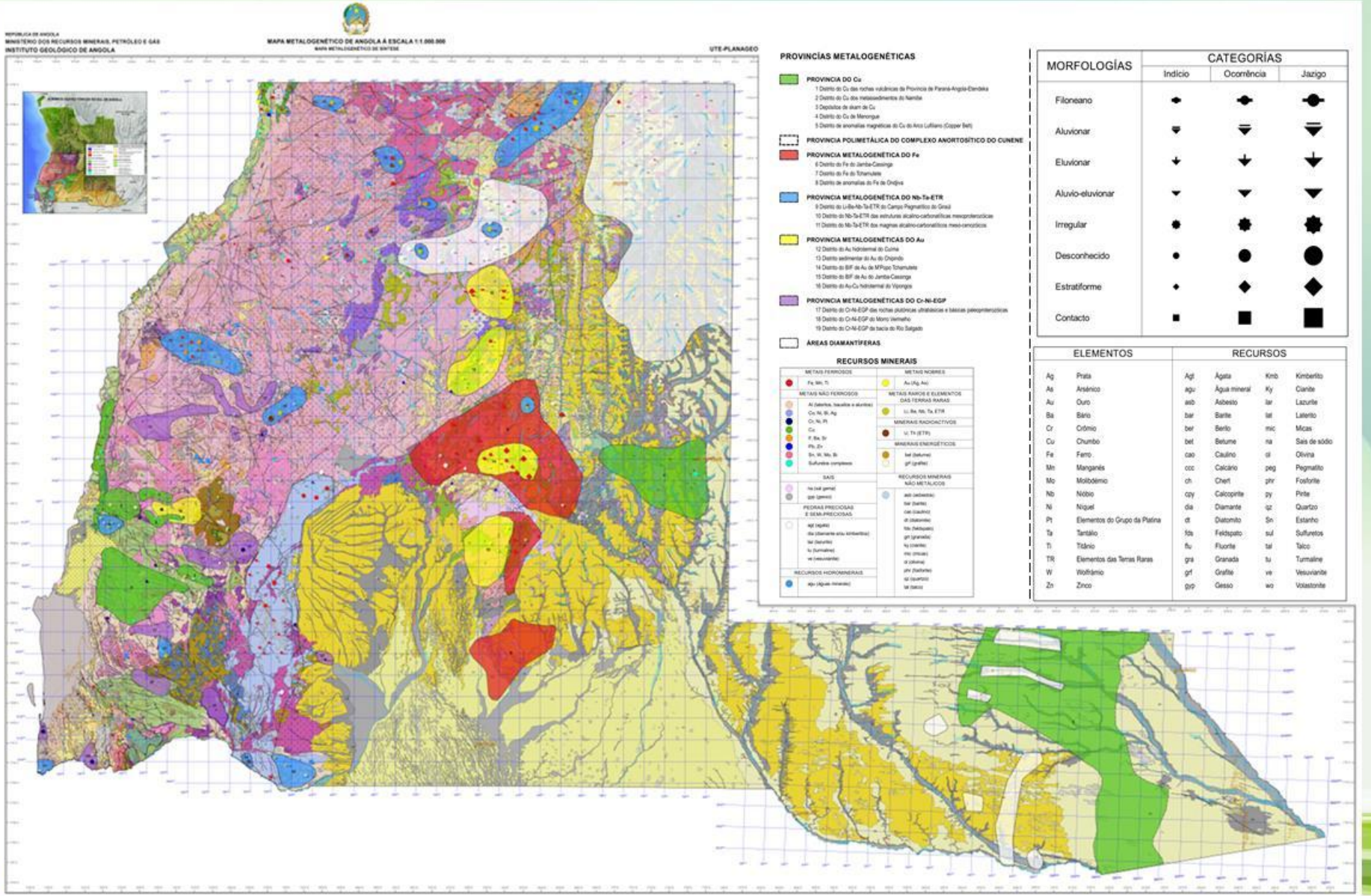


Potential Kimberlites Anomalies Interpreted

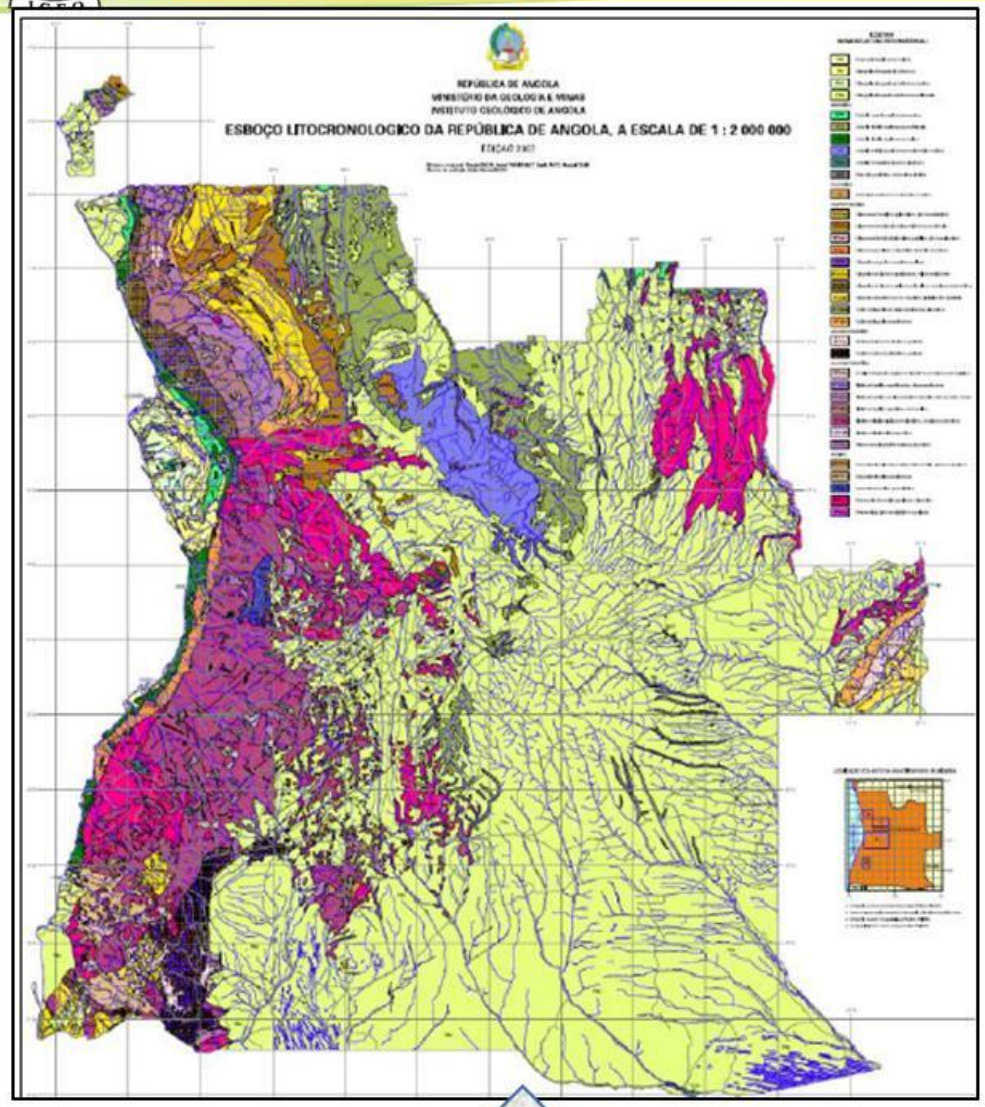
2. Metallogenic Map

2.2. Map of Metallogenic

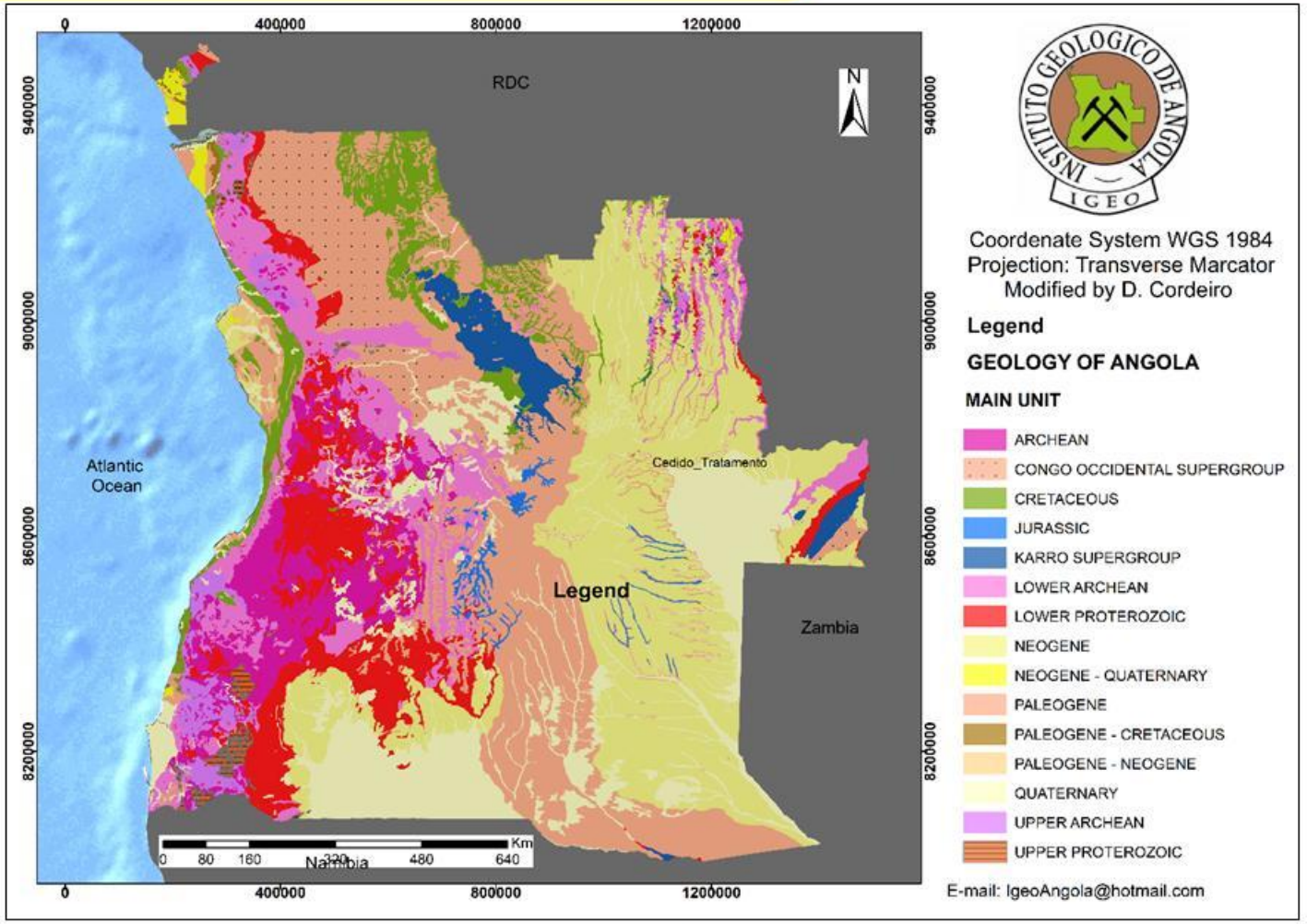
- **Copper Provinces;**
- **Polimetallic Province of the Cunene Complex;**
- **Polimetallic Province for Irone Ore;**
- **Polymetallic province of Niobium, tantalum, and rare earth elements**
- **Gold Province;**
- *Polimetallic Province for Cromium, Nickel and PGE´s;*
- *Diamond Areas*



2.3. AVAILABLE GEOCIENTÍFIC INFORMATION



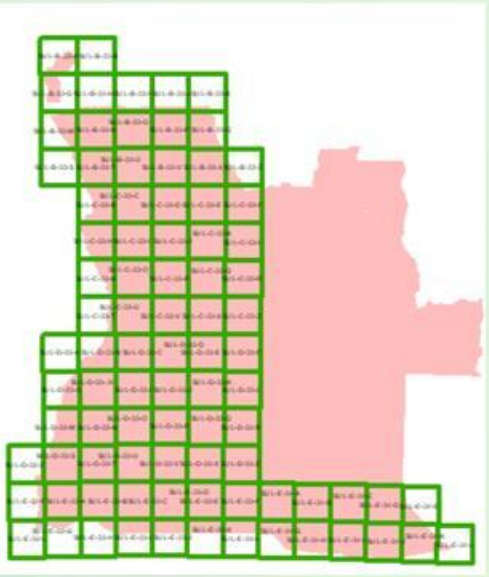
Map of Geology 1:2000.000

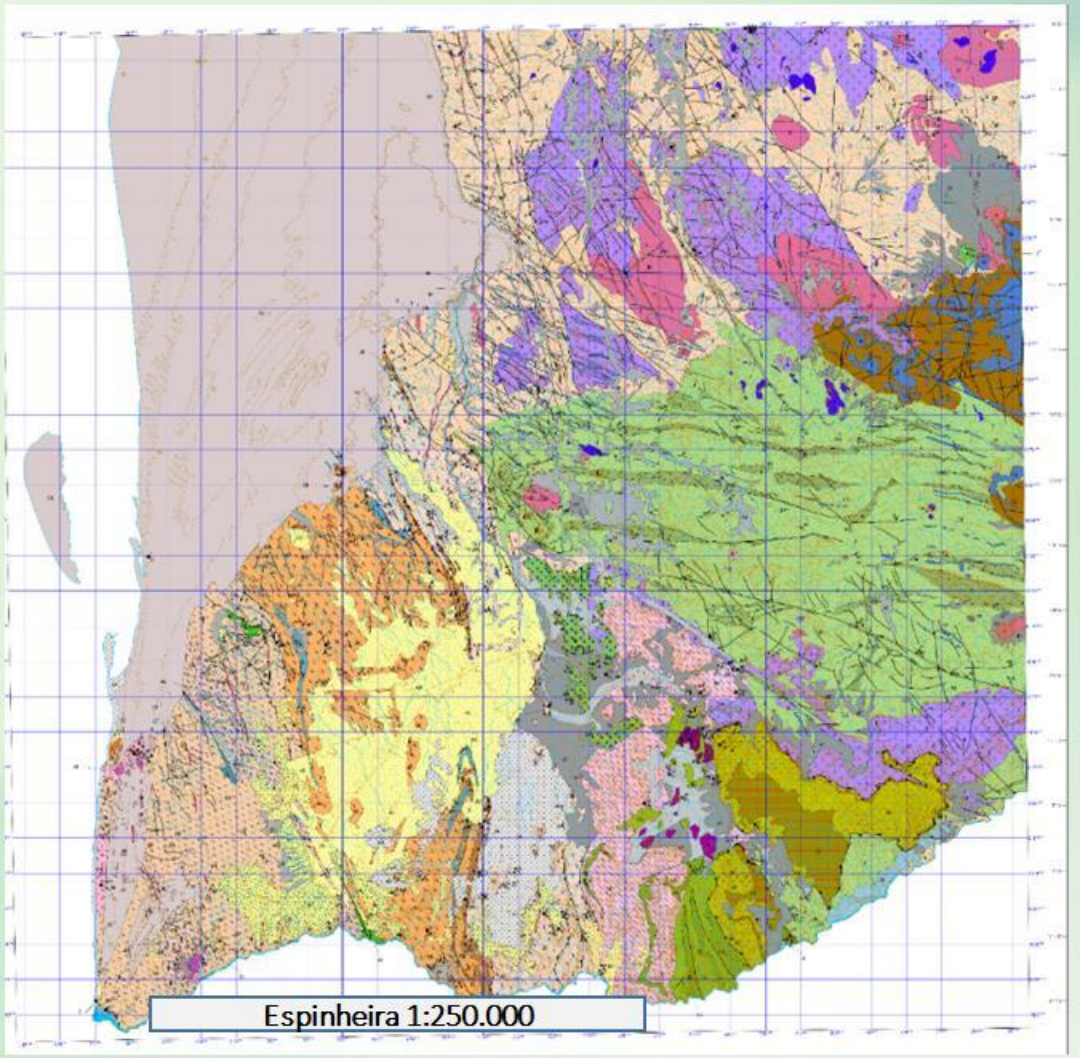


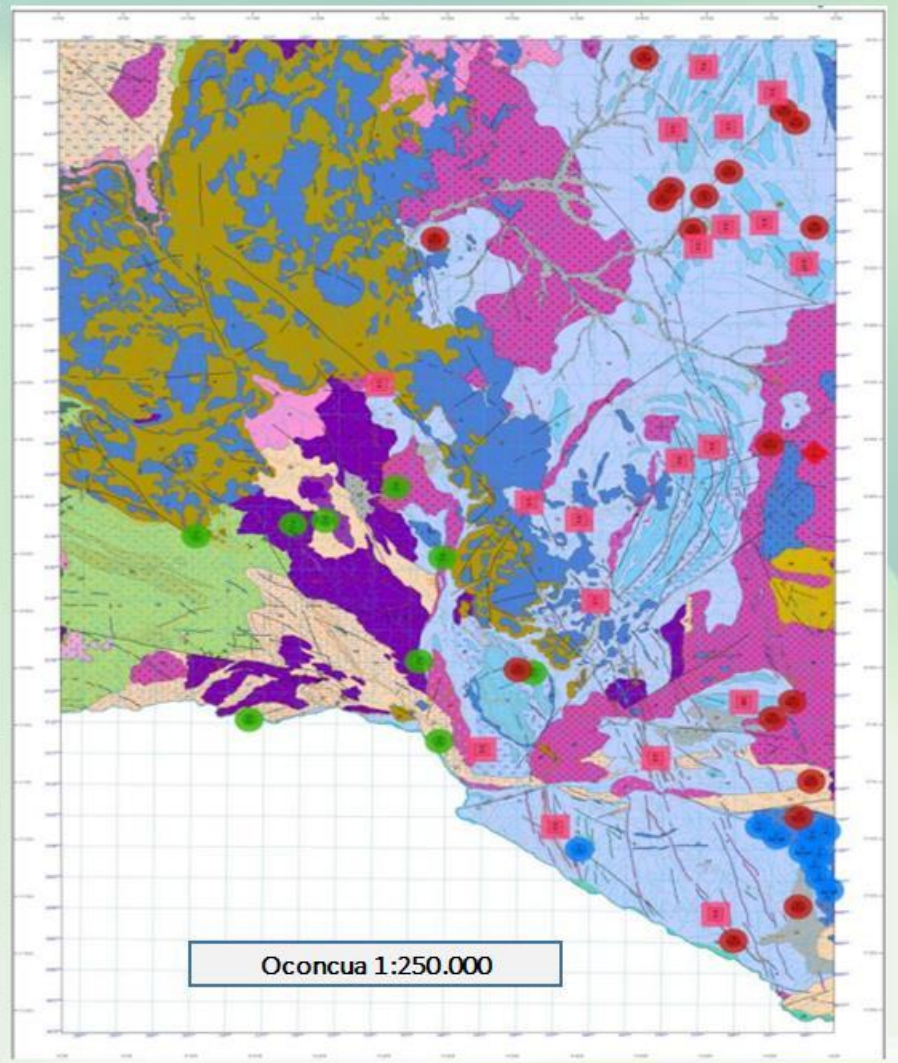
Map of Geology 1:1000.000

2.3. AVAILABLE GEOCIENTÍFIC INFORMATION

Map of geology 1.250.000 (PLANAGEO)

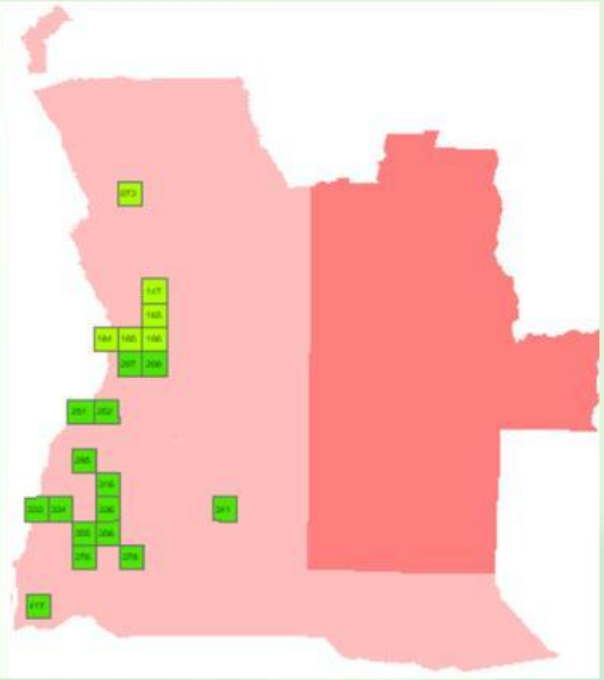




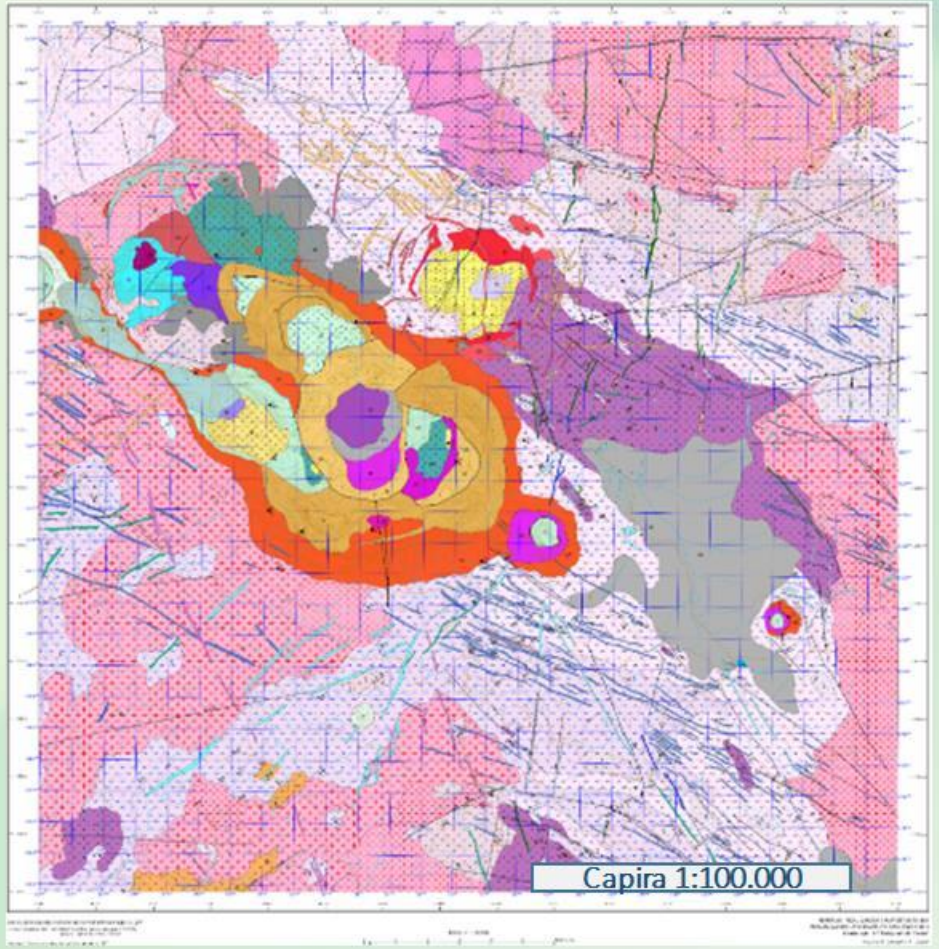


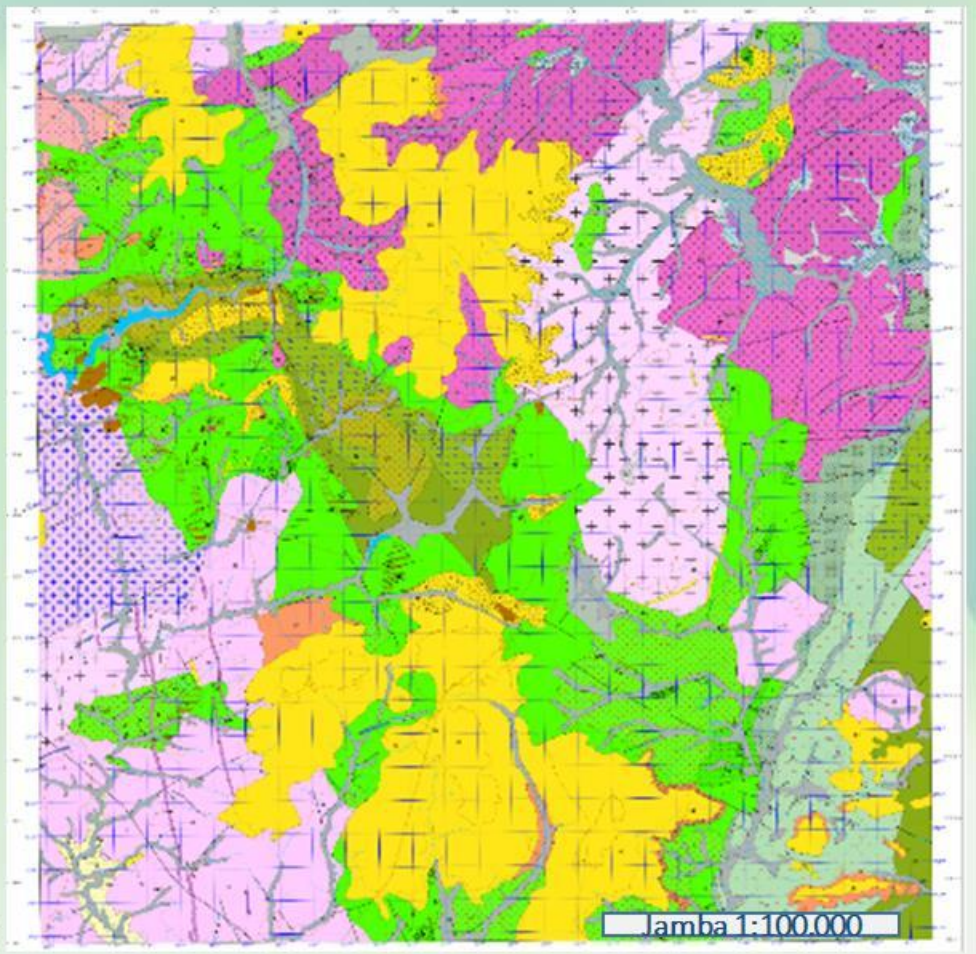
2.3. AVAILABLE GEOCIENTÍFIC INFORMATION

Map of Geology 1.100.000 (PLANAGEO)



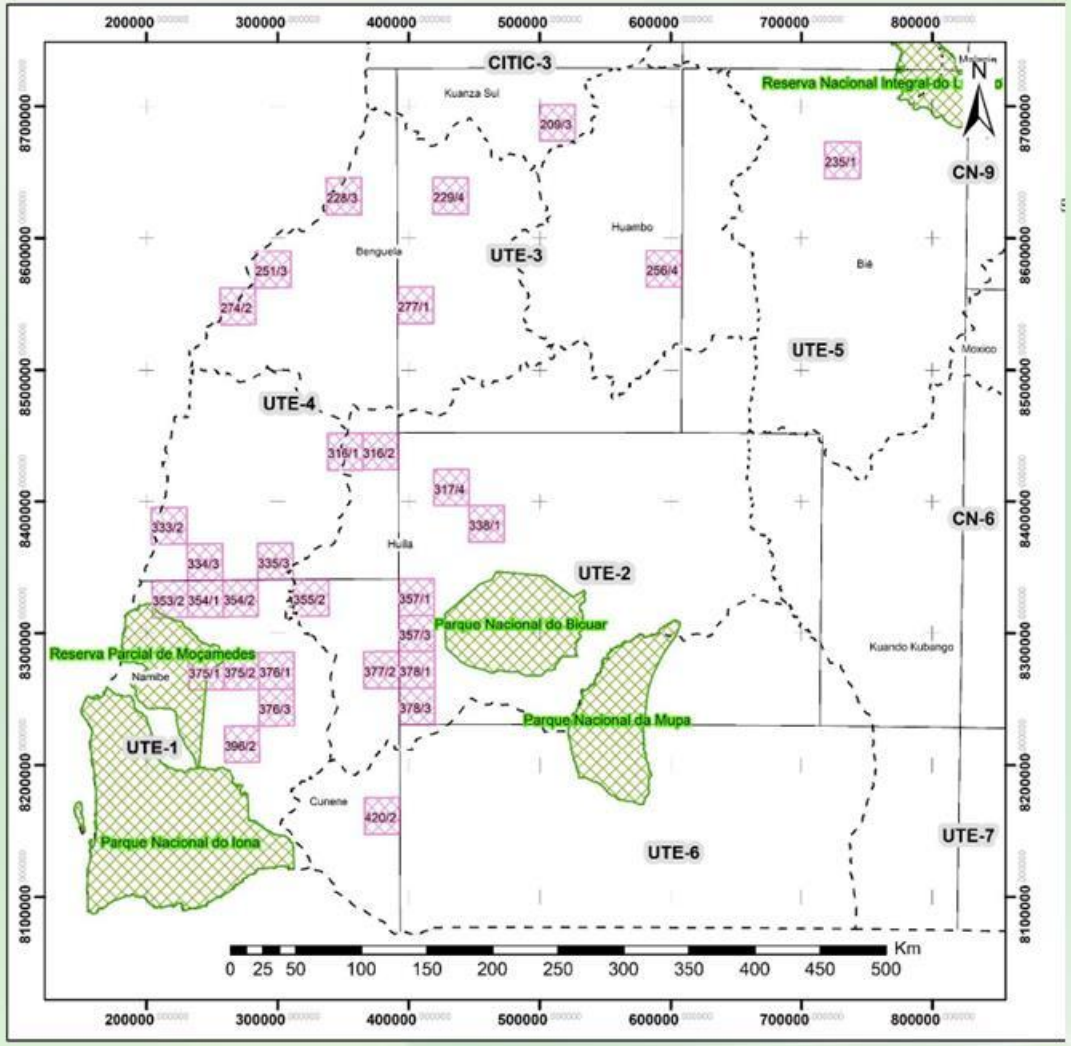
Thera are 21 completed geological maps at a scale of 1:100.000

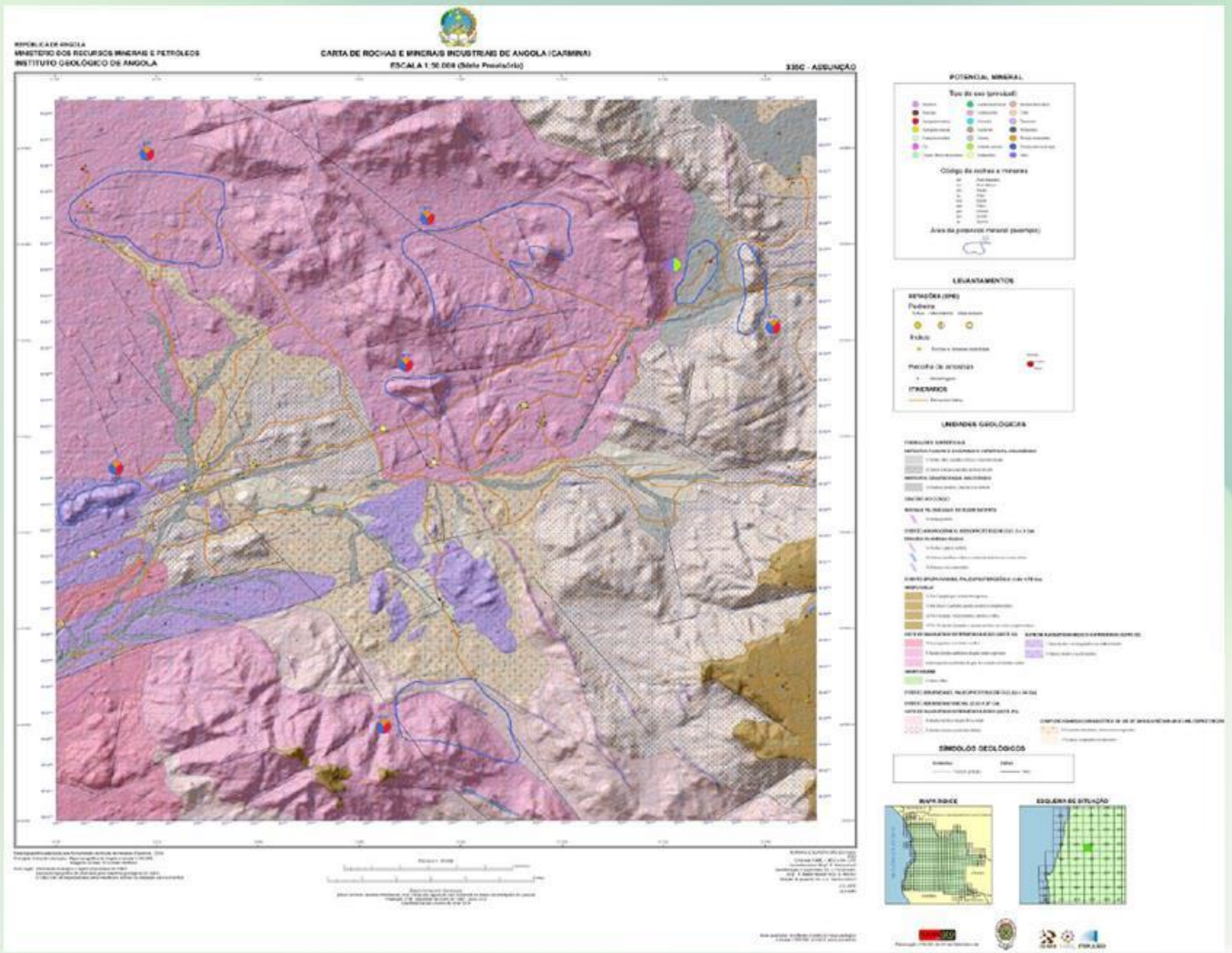




2.3. AVAILABLE GEOCIENTÍFIC INFORMATION

Map of Geolology at scale of 1.50.000 (PLANAGEO)
Exemple of the map of Assunção (there are 31 maps)

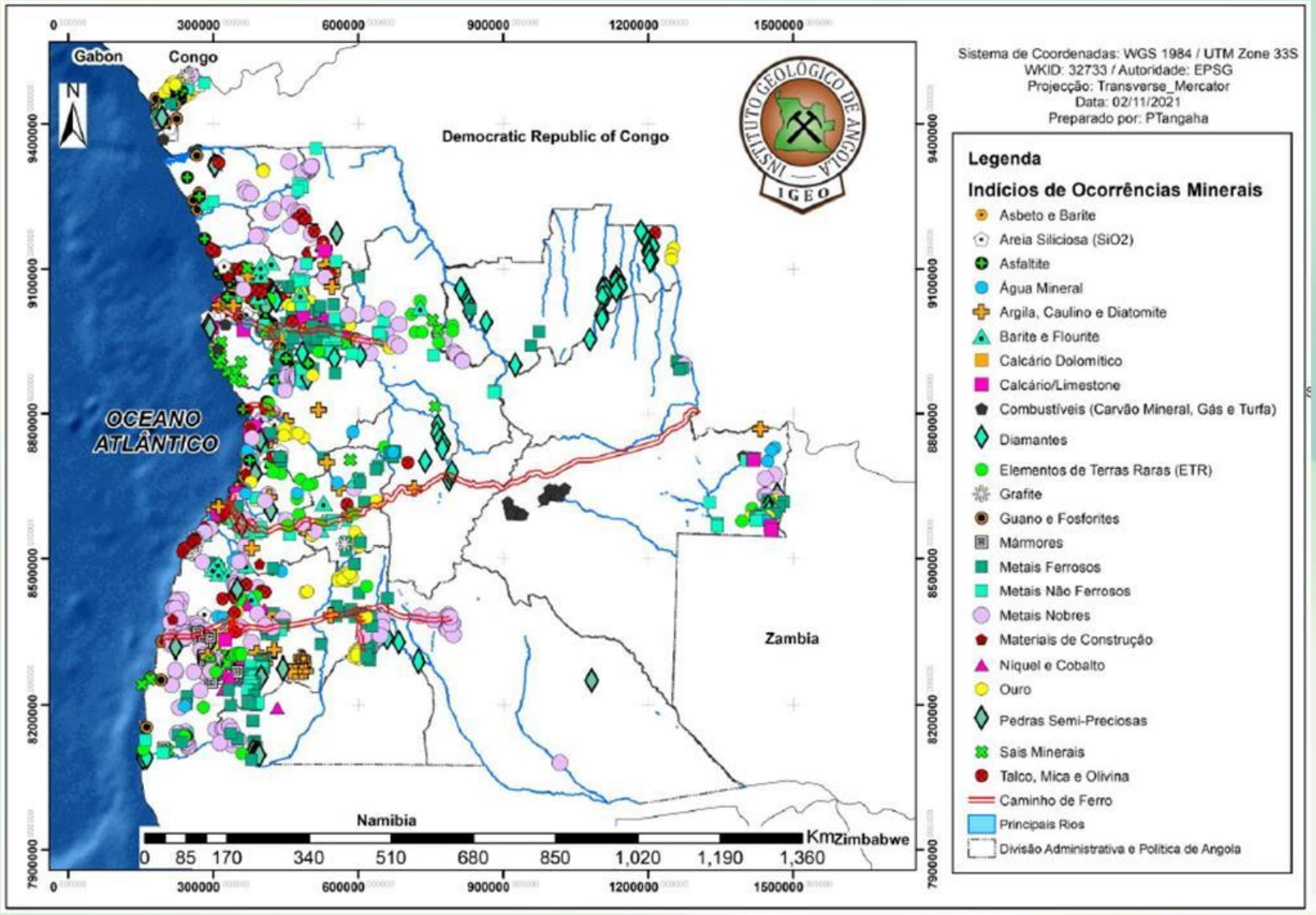




3. AVAILABLE GEOCIENTÍFIC INFORMATION

3.1. OCCURRENCE OF GENERAL MINERALS IN ANGOLA

There are more than 3000 points of minerals occurrence in Angola



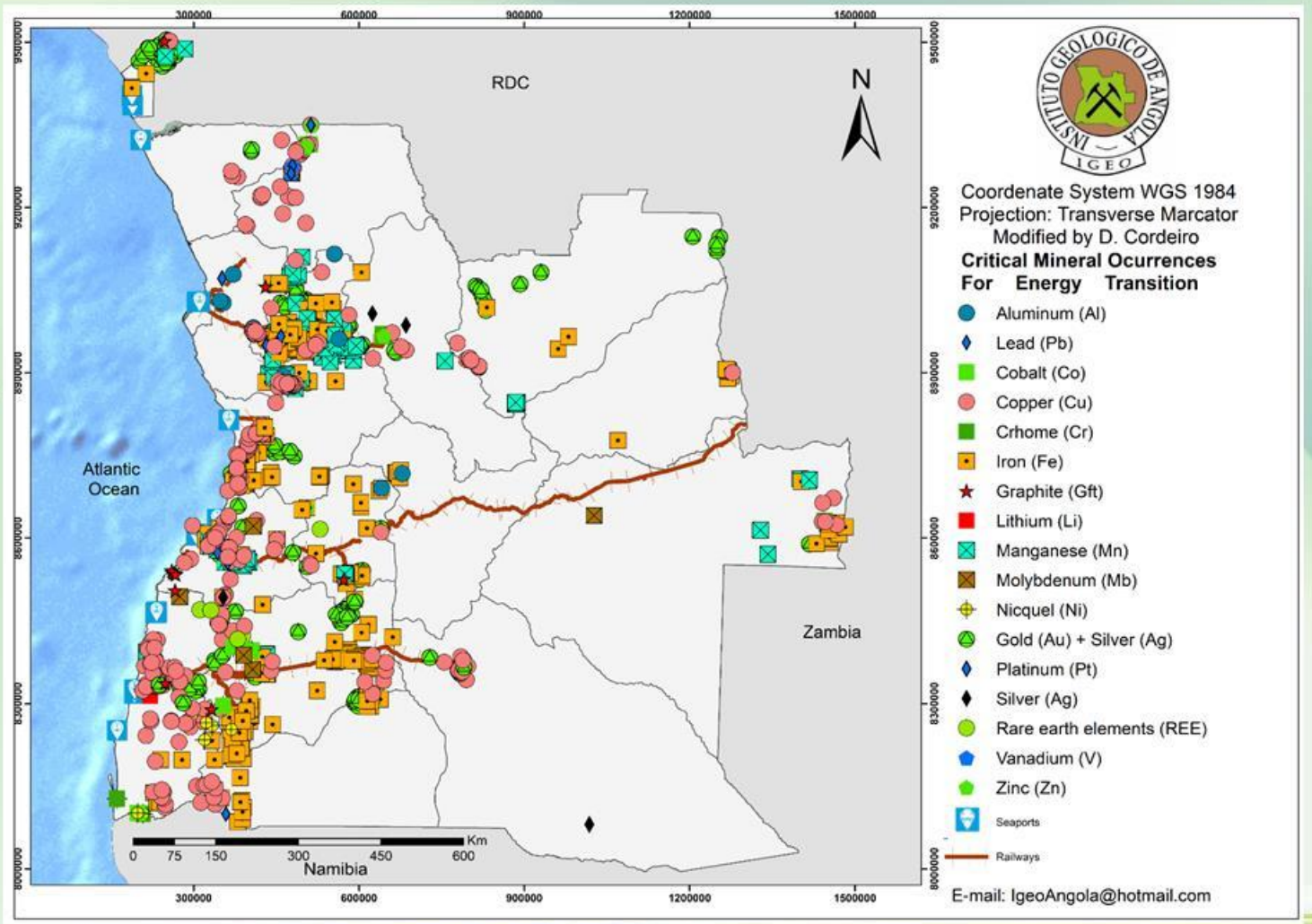
3. AVAILABLE GEOCIENTÍFIC INFORMATION

3.2. CRITICAL MINERALS FOR THE ENERGY TRANSITION IN ANGOLA

Table of highly demanded mineral resources (51minerals)

No.	Metal/Mineral	No.	Metal/Mineral	No.	Metal/Mineral
1	Aluminum	19	Gypsum	37	Light Rare Earth Elements (REE)
2	Antimony / Stibium	20	**Hafnium**	38	**Rhenium**
3	Barite	21	**Indian**	39	**Scandium**
4	Bauxite	22	Iron ore	40	**Selenium**
5	Bentonite	23	Limestone	41	Silica sand
6	Beryllium	24	Lithium	42	Silicon metal
7	Borate	25	**Magnesite**	43	Silver
8	Chromium	26	Magnesium	44	Talc
9	Clays	27	Manganese	45	Tantalum
10	Cobalt	28	Molybdenum	46	Tellurium
11	Coking coal	29	Natural graphite	47	Tin
12	Copper	30	Nickel	48	Titanium
13	Diatomite	31	Niobium	49	Tungsten
14	Feldspar	32	**Perlite**	50	Vanadium
15	Flourite	33	Platinum Group Metals (PGMs)	51	Zinc
16	**Gallium**	34	Phosphate Rock		
17	**Germanium**	35	Potash		
18	Gold	36	Heavy Rare Earth Elements (REE)		

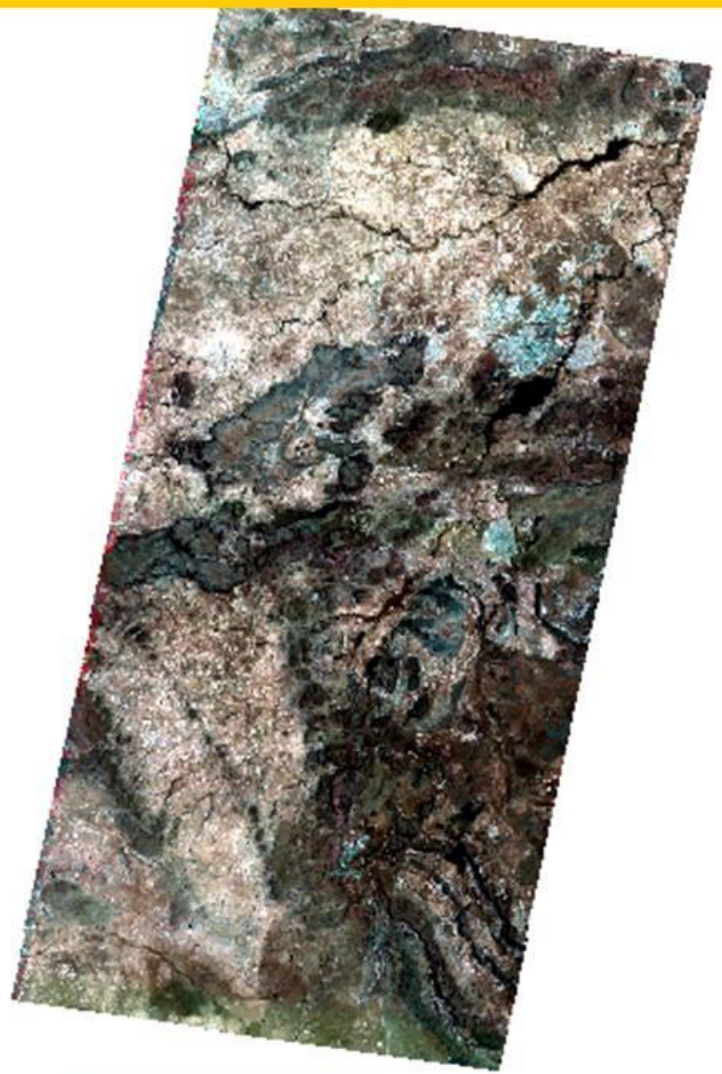
36 of most important minerals or substances are locatede in Angola.



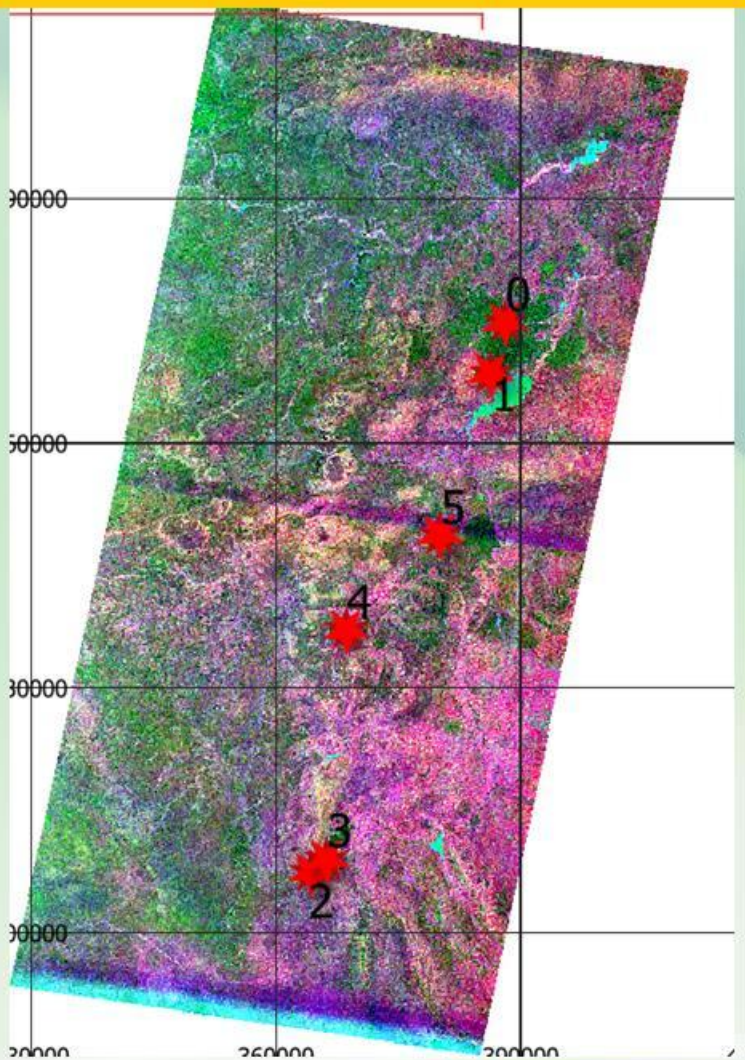
4. AVAILABLE TECHNICAL SERVICES

4.1. Remote Sensing (Aster images)

ASTER_321



ASTER_468



ASTER_BandRation 4/6; 5/6; 5/8

4. AVAILABLE TECHNICAL SERVICES

4.1. Remote Sensing (Drones)

4. AVAILABLE TECHNICAL SERVICES

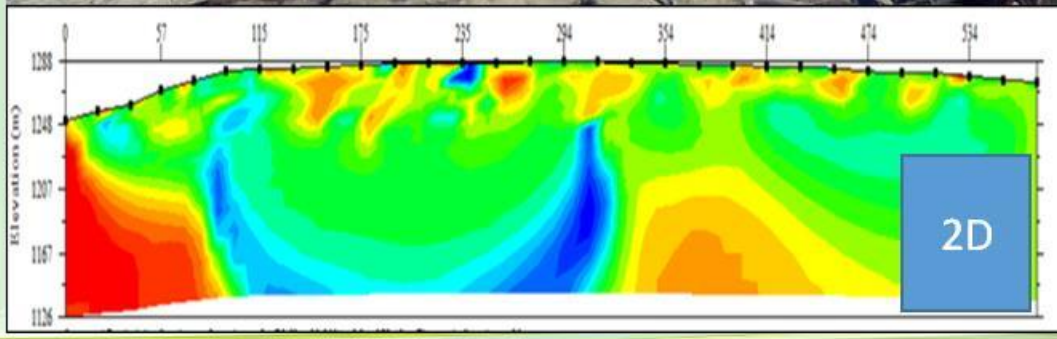
4.1. Geophysics Equipments (Resistivity meter)

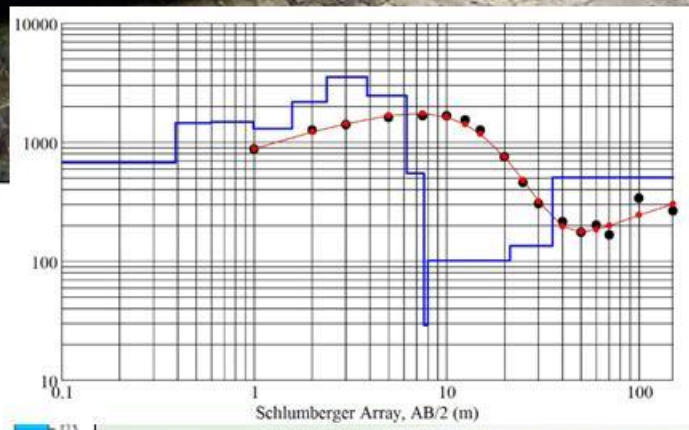
Metodos:

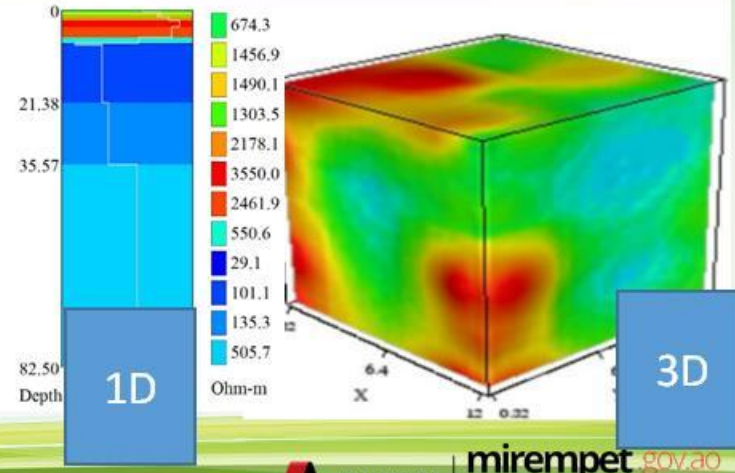
- Electrorresistividade
- Polarização Induzida

Arranjos
Schlumberger, dipolo-dipolo, polo-dipolo

Técnicas:
Schlumberger (SEV)
Caminhamento eléctrico (CE)







4. AVAILABLE TECHNICAL SERVICES

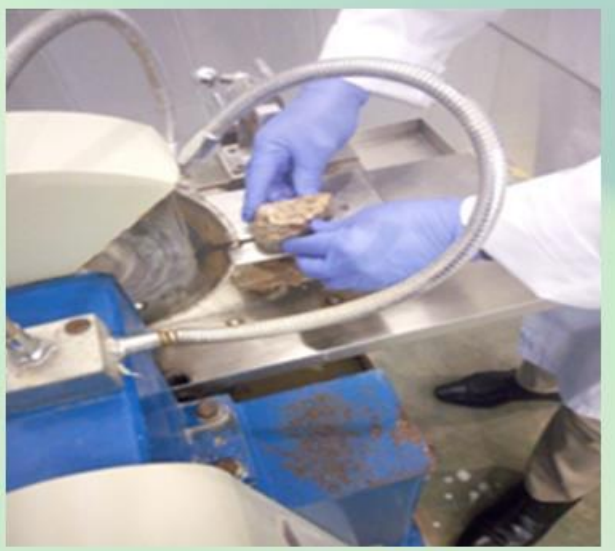
4.1.Geophysics Equipments

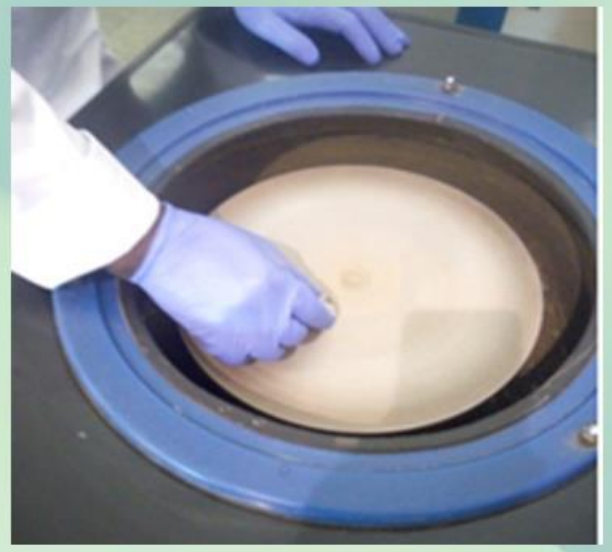
- Gravimeter
- Magnetometer,
- elecromagnetic

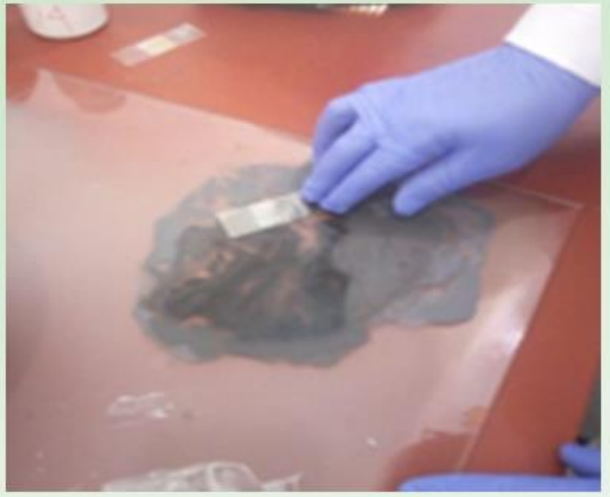
Magnetómetros: a) Geometrics 857 e b) GMS 19

4. AVAILABLE TECHNICAL SERVICES

4.2. Analytical Laboratories (Sample preparation)







Physical Preparation Of samples (Rocks And Soils)

4. AVAILABLE TECHNICAL SERVICES (XRF, ICP MS

4.2. Analytical Laboratories (XRF and ICP MS

Name	Name of proficiency test	Reference Method
Geoscientific Laboratory	Determination of the content of heavy metals in the soil (Mn, Co ,Bi,U)	ICP-MS Methods - 53
	Analysis of the chemical composition of gold ore	GFAAS Methods -16
	(Au, Ag)	AES Methods -12
	Analysis of chemical composition in silicate rock (CaO, K_2O, TiO_2, P_2O_5)	XRF Methods -51

4. AVAILABLE TECHNICAL SERVICES

4.2. Analytical Laboratories (Identification of minerals)

Analysis of Minerals Using Microscope

Name	Name of proficiency test	Reference Method
	Qualitative phase analysis of XRD (X-Ray Diffraction) for unknown powder Qualitative phase analysis	XRD Methods -70
	Microprobe analysis	EPMA Methods - 75,76,77,78

4. AVAILABLE TECHNICAL SERVICES

4.2. Analytical Laboratories
(Dimission Rocks and construction materials)

The Technological Center for the Valorization of Ornamental Rocks of Angola (CVRO) in Lubango was inaugurated on April 27, 2021 and is located at Lubango, Huíla province

Mechanical Testing Services for Dimission Rocks and Aggregates

Tests for quality of rocks and aggregates

4. AVAILABLE TECHNICAL SERVICES

Liquid chromatography.

Can Analyse 4 elements in a sample (ppm):

- Fluoride,
- Calcium,
- Sulfate,
- Nitrate

Method used is 32.

Digital Meter of Fluoride ion In a water sample, it analyzes the element Fluoride (ppb).

Digital Meter of PH

In Liquid or solid sample analyse:

- Acidity
- Alkalinity
- Neutral

PH scale: 0 to 14 and 7 neutral for water sample Method: 26

4. AVAILABLE TECHNICAL SERVICES

4.5. Laboratoty – CAPACIBILITY

LABORATORY SPECIALIZATION

1. Geochemical analysis
2. Quality control and assurance
3. Identification of minerals and rocks

Laboratory Equipment

129 Equipments

Rocks and Minerals identification

Chimical Analysis

Sample Preparation

Laboratory Technicians

CAPACIDADE

Can receive 99 Samples per batch

115 Samples /day, by ICP-MS

50 Samples/ day, by XRF

Spraying: 50 Samples of soil and 25 of samples rocks

Produces 40 Finy session / Day

Identification of 20 finy session per day

4. AVAILABLE TECHNICAL SERVICES

4. LABORATORY ACCREDITATION CERTIFICATE

The Geoscientific Laboratory of the Geological Institute of Angola holds the Laboratory Accreditation Certificate registered under number CNAS L15776, issued by the China National Accreditation Committee for Conformity Review (CNAS) in accordance with the ISO/IEC 17025:2017 standard, general requirement for the competence of testing and calibration laboratories. (CNAS-CL01: Laboratory Testing and Calibration Capability Accreditation Standard).

4. DRILLING CAPACITY

Drilling Capacity with the following methods:

- Core Drilling;
- Reverse Circulation Drilling;
- Mud Rotary Drilling;
- Bucket Auger Drilling;
- Down the Hole Drilling

4. Museum of geology and minerals

4. 4. Exhibition of mineral resources samples

The Museum is a Center of Research in:

- **Rocks**
- **Paleontology**
- **Mineralogy**

Visitors

- Mining companies
- Business people

- Students
- Ambassadors

4. Library

4.5. Library, geological map store and Geoscientific photo library

A Biblioteca do IGEO é administrada pelo Centro de documentação Geológica nela podemos encontrar:

- Publications of scientific research in the field of general geology
- Technical Field Reports of all the Country
- Scientific Journals

Currently, the library is digitizing all the documentation that makes up its archive

Visitors

- Mining companies
- Business people
- students





5. BADABASE

5. BADAGEO (DADABASE GEOCIENTIFIC)

Geospatial Data (shapefiles, *gdb, *.geotiff and others) with PostgreSQL extension.

MS WORD, MS EXCEL, MS POWERPOINT, PDF, photos, videos.

Structured File System for data storage.

6. CONCLUSION

Angola offers greatest investment opportunities in the mineral resources sector; please come and join us in diversifying the mining sector and contributing to the sustainable development of Angola.

THANK YOU BY YOUR ATTANTION

Address:
Geological Institute of Angola
Kilamba City, street 311
Telephone: +244 914 077737
Luanda - Angola