



Republic of Angola

MINISTRY OF GEOLOGY, MINES AND INDUSTRY

Mineral Resources of Angola, its importance for the socio-economic and sustainable development of the country

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General information

Angola is located on the western coast of southern Africa. It has eighteen provinces: Cabinda, Zaire, Uíge, Luanda, Bengo, Cuanza Norte, Cuanza Sul, Malanje, Lunda Norte, Lunda Sul, Bié, Moxico, Benguela, Huambo, Namibe, Huíla, Cuando Cubango and Cunene.



- President of the Republic: José Eduardo dos Santos
 - Area: 1 246 700 km²
 - Population(2009): 18.498.000
 - Climate: Inter-tropical
 - Capital: Luanda
 - Official Language: Portuguese
- Currency: Kwanza(Akz)



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Geology of Angola

Angola can be subdivided into 5 main regional geological units, each one containing a distinct combination of mineral deposits.

Quaternary to Tertiary Sedimentary Cover Rocks comprising sand, quartzic sandstone, gravel and clay extend over nearly half of Angola, including the entire eastern part.

Pleistocene to Cretaceous marine sediments lie in a series of coastal basins on the western margin of Angola

Mesozoic to Paleozoic sediments equivalent to the Karroo Supergroup occur mainly in the Cassanje Graben, a north-central to north-western geographical depression. Diverse sub-volcanic and volcanic bodies occur including kimberlites and carbonatites along a major south-west to north-east trend line across Angola (Lucapa's corridor), as well as basalt, dolerites, syenites, trachytes and phonolites

Upper Proterozoic fold belts (Pan African age) occur along the margins of Angola's Precambrian shield, the most important being the West-Congo, Damara And Maiombe-Maongo. They are characterized by the occurrence of base metal mineralisation and a variety of industrial minerals

Lower Proterozoic to Archaean rocks from the Angolan, Maiombe, Cassai and Bangwelo shields and the Kwanza horst. Granite-gneissic terrain meta-volcano sedimentary (greenstone) belts are present in south-central Angola (Cassinga and Menongue). The Cunene basic (ultrabasic) complex occupies 20 000Km² of the south-western part of the Angolan shield



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Geology of Angola

- Most of Angola's mineral potential, apart from its oil and gas reserves, is related to its Precambrian Shield which outcrops over large parts of the country
- Of great interest for future exploration are greenstone belts of Archean and Lower Proterozoic age, in which basemetals and gold occur
- Angola's most important mineral resource (after oil and gas) are diamonds. Their distribution is also related to the Precambrian basement. They have been brought to surface by kimberlite pipes of Cretaceous age (80 – 100 Ma) which are aligned along a 1200 Km long structural trend (Lucapa's corridor) which intersects the Precambrian shield in a north-easterly direction
- Closely related in time and space with kimberlites are carbonatites, which offer exploration opportunities for carbonatite associated minerals such as nepheline, niobium tantalum, fluorite, barite and rare earths
- 3 fold belts of Panafrican age occur around certain parts of the Angolan Precambrian shield. Associated with them are exploration opportunities for stratabound polymetallic copper ores of the copper belt type



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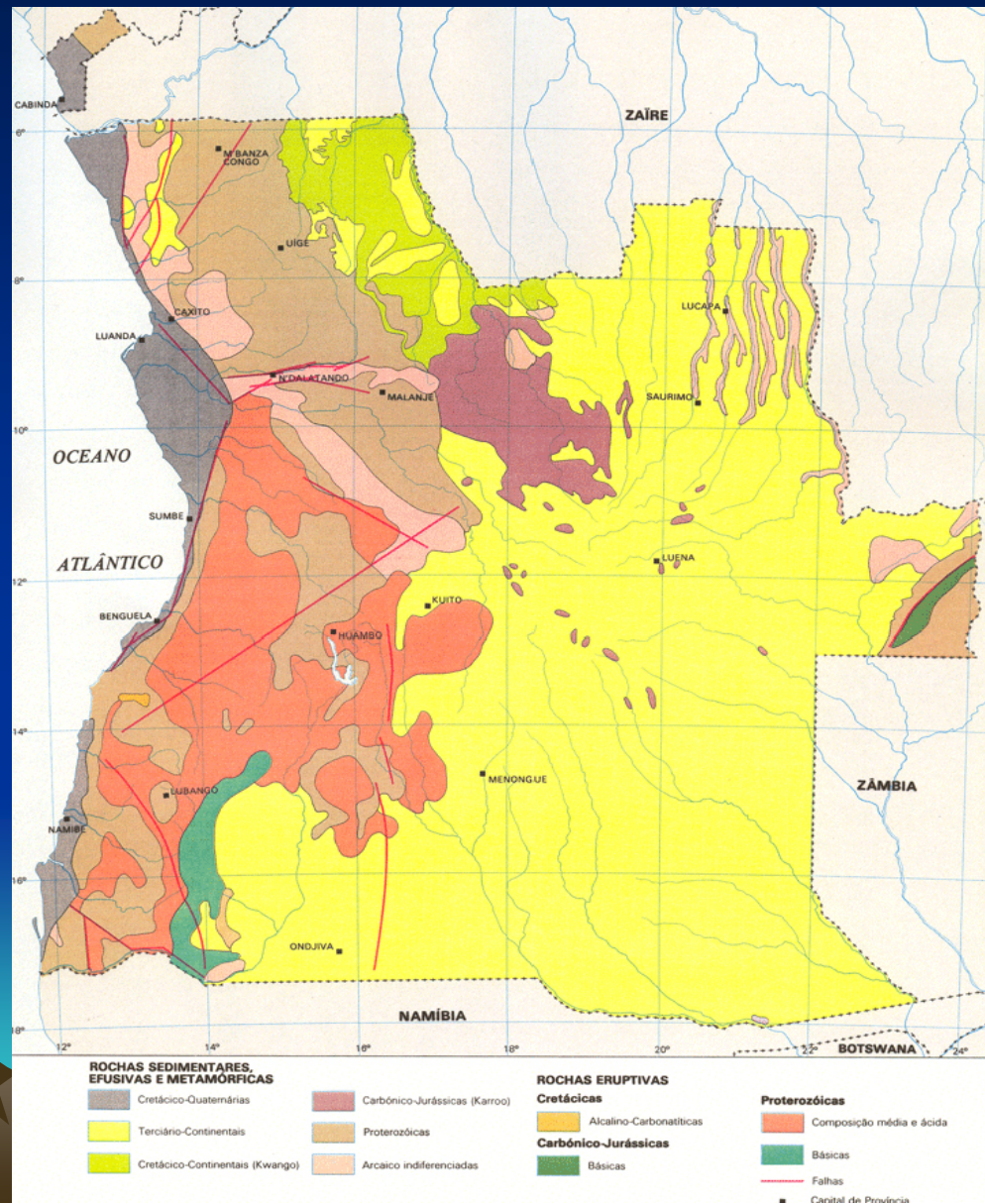
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- Marine coastal basins of Lower Cretaceous to Quaternary age host Angola's important oil and gas reserves, which are the country's most significant mineral resource. Also associated with the coastal basins are low grade stratabound copper deposits and asphalt, bitumen and a number of industrial and chemical minerals, including salt, potash, phosphate, sulphur, gypsum and limestones
- Extensive areas of south-eastern Angola are covered with Kalahari sand deposits. They contain lignite seams

The Cenozoic-Cretaceous coastal basins are well Known due the borehole data from oil-exploration, whereas the Kalahari covered areas of Moxico and Cuando Cubango provinces are virtually unknown.



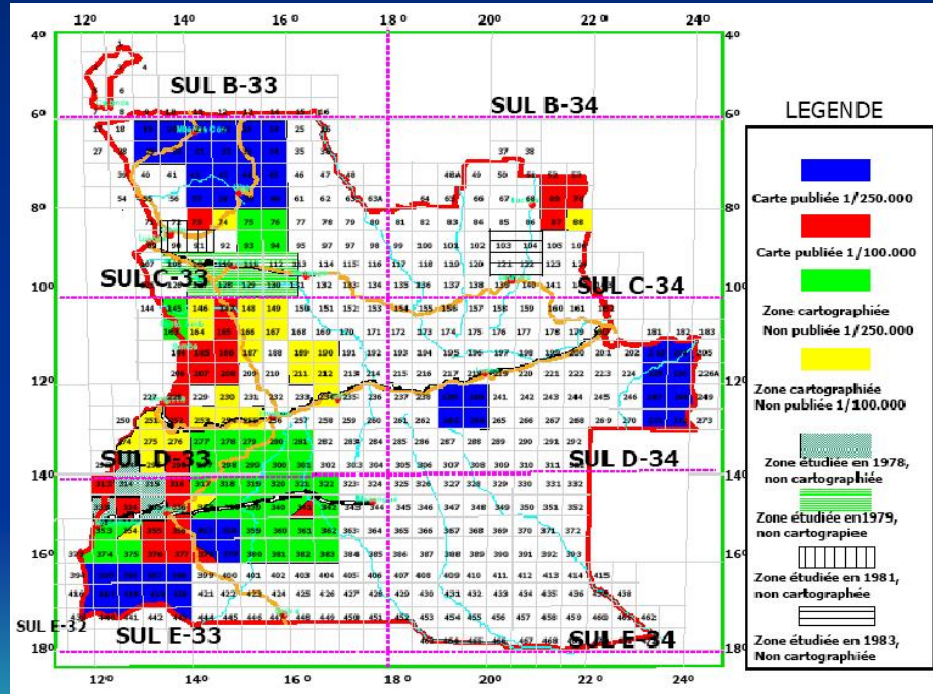
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Geological knowledge status in Angola: Index of coverage of geological mapping





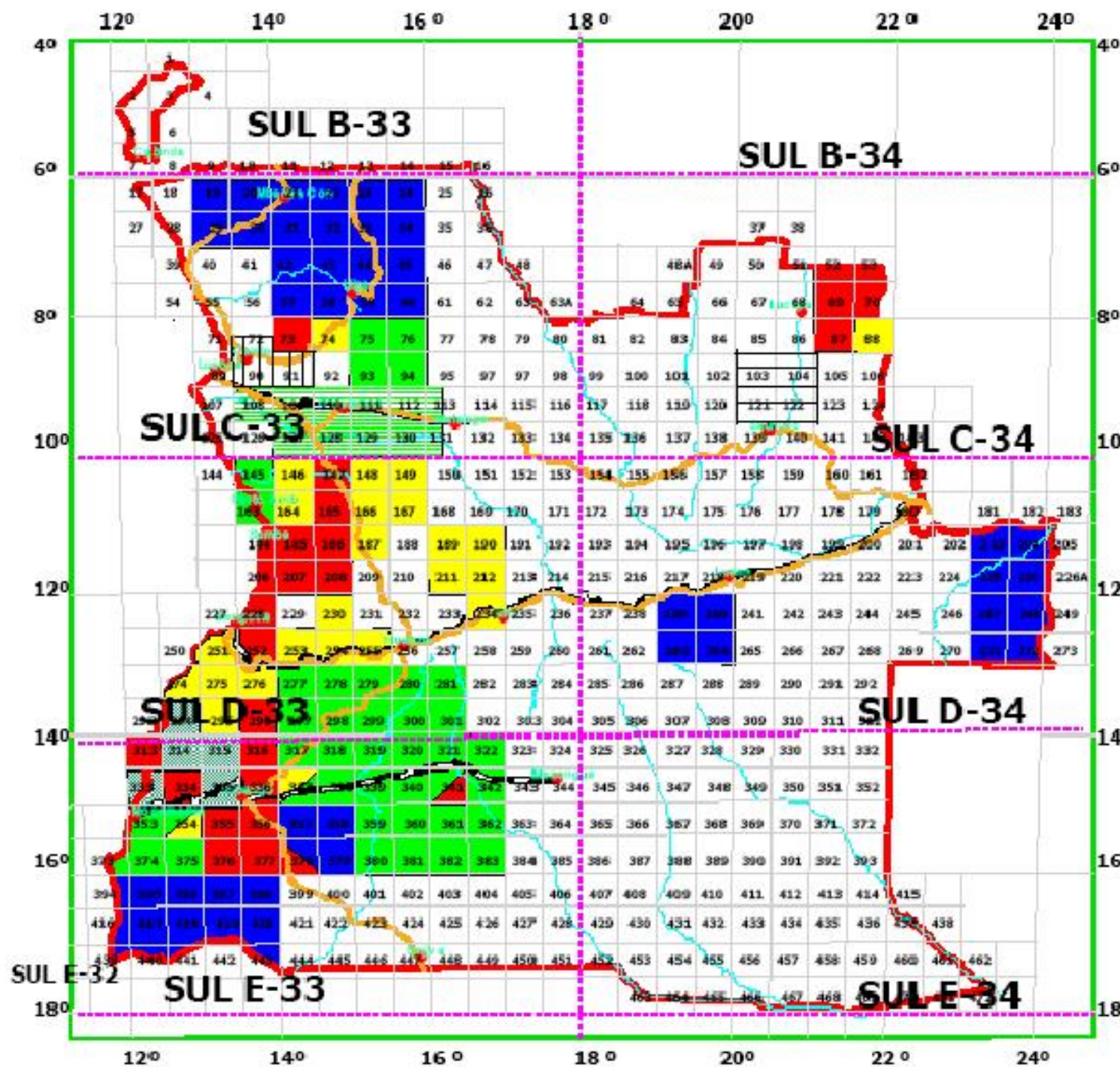
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Regional Geological Mapping

- . 31% of the country has been geologically mapped
- . 28 geological maps at scale 1:100 000 and reports published
- . 14 geological maps at scale 1:250 000 and reports published

After 1975 Angola's independence

- . 1 geological map at scale 1:25 000 and report published
- . 1 geological map of the whole country at scale 1:1 000 000 and report published
- . 1 Mineral Resources map at scale 1 000 000 and report published
- . 14 mapped at scale 1:250 000, but not published
- . 25 mapped at scale 1:100 000, but not published

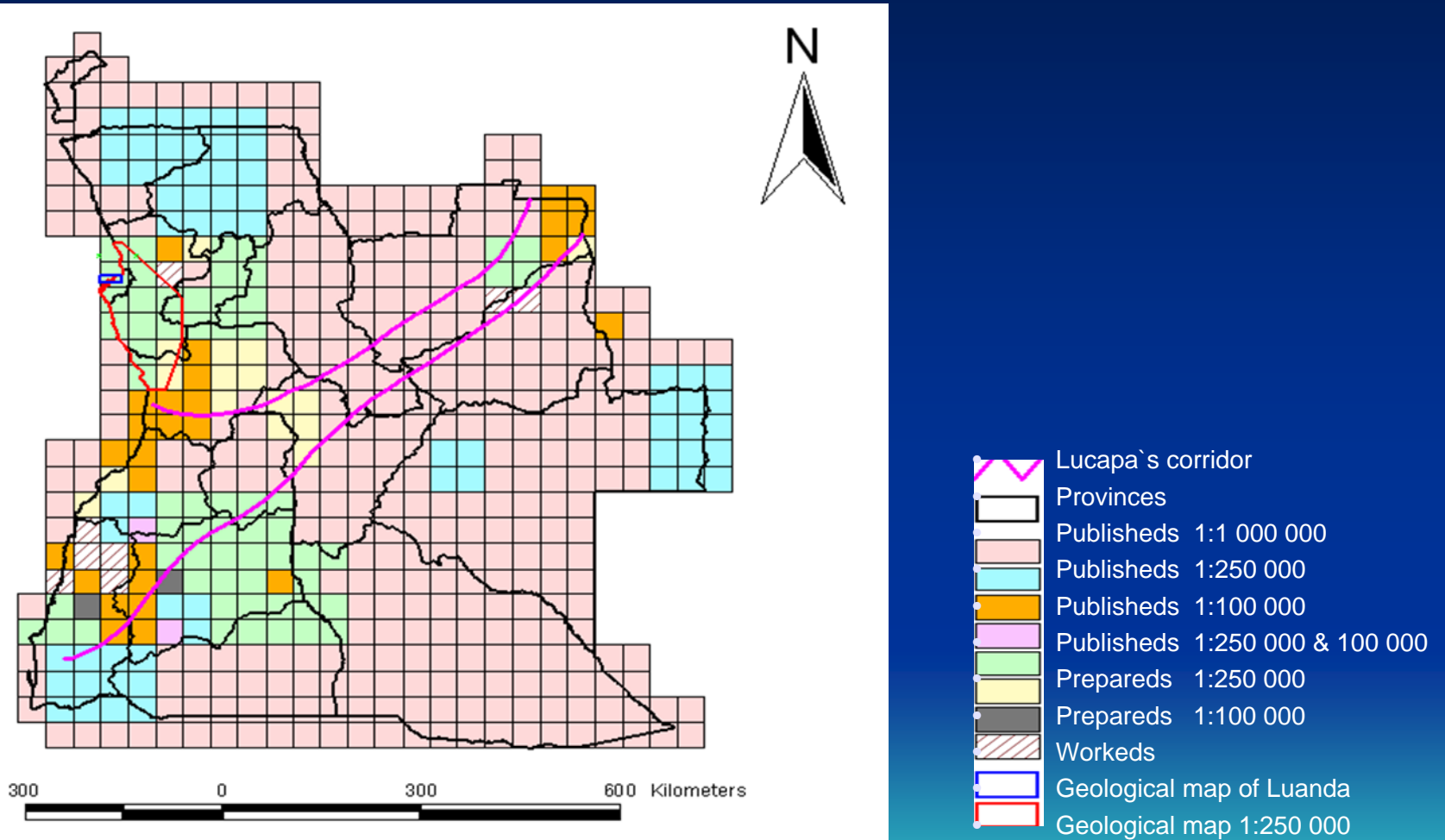


LEGENDE

-  Carte publiée 1/250.000
-  Carte publiée 1/100.000
-  Zone cartographiée
-  Non publiée 1/250.000
-  Zone cartographiée
-  Non publiée 1/100.000
-  Zone étudiée en 1978, non cartographiée
-  Zone étudiée en 1979, non cartographiée
-  Zone étudiée en 1981, non cartographiée
- Zone étudiée en 1983, Non cartographiée



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There are evidences that most of the geological sheets at scale 1:100 000 published and/or prepared are spacially related to the Transcontinental Structure of Lucapa (Lucapa's corridor), that is a zone of tectonic-magmatic reactivation of Mesozoic age with manifestações of kimberlites, acid, ultrabasic, alcalines rocks and carbonatites



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The main mineral resources:

- **Diamonds;**
- **Gold;**
- **Platinum Group Minerals (PGM);**
- **Iron;**
- **Manganese;**
- **Copper (Lead, Zinc, Vanadium, Cobalt);**
- **Nickel, Chrome;**
- **Mineral associated with carbonatite complexes (niobium (pyrochlore), tantalum, rare earths, fluorite and barite;**
- **Tin, tungsten;**
- **Uranium; Coal, lignite; Dimension Stone; Quartz; Phosphate; Kaolin; Mineral Sands; Mica; Salt; Potash; Gypsum; Sulphur;**



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Exploration Data Base

Topography – A complete coverage of 1:100 000 scale topographic maps is available for whole country. The maps are of good quality but old.

Airphotos-Usable airphotos coverage is available to all areas, except for certain parts with dense cover of tropical forest in the north/north –west (Cabinda,Zaire,Uíge). They were flown 60 years ago.

Satellite Imagery- Complete coverage 1:1 million scale black and white MSS of poor quality

Geological maps- Besides 1:1 to 1:2 million scale geological compilation maps , Angola,s present geological map coverage is rather poor. For only 31% of the country geological maps at scales 1:100 000/1:250 000 exist and only 50% of them has been published. The information quality of these maps varies from excellent to extremelly poor

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Exploration Data Base

Geochronology – The existing data is insufficient

Geophysical Airborne coverage- The aeromagnetic coverage of Angola is 10%. It is one of the lowest of any African country. Other airborne surveys have been flown on coastal areas for oil –exploration.

Ground geophysics- With the exception of oil-exploration, geophysics has been used on a limited areas.

Geochemistry – Traditional heavy mineral stream sampling for diamond indicator minerals was carried out by Diamang and Condiama. The actual coverage and detail has not been evaluated. Other organizations carried out geochemistry for heavy minerals, stream and soil but a compilation of this work does not exist. Geochemistry coverage is about 10% of Angola's surface



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Most of this information/data was generated by the former Geology and Mines Services, before 1975 (Independence Date). After that almost all geological activities, stopped, except for oil and diamonds which are responsible for the forgetfulness of existence of the Geological Survey of Angola.

In 90's, the government created the Ministry of Geology and Mines to have a full control of all geological and mines exploration through

- Geological Survey of Angola, now Angolan Geological Institute – Prospecting /Researching and Geological Mapping of whole country
- National Directorate of Mining Licence and Registration – responsible for the attribution of concessions
- National Directorate of Mines – controls the minerals extraction
- Endiama – full control of diamonds activities



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The National Planning of Geology (PLANAGEO)

- **In June 2009 was approved by Angola's President and is comprised of:**
- **Aerogeophysics coverage for whole country**
- **Regional Geological Mapping at scale 1:250 000**
- **Regional Geochemical Mapping at scale 1:250 000**
- **For the implementation of this programme, the Ministry of Geology, Mines and Industry opened a public concourse for those who are interested to compete**



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Challenges

- **Updating of Mineral Resources map at 1:1,000,000 scale;**
- **Geological mapping of prospective areas at scale of 1:50,000;**
- **Training the IGEO staff on Remote Sensing and GIS softwares;**
- **Provide easy access of geological and mining information through the intranet to the public;**
- **Security of the system against virus and invasion;**
- **Reinforcement on the geoscientific cooperation with PGI;**
- **Implementation of the National Planning of Geology (PLANAGEO)**



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Thank you for your attention

OBRIGADO

Warsaw, June 2010