An Example of Country Scale Airborne Geophysics - Angola

John Bell
Xcalibur Multiphysics
john.bell@xcaliburmp.com

Billy Steenkamp
Consultant
Billysteenkamp@gmail.com

SUMMARY

A regional airborne geophysical survey was carried out over Angola as part of a wider programme of investment and regulatory changes to the country's mining industry.

Survey specifications were lines 1 kilometre apart with control lines spaced at 10 kilometres. Total survey size was 1.4-million-line kilometres and was carried out between 2014 and 2018. The nominal survey clearance was 100 m. All surveys were flown with fixed-wing aircraft equipped with horizontal gradiometers and gamma -ray spectrometers.

The country's regional geological setting is examined in the context of the airborne geophysical results. Angola is largely underlain by the Congo Craton. The shield rocks are mostly obscured by younger cover rocks. The location and extent of the Lufilian Arc is unclear although tentative correlations are made with the Damara Belt in Namibia. The geophysical signatures of the potash deposits of Cabinda are reviewed as well as the regional setting of the Lucapa kimberlite field.

Several countries in Africa have completed or are in the process of acquiring regional surveys (Togo, Nigeria, Burkina Faso, etc). This highlights the recognition that investment in the geological endowment is critical to attract investment in the mining industry.

Key words: Angola, regional, Xcalibur, magnetics, radiometrics

INTRODUCTION

The factors for a country to have a successful, thriving mining industry are:

- Investment in the country's geological endowment.
- A functional regulatory regime.
- The ability to attract investment capital.

Other factors include:

- Skills
- Infrastructure
- Power and water

Airborne geophysics forms a critical component of geological mapping and mineral resource inventory programmes. Angola started a mapping programme carried out under the name: "National Geology Plan" with the Portuguese acronym "PLANAGEO" in 2014. This was completed in 2018. Work included geophysical, geochemical and geological surveys. Geological mapping was carried out at various scales.

AIRBORNE GEOPHYSCIAL SURVEY PROGRAM

Three consortia were awarded the airborne surveys to cover Angola in its entirety (Figure 1).

Basic survey specifications were lines 1,000 m apart with 10,000 m spaced control lines and a nominal terrane clearance of 100 m. All surveys were flown with fixed-wing aircraft equipped with horizontal gradiometers and gamma-ray spectrometer systems. Most of the surveys were flown with a north-south line direction.

Xcalibur utilized four aircraft concurrently over the three-year period. The total survey size was 1.4-million-line kilometres of which 80% was flown by Xcalibur using Air Tractors. The remaining 20% was surveyed by CGG using their Cessna Caravan and 406.

The survey specifications are suitable for mapping large-scale regional features. It will not be possible to delineate narrow, small and weakly magnetised features.

The regional data provides a framework from which high-resolution surveys can be flown as in-fill (up to 200 m line-spacing with 100 m terrane clearance).

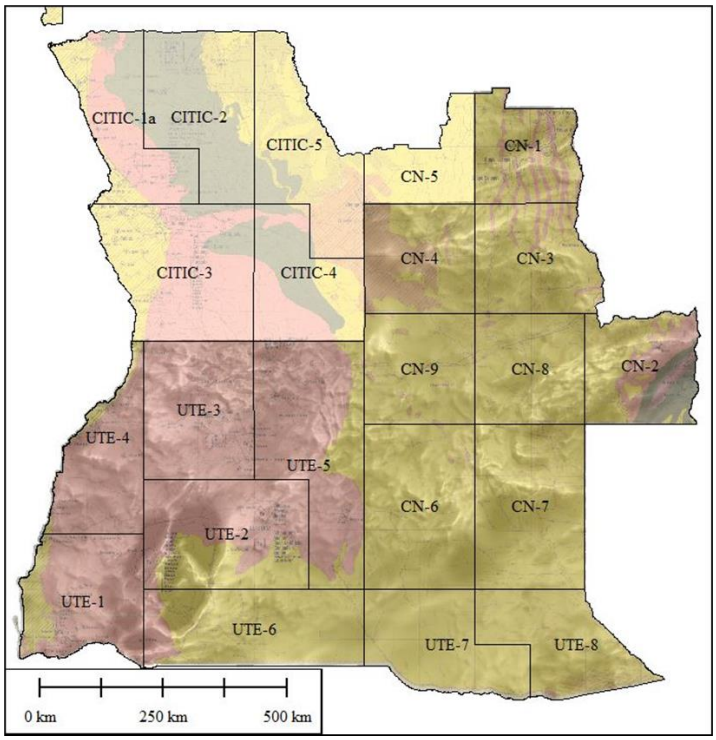

Figure 1. Survey blocks awarded to the three consortia (UTE, CN and CITIC) in Angola.

PRELIMINARY RESULTS

Prior to the survey, there was no regional aeromagnetic dataset for the country of Angola (Figure 2).

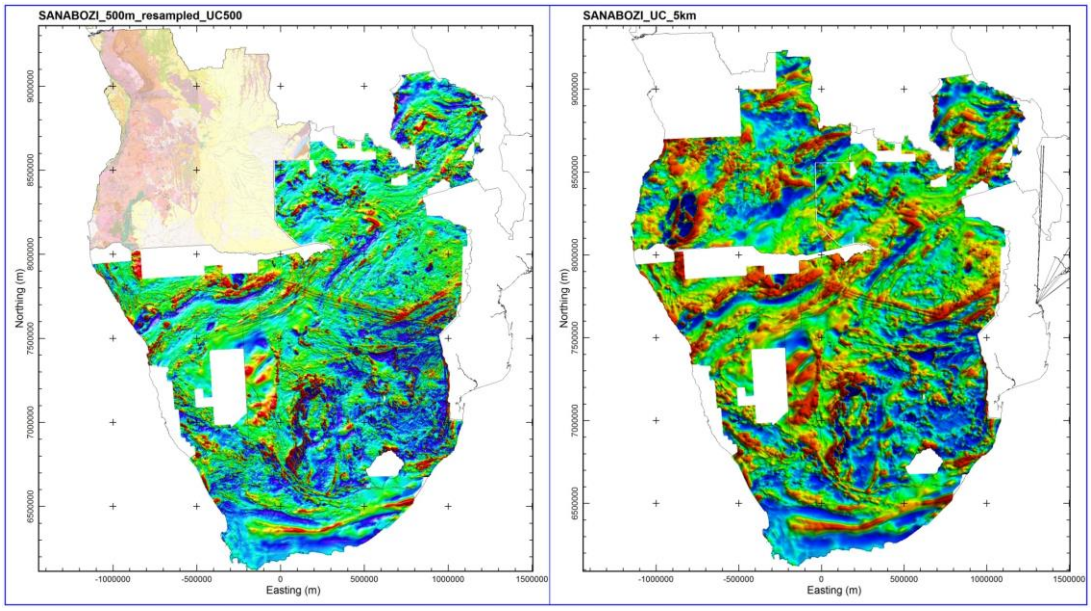

Figure 2. Southern Africa regional aeromagnetics before and after PLANAGEO survey (UTE and CN).

The magnetic and radiometric data products have been released to the public (Figure 3).

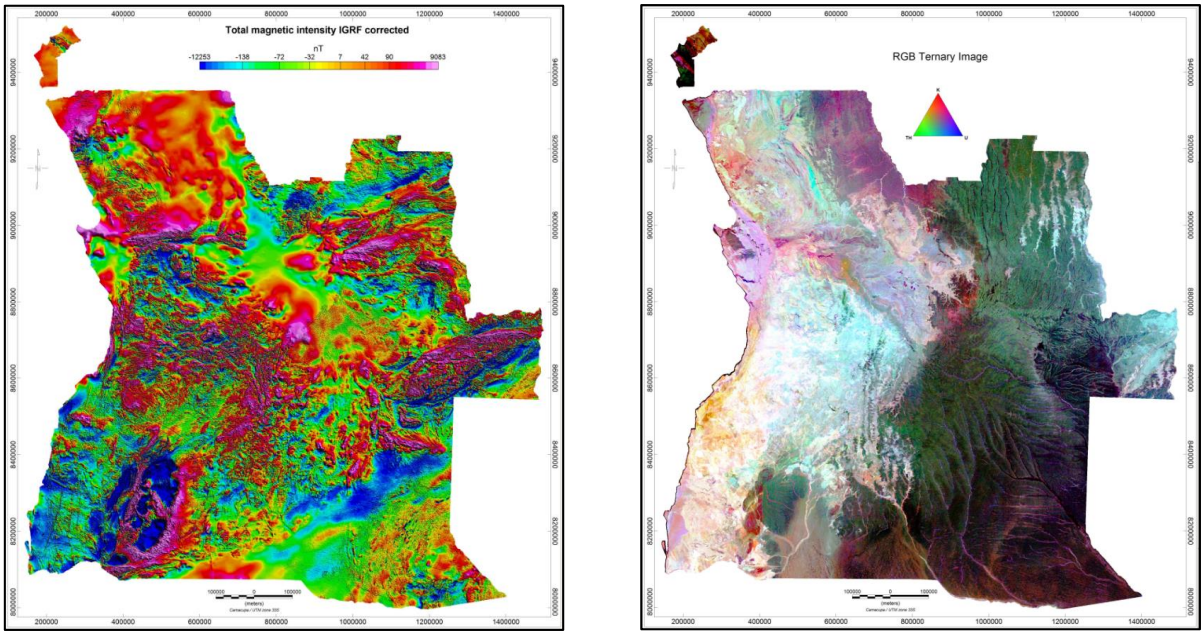

Figure 3. Total magnetic intensity and radiometric ternary image (Angola).

MINERAL EXPLORATION APPLICATIONS

The majority of Angola is underlain by the Congo Craton with a mobile belt located in the west due to the collision with the Sao Francisco Craton. From a mineral exploration viewpoint, it is important to note that a large portion of the country is covered by the Kalahari Group.

Extension of the Lufilian Arc

The Lufilian Arc is the orogenic belt formed between the Congo and Kalahari craton. It is of economic importance as it hosts significant copper and cobalt deposits. The western extension of the Lufilian Arc is obscured in eastern Angola by the Kalahari Group. Interpretation of the regional aeromagnetics facilitates an interpretation of the extension of the Lufilian Arc beneath this cover (Figure 4).

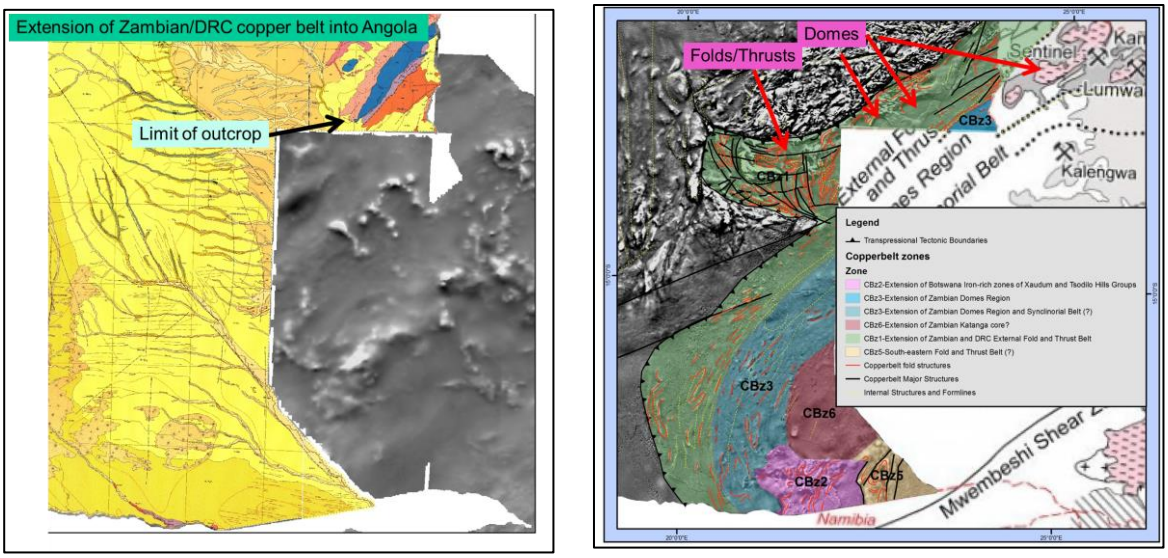

Figure 4. An aeromagnetic interpretation of the Lufilian Arc in eastern Angola.

Cabinda Phosphate Deposits

The Cabinda Phosphate deposits are described as being of the Florida/Morocco sedimentary-type and occur in several beds of marine and coastal/fluvial origin.

Radiometric ternary image clearly maps the prospective sedimentary sequence with the uranium channel seemingly correlated with the larger deposits (Figure 5).

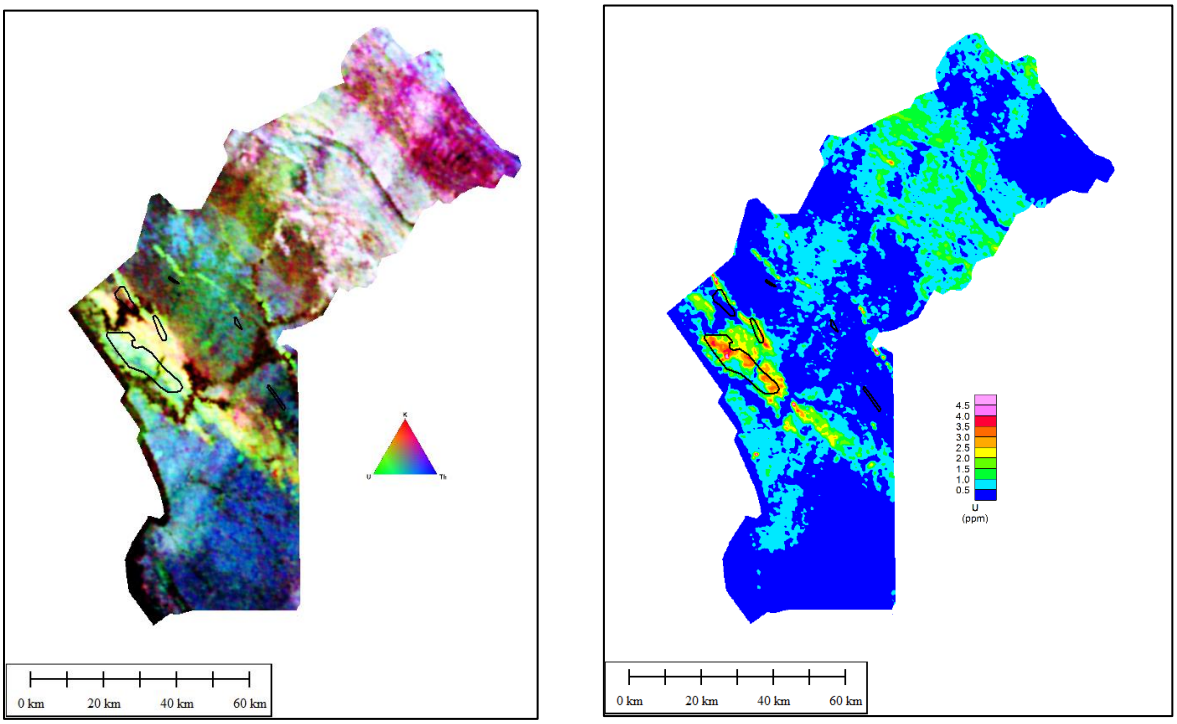

Figure 5. Radiometric ternary and Uranium channel images from Cabinda showing location of major phosphate deposits.

Lucapa Kimberlite Field

Kimberlites and carbonatites in Angola are concentrated along the Lucapa structure. This is a rift-related Lower Cretaceous fault system, and the kimberlites and carbonatites are mostly Early Cretaceous in age. Carbonatites occur preferentially in the southwest of the structure while kimberlites dominate in the northeast (Torro et. Al., 2012).

The vertical integral of the aeromagnetics allows for an interpretation of the extents of the Lucapa structure (Figure 6). This could be used as a guide for REE and diamond exploration.

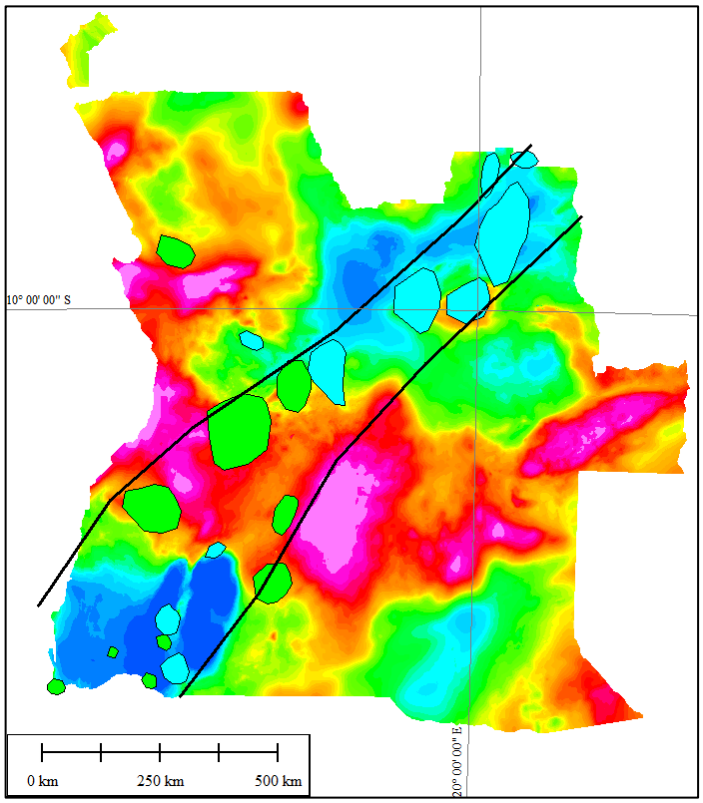

Figure 6. Vertical integral of the reduced the pole magnetic intensity, location of kimberlites (blue) and carbonatites (green) and the Lucapa structure.

CONCLUSIONS

The airborne geophysical surveys flown in Angola have provided new insights into the tectonic setting of Angola which is underexplored relative to its neighbours. Examples have been provided of how the data may be utilized for several different exploration applications.

The data provides a legacy for mineral exploration and will allow development of regional geological models. It provides a framework for future high-resolution surveys in areas deemed prospective.

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