Natural Resource Geophysics In The Northern Territory - New Tools Or New Ideas?

Gary Humphreys
Dep Lands Planning & Environment
Northern Territory, Australia
gary.humphreys@nt.gov.au

Desmond Yin Foo
Dep Lands Planning & Environment
Northern Territory, Australia
des.yinfoo@nt.gov.au

Daryl Chin
Dep Lands Planning & Environment
Northern Territory, Australia
daryl.chin@nt.gov.au

Anthony Knapton
Dep Lands Planning & Environment
Northern Territory, Australia
anthony.knapton@nt.gov.au

Rossimah Sinordin
Dep Lands Planning & Environment
Northern Territory, Australia
rossimah.sinordin@nt.gov.au

Brian Lynch
Dep Lands Planning & Environment
Northern Territory, Australia
brian.lynch@nt.gov.au

SUMMARY

In the Northern Territory, natural resource assessments are performed before land is released for horticulture or for intensive agriculture.

With the advent of detailed airborne geophysical surveys, funded by the NT Geological Survey, advanced assessment methodologies have been introduced. The new methods combine traditional site assessment skills with advanced image processing and GIS analysis.

The assessment process targets both water and land resources, with the intention of planning and managing development in a sustainable manner.

Initial tests of Enhanced Resource Assessment tools have shown the value of using airborne data to reduce the amount of ground truthing, and have been invaluable in modelling hydrogeological environments.

Key words: airborne, radiometric, enhanced resource assessment, hydrogeology

INTRODUCTION

In the Northern Territory no sizeable developments have drastically changed natural processes above local scale. Only in small intensive horticultural developments and in desert communities do productive activities have major immediate impacts on natural resources. Scientific investigations can be carried out prior to development, so regional resources can be quantified and allocated. Geophysical tools used regularly for assessment include satellite remote sensing, reinterpreting airborne geophysics and intensive ground resistivity / electromagnetics. Geomorphology often bears little relationship to development potential.

The population is spread over towns, Aboriginal communities and pastoral stations. Each population centre has unique needs for water and land. A number of site-specific studies are being integrated into regional hydrogeological mapping. Airborne geophysics is of major benefit, particularly in areas where the NTGS has recently conducted detailed surveys. Airborne mapping avoids problems with access, Aboriginal sites clearances and timeliness. Remote desert communities may eventually rely on airborne electromagnetic surveys to define palaeochannel water supplies. Ground geophysics, including borehole logging to measure physical properties, provides rapid and reliable ground-truthing

GEOLOGICAL SETTINGS

In the Top End of the Northern Territory, development of horticulture is dependent on good dry-season supplies of groundwater. In the outer Darwin region, groundwater is derived from a number of limestone/dolomite aquifers. These are generally well-mapped because of the intensity of earlier development, so little advanced interpretation is needed. Specific detailed investigations are conducted in areas of Government priority.

Around the town of Katherine, the Tindal Limestone can supply over 100 litres per second from a single bore. The area has potential for intensive horticultural developments where the suitable soils and large water supplies coincide. Airborne magnetics and borehole logging have enabled the interpretation of geological structures that control the occurrence and thickness of the limestone. Satellite imagery is being used to interpret soils and land units.

Further south, the Sturt Plateau region is an area where the Tindal Limestone has limited depth extent. Depth to the base of the limestone, particularly its relationship to the regional water table, define the prospects for water. Knapton et al, 2000 demonstrated that the most valuable geophysical data was the regional airborne magnetic survey. Depth to basement interpretations (of hydrogeological use) were limited by the survey geometry and the instrument specifications.

Tertiary basins in central Australia may have significant groundwater resources (Senior et al 1995), and the Ti-Tree basin has been studied in detail (e.g. Harrington 1999, McDonald 1988). Ground geophysics has mapped basement depth, and careful borehole logging can locate aquifers. There is potential for improved assessment and quantification of water resources within tertiary basins using precision airborne electromagnetic surveys. Since the groundwater is not saline and the stratigraphy is mostly sandy, any geophysical signatures will necessarily be quite weak, and tightly-controlled survey parameters are required. In the past, this level of performance was considered to be beyond the technical specifications of available airborne EM systems. With the newest generation of airborne EM, the method should be assessed as a soil and water mapping tool.
NEW TOOLS

High resolution airborne geophysical surveys and satellite imagery are powerful tools for regional mapping. With improved ground geophysical methods and instrumentation in ground-truthing, natural resource applications of geophysics should become a major force in the economic development of the Northern Territory beyond 2000. Radiometric and elevation data from the NTGS airborne geophysical surveys have proven valuable in mapping land systems and geomorphology.

The Natural Resources Division is the Government’s custodian of land and water resource information. Database management and GIS analysis have allowed the Division to integrate site data and spatial information to add significant value to base data.

NEW IDEAS

The application of airborne geophysical data to assessing development potential is a rapidly-developing field. The advent of differential GPS included with 256-channel radiometrics has meant that the Government-sourced NT Exploration Initiative for mineral exploration is providing perfect datasets for interpreting land systems. The terminology for this type of land mapping is Enhanced Resource Assessment (ERA), and the methodology has been applied successfully in Queensland and Victoria (see Wilson et al 1999 and Rampant 2001).

The ability of radiometrics to image subsurface structure (while being insensitive to vegetation cover) gives the soil scientists a better 3-dimensional understanding of soil/rock/water relationships, and allows a better assessment of the agricultural value of soils.

Attempts to map land units using classified satellite imagery have generally been limited by the need for a large number of ground-truth sites, and a good understanding of local vegetation patterns and seasonal variations. The use of radiometrics includes an extra dataset with signatures independent of vegetation.

The elevation data provide a better elevation model than does the AUSLIG 9-second DEM. The improved control on elevations gives better precision of hydrological modelling and landform analysis.

CONCLUSIONS

Newly-available datasets for use in Natural Resource assessments have assisted the Northern Territory Government to plan land releases for sustainable management of water and land resources. In particular, airborne geophysical data have been used to extrapolate field observations of land systems to areas with poor access.

Improved methods of modelling and assessing water availability are a key component of water allocation plans for sustainable water usage.

REFERENCES


Knapton A, Humphreys G, Yin Foo D Chin D & Sinordin R: Geophysical studies for groundwater assessment in the Sturt Plateau, Preview No 84, Feb 2000


Wilson P and Philip S 1999 The use of airborne Gamma Spectrometry (radiometrics) and digital elevation models for soil mapping in North Queensland 4th North Australina Remote Sensing and GIS conference