**Geophysics - TEMPEST**

In July 2004, Fugro Airborne Surveys Pty Ltd (Fugro) undertook a TEMPEST airborne electromagnetic survey over the southern portion of the project. The flight lines are oriented 133°, with a spacing of 200 m, flying height of 120 m, totalling 1785 line km. TEMPEST is a high-powered airborne time-domain system with a broad bandwidth, which enables good resolution of variations in resistivity whilst maintaining reasonable ground penetration. In addition, the airborne platform allows electromagnetic data to be acquired over broad areas where ground geophysics is impractical due to rugged topography. The survey was flown with the aim of providing 3-D electromagnetic data to assist with the identification of basement graphite, structural offsets, alteration and to infer the depth to the unconformity below sandstone.

Data for the survey was submitted with the previous (2004-2005) annual report, however, at that time the interpretation was incomplete, which is now discussed.

TEMPEST Logistics Report by Fugro

TEMPEST Location Map

TEMPEST Time Constant Map

TEMPEST RGB=CH1,4,7 Map

CDIs are the primary product calculated by Fugro using EMFlow software and useful for visualizing the TEMPEST response with plan and section geology. However, Cameco has also utilised Profile Analyst software (Encom Pty Ltd) to calculate a 3D voxel, which can be used to investigate 3D features. This allows conductivity depth slices to be calculated as well as the depth and elevation of the first conductive layer, referred to as the "conductive unconformity". The 3D voxel has also been filtered to highlight conductivities greater than 10 mS/m and exclude conductivities within 10 m of the surface, which are likely to relate to cover and weathering rather than bed-rock. A number of these 3D aspects have also been reprojected to plan view to facilitate comparison with ancillary datasets including geology. The z-component data has been used extensively since it is less prone to noise and couples best with sub-horizontal features such as the conductive unconformity.

Conductive Unconformity and Structure

The "conductive unconformity" is a term adopted to describe the first sub-horizontal conductive layer, commonly depicted in TEMPEST CDIs. In areas of Mamadawerre Sandstone this layer generally relates to the sandstone-basement unconformity contact. However, the response depends on the stratigraphy and at Gunbatgarri sub-horizontal conductors could also relate to the Nungbalgarri Volcanic Member or Gilruth Volcanic Member, in areas of Gumarrimbang and Marlgowa Sandstone respectively. A further complication is that the Nungbalgarri Volcanic Member may be absent at some localities. Clearly, conductive layers must be carefully interpreted in the context of the known geology. Also, it should be recognised that the top conductive layer may masks deeper responses, although some parts of the survey do show a more diffuse second layer.

Localised synformal and synclinal changes in the elevation of the unconformity may be important to recognised since they could relate to important controls on the flow of uranium-bearing fluids and also imply significant structure, which could focus or trap fluids. At Gunbatgarri the conductive unconformity response is relatively flat and likely to be due to volcanic layers, rather than the basement/sandstone unconformity.

Abrupt changes in the elevation of the TEMPEST conductive unconformity can be utilised to infer faulting and structure. However, as discussed, geology must be carefully considered since there are several conductive layers that the TEMPEST response may alternate between. Also, care must be taken not to over-interpret the CDIs since 1D inversions can produce edge effects and incorrect geometry. The Sawcut Fault is an example of a regional scale northeast trending fault, which is associated with an abrupt change in the elevation of the conductive unconformity. Many other faults are already mapped at Gunbatgarri and the TEMPEST can assist with confirming these along with the identification of new structures. Some faults at the Gunbatgarri project show localised ridges / troughs in the conductive unconformity image. This phenomenon has only recently been observed elsewhere at the Kukalak project and cannot be readily reconciled against known geology, although they possibly are related to the emplacement of dykes.

Targets

One of the primary objectives for the TEMPEST survey is to identify conductors, associated with structure, since these could relate to clays, porosity or graphite; indicative of alteration and/or fluid-rock interaction with potential to precipitate uranium. Unfortunately, conductors can be difficult to reliably identify with 1D inversions due to artefacts and tails related to edge effects. Geometry, line-to-line consistency and x/z characteristics help to increase confidence that conductors are real, especially in the context of known geology.

*Target – Drill Hole GGD001*

Hole GGD001 was drilled in 2005 to test the highest ranked TEMPEST anomaly (approximately 398,433mE/8,610,552mN: AGD66, TMAMG53). This anomaly was selected because it is one of the most complex conductive responses ever encountered (at depth) in Arnhem Land and could relate to alteration associated with structure. Although Gumarrimbang sandstone is present, there were indications that the basement could be relatively shallow and the lower stratigraphy could in fact be absent. It was recognised that the CDI response was complex and could have some misleading artefacts. To investigate this aspect Fugro carried out some alternate 1D inversions using Occam and Zhody algorithms. However, these failed to provide additional information to assist with targeting.

TEMPEST and Geology at GGD001

Unfortunately, the drill hole failed to intersect significant structure or alteration, to explain the anomaly. Instead, there is a relatively monotonous sequence of

Gumarrimbang Sandstone overlying Nungbalgarri Volcanics and then Mamadawerre Sandstone. The hole did not reach basement and was terminated at 464 m. Details about the hole are discussed in the drilling section of this report. Unfortunately, an attempt to probe the hole for down-hole resistivity failed due to a blockage at the surface. It is worth noting that basement windows are mapped 5 kms to the south-east and 10 kms to the north-east of hole GGD001, which implies complex intervening geology such as major faulting and/or stratigraphic thinning.

It is tempting to assume that the TEMPEST anomaly is due to Nungbalgarri Volcanics, albiet unusually conductive. However, consideration should also be given to the possibility that the hole did not fully test the target. For instance, perhaps CDI artefacts misled the positioning of the hole, which missed the inferred structure and conductor? There are a couple of recommendations to further investigate the area:

1. Undertake surface reconnaissance to better understand the structural controls and complex geology of this area, especially towards the basement windows.
2. AMIRA project P223f is being sponsored by Cameco and is developing software, which should be used to calculate accurate inversions on the TEMPEST data.
3. Ground electromagnetic methods could be undertaken to better understand the TEMPEST response.

*Other Targets*

The identification of legitimate conductive targets at the Gunbatgarri project is impeded by the presence of the volcanic members, which are conductive. In fact, there are no potential targets that are recommended for follow-up since the existing possibilities occur below the Marlgowa Sandstone or lie proximal to the Gilruth Volcanic Member. Unfortunately, there are no targets that exist close to the basement inliers that are more likely to be associated with basement features.

There is one low priority conceptual structural target that is recommended for ground prospecting and evaluation. It is located 600 east of the western EL boundary and is situated in the most northern part of the TEMPEST survey at 391663 mE / 8620243 mN (AGD66, TMAMG53). The TEMPEST CDIs and interpreted geology combine to infer a possible transfer jog associated with a NE trending fault. Unfortunately, the potential target is within Marlgowa Sandstone, which does reduce the prospectivity.

## Conclusion and Recommendation

An extensive airborne electromagnetic TEMPEST survey has been flown over the western part of the project, which has provided some insights into the subsurface geology. However, major structures, possible stratigraphic thinning and the presence of volcanic members combine to severely impede the identification of legitimate targets. Furthermore, drilling of the premier TEMPEST anomaly has

failed to unequivocally confirm a conductive source with further investigations recommended.