Jim Kastrissios

2nd Annual Report for Exploration Licence 22440
Period ending 26 February, 2006.

Mt Evelyn, SD53-05, Northern Territory
Pine Creek Geosyncline

Tenement Holder: Mr Demetrios (Jim) KASTRISSIOS
Mr David John LANGLEY

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Author: Angus McCoy (Geoimage Pty Ltd)

Submitted: Jim Kastrissios

Distribution: Jim Kastrissios
Geoimage Pty Ltd (Darwin)
David Langley
Dept Primary Industry, Fisheries and Mines (NTGS)
LIST OF CONTENTS

LIST OF CONTENTS ............................................................................................................. i
LIST OF FIGURES .................................................................................................................. ii
LIST OF APPENDICES .......................................................................................................... ii
LIST OF ENCLOSURES ......................................................................................................... ii
SUMMARY .............................................................................................................................. 1

1 INTRODUCTION .................................................................................................................... 2
2 CONCLUSIONS AND RECOMMENDATIONS .................................................................... 2
3 LOCATION AND TENURE .................................................................................................... 3
4 REGIONAL GEOLOGY ........................................................................................................... 4
5 LOCAL GEOLOGY ................................................................................................................ 4
6 MINERALISATION POTENTIAL .......................................................................................... 7
7 PREVIOUS EXPLORATION .................................................................................................. 8
8 WORK COMPLETED ............................................................................................................. 11
  8.1 Year 1 - Data Compilation .............................................................................................. 11
    8.1.1 Geology data ............................................................................................................. 11
    8.1.2 Sampling data ......................................................................................................... 11
    8.1.3 Drilling Data .......................................................................................................... 12
    8.1.4 Historic Geophysics ............................................................................................... 12
  8.2 Current Year - Geophysical Surveys ............................................................................. 12
    8.2.1 Magnetics and Radiometrics .................................................................................. 12
    8.2.2 Processing ............................................................................................................ 12
9 PROPOSED PROGRAM FOR YEAR 3 ............................................................................ 13
10 REFERENCES ..................................................................................................................... 14
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location Diagram</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Regional Geology</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Stratigraphy</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Geology and Magnetics</td>
<td>13</td>
</tr>
</tbody>
</table>

## LIST OF APPENDICES

<table>
<thead>
<tr>
<th>No</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>File Verification Listing</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>UTS Survey Logistics Report</td>
<td>22</td>
</tr>
</tbody>
</table>

## LIST OF ENCLOSURES

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<thead>
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<th>No</th>
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</thead>
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<tr>
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</tr>
<tr>
<td>3</td>
<td>DTM Contours</td>
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</tr>
<tr>
<td>4</td>
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</tr>
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<td>7</td>
<td>Potassium Contours</td>
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<td>Thorium Contours</td>
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SUMMARY

The work carried out during year 2 has focussed on the magnetic anomalies identified during the year 1 review and interpretation of the regional Mary River magnetic survey.

An ultra-detailed airborne magnetic and radiometric survey at 40m line spacing and 30m terrain clearance was flown over the most prospective portion of the tenement based on previous competitor sampling results. A total of 526 line km was completed covering an area of 17 sq km.

The results of the survey have clearly shown several high amplitude magnetic anomalies occurring within the Koolpin Formation or at the Zamu/Koolpin contact within the fold nose and flanks of the steeply dipping or overturned Spider and McCarthys anticlines. These magnetic features may represent massive sulphide (pyrrhotite) lenses prospective for precious and base metals.

Linear north to north west trending magnetically suppressed zones transecting the Wildman Siltstone near the granite contact may be analogues to the shear zone that hosts the McCarthys Pb mineralisation.

Additional sampling work is recommended for the most prospective zones and a thorough GIS data compilation, interpretation and magnetic modelling program should be undertaken. Ground follow-up using various geophysical techniques may be required to define drill targets.
1 INTRODUCTION

In June 2005 the principal holder of EL22440 (Jim) approached Geoimage Pty Ltd (Darwin) to undertake a review and interpretation of regional magnetic data covering the licence. The report was submitted as an appendix to the annual report for year 1 (authored by J Kastrissios). The services of Geoimage P/L were subsequently engaged to provide further assistance with exploration activities and reporting for the current period.

At the conclusion of the last active phase of consolidated exploration for in 1995 the following conclusions were drawn;

Despite a considerable amount of previous exploration for different commodities, and using different mineralisation models, the base metal and gold potential of the McCarthys area has not been fully tested.

Base metal mineralisation appears to be associated with discordant and concordant gossanous limonitic and siliceous structures that trend in two principal directions, west northwest and northerly. The widest development of mineralisation commonly occurs where the structures intersect in a favourable brittle lithology. The northerly trending discordant structures are lead rich and west northwest concordant structures are zinc rich. The ferruginous concordant structures are wide actinolite-chlorite-carbonate alteration zones commonly with siderite breccias but low in sulphides.

Impetus to re-evaluate the prospectivity of the area for base metals, precious metals and iron ore stemmed from this conclusion, together with that lack of exploration since 1995 and the upward trend over the past decade of relevant metal prices which at the time of reporting were;

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2 CONCLUSIONS AND RECOMMENDATIONS

Results from the airborne survey have delineated several high amplitude magnetic anomalies that may be the result of massive sulphide (pyrrhotite) lenses. Other subdued linear features in the data may be the signature of shear zones similar to that which hosts the McCarthys Pb deposit.

Year 3 work recommendations are given in section 9.
3 LOCATION AND TENURE

Exploration Licence 22440 falls within Pastoral Lease No. 1134, Mary River Cattle Station, and is located 30 kilometres east-north-east of Pine Creek, within the Cullen Mineral Field. It is located on the Ranford Hill 1:100,000 map sheet, and the Moline and Wandie 1:50,000 map sheets. Access is via the Stuart Highway to Pine Creek and then via the Kakadu Highway and along station tracks (Figure 1). These tracks are only accessible by 4x4 vehicles in the dry season.

The tenement, consisting of 14 graticule blocks, 47 square kilometres in area, lies between latitudes 13°42’ south and 13°48’ south and longitudes 132°01’ east and 132°08’ east. EL 22440 was granted to Messrs Jim Kastrissios (66.66%) and John Langley (33.34%) on the 27 of February, 2004 for a period of six years. A reduction of 11 blocks was made at the end of year 1 (from 25 blocks to 14 blocks) and a further reduction of 2 blocks was made at the end of the current reporting period.

Figure 1 – EL 22440 Location Diagram
4 REGIONAL GEOLOGY

Exploration Licence 22440 is located near the centre of the Pine Creek Geosyncline with Early Proterozoic metasediments of the Mt Partridge, South Alligator and Finnis River Groups exposed in the area.

Within the southern portion of the licence, the Cullen Batholith outcrops and is comprised of the McCarthy’s Granite, which is a coarse grained porphyritic hornblende biotite rock. The granite is generally well exposed in the area and forms low undulating hills, well incised by numerous perennial streams. The intrusive contact with the sedimentary rocks to the north is often marked by a zone of quartz, pegmatite and aplite veining, rafts of sedimentary rocks within the granite and slivers of granite within the sedimentary rock pile.

Directly north of the granite contact, the Early Proterozoic sedimentary sequences of the Mt Partridge, South Alligator and Finnis River Groups have been folded into an asymmetrical sequence along a north-westerly trending axis: Two anticlines, called the McCarthy's and Spider Anticline, (Goldfield, 1988) form the prominent features within this folded sequence. These anticlines expose Mundogie Sandstone in the core and Wildman Siltstone and Koolpin Formation along the limbs of the structure. Further to the north, the folding exposes stratigraphically higher units of the South Alligator and Finnis River Groups (Figure 2)

5 LOCAL GEOLOGY

The following is a description of the lithological units occurring within EL 22440 (Melville, 1995). The lithologies are related stratigraphically as shown in Figure 3.

Mundogie Sandstone

The Mundogie Sandstone consists of coarse grained felspathic quartz sandstones and pebble conglomerate. It forms a prominent topographic high feature with rugged and deeply incised streams draining from it. On the contact with the Wildman Siltstone a strongly ferruginous, brecciated, gossanous and quartz veined horizon is occasionally developed. Secondary ferruginisation is ubiquitous in these instances, often forming the framework within the sandstones and breccias. This horizon is conformable and can be mapped over a considerable strike length. It is interpreted to be a décollement structure. A relic boxwork texture is observed at times and contributes to the strong ferruginous alteration. Quartz veining in this horizon is multi-phased and stock-worked in appearance and also often affected by later tectonic brecciation.

Wildman Siltstone

This unit predominantly comprises siltstones and carbonaceous phyllite, and forms areas of relatively gentle undulating relief. A strong cleavage is developed in these rocks and exposed bedrock is typically stained by iron oxide. The McCarthy's deposit is hosted by the Wildman Siltstone. A distinctive haematite rich horizon can be traced within the unit over most of the licence area. It is interpreted to be a lateral equivalent of the iron ore deposits at Frances Creek and is locally termed, 'Frances Creek beds'.

Figure 2 – Regional Geology (from NTGS 1:250k Mt Evelyn Geology Map, 2004). Cross section from NTGS/BMR 1:100k Ranford Hill Geology Map, 1986.
Koolpin Formation

The Koolpin Formation forms the topographic high ridge lines. On the limbs of the Spider Anticline, these ridges are flat topped and have cliff like drop offs along the edges. Silicification as a result of weathering phenomena has strongly altered these rocks, although the original texture and nature can still be discerned. The Koolpin predominantly comprise carbonaceous mudstone but has chert, ironstone and phyllite interbeds. A commonly exposed ironstone interbed is characterised by the presence of sugary and nodular cherty bands which resemble the 15 ironstone horizon as known within the Middle Koolpin Formation in the Mt Bonnie and Burrundie Dome regions. The nodular chert ironstone horizon often forms the steep drops along the edges of the ridge. Strong secondary silicification in conjunction with ferruginisation within this bed make it particularly resistant to erosion. Ferruginisation within the Koolpin Formation is a common feature. Box work textures as disseminations and within fractures are often observed throughout, but are particularly concentrated along cherty and ironstone horizons.

Gerowie Tuff

The Gerowie Tuff comprises light brown siliceous siltstones, argillites and albitic cherts. These rocks, along with the Mt Bonnie Formation, form a series of relatively low undulating hills that are well incised by a perennial drainage system. Very thin skeletal soils develop over the Gerowie Tuff and rock types are difficult to discern through the effects of weathering on similarly textured and coloured lithologies.

Mt Bonnie Formation

The Mt Bonnie Formation superficially, at least, resembles the Gerowie Tuff in its occurrence and nature. Siliceous siltstones, slates, argillites, cherts, and greywackes are observed. Areas of well incised but low relief are formed and thin skeletal soils are commonly developed.

Burrell Creek Formation

The Burrell Creek Formation is typified by felspathic greywacke, slates and siltstones.

Zamu Dolerite

The dolerite occurs as a medium to coarse grained sill intruding the Koolpin Formation. It can occur as a distinctive series of resistant outcrop and rubble or become preferentially weathered and be obscured under soil and regolith cover. Distinctive dark red clay-rich soils are developed over the dolerites in these instances.
6 MINERALISATION POTENTIAL

Gold

Stratiform gold deposits occur throughout the Pine Creek geosyncline in the carbonaceous mudstones of the Wildman siltstone and lower and upper Koolpin formation as well as the interbedded mudstone & banded iron sequences of the middle Koolpin formation. Vein type deposits are known to occur within the Gerowie Tuff and the lower Mt Bonnie Formation. Tightly folded and sometimes overturned anticlinal structures are the key to development of economic gold mineralisation (Nicholson & Eupene, 1984). The Spider and McCarthys anticlines are the main focus areas for gold mineralisation (predominantly quartz-sulphide-vein style but also as part of larger polymetallic systems) in the licence area.

Base Metals (Cu, Pb, Zn)

McCarthys silver-lead mine is the only documented economic mineral occurrence near the licence area. The lode is 0.3m to 1.0m wide and was worked between 1912 and 1927 from
several shafts. The mineralisation occupies a shear zone dipping between 70° and 80° west and transgresses carbonaceous siltstone of the Wildman Siltstone. The ore comprises an oxidised zone with pyromorphite, cerussite, anglesite and galena. It is postulated that the mineralisation formed due to metal precipitation by reduction during contact metamorphism within the hornblende-hornfels zone around the McCarthys Granite. Total recorded production is estimated at 580t concentrate of silver and lead (Stuart-Smith et al, 1988). In the areas surrounding McCarthys mine, detailed exploration located discordant lead and zinc mineralisation in northerly and west northwest trending structures. The mineralisation commonly occurs as linear gossanous limonitic outcrops variably silicified with a trace of galena and pyrite. Within Zamu Dolerite the mineralisation occurs more as a stockwork of gossanous veinlets. The widest development occurs where two structures intersect. There is significant potential for other concealed McCarthys style deposits along the contact margin of the metasediments with the McCarthys granite.

Stratabound replacement type polymetalic massive sulphide deposits similar to the Ironblow and Mt Bonnie deposits form the focus of exploration work at the apexes and on the limbs of the Spider and McCarthys anticlines.

Other Metals

Other potential mineralisation styles being investigated include Tin and Tin-tantalum in Sn-quartz or sulphide veins and Sn-Ta pegmatites within the hornfels facies contact metamorphic aureole of the granite.

The characteristics of the area are in many ways also very similar to the Frances Creek Iron Field and the opportunity for a crystalline hematite deposit within the Wildman siltstone needs to be investigated further. Already explorers have noted the presence of crystalline hematite (62% Fe) from gossanous outcrops in the laterally equivalent iron ore horizon called the Frances Creek beds.

7 PREVIOUS EXPLORATION

Exploration in the region of the licence area has been well documented since the mid 1960s. The following companies have conducted programmes over all or part of the area covered by EL22440.

UNITED URANIUM NL

Sturm (1966) undertook an investigation of the McCarthys lead prospect which included geological mapping, soil sampling and wagon drilling. Two separate lodes were identified: A, to the south, and B, to the north.

Channel sampling in the areas of one of the inclined shafts at 10 metres recorded 26.5% Pb over 1m and 19.5% Pb over 0.9m. Sturm indicated that there was no one distinctive lode, but that mineralisation occurred in siltstone bordering an aplite dyke. Unfortunately the 16 percussion drilling (wagon) drill holes to a maximum depth of 30m (23m average) did not fully test the mineralisation at depth due to ground water and loss of circulation.

Weber (1968) undertook geological mapping and rock chip sampling in the vicinity of the McCarthys mine for United Uranium. The only sulphide mineralisation he found in the region
was pyrite, however, he recorded high base metal values throughout his sampling grid. These could not be traced to actual base metal mineralisation, but he recommended that further sampling take place to determine whether non-outcropping sulphide-rich zones occurred in the region. Concurrent with this programme, a reconnaissance stream sediment (-80#) sampling programme was completed in the area and reported by T W Middleton (1968). The samples were analysed for Cu, Pb, Zn, Ni, Co and Bi. A number of drainages were geochemically anomalous in base metals.

CRAE 1977-1978

CRAE (Wills, 1978) reported on exploration over the Moline region in EL 1091 which incorporated the area now covered by EL 22440. Soil sampling across the Spider Anticline revealed elevated base metal values through the Wildman Siltstone and Zamu Dolerite lithologies. Two soil anomalies were identified from the 1977 sampling (Anomalies 11.3 and 11.5) with analyses up to 795ppm Pb, 490ppm Zn and 89ppm Cu recorded.

The results from the second year of exploration (Wills, 1979) repeated Anomaly 11.3, with soil samples returning maximum analyses of 75 1ppm Pb, 296ppm Zn and 75ppm Cu. Rock chips returned a maximum lead value of 1.28%, while maximum Zn, Cu and Ag were 691, 510 and 1ppm respectively. These anomalous results were obtained from a line of ironstone breccias along a fault zone.

Follow-up work on Anomaly 11.5 recorded best soil results of 265ppm Pb, 260ppm Zn and 78ppm Cu. These results were obtained from a zone of ironstone and haematitic shales adjacent to Zamu Dolerite. Maximum rock chip values were 2040ppm Pb, 1.31% Zn and 748ppm Cu. Both anomalous zones lie parallel to the dominant north-west trending fold axis.

ANZ EXPLORATION COMPANY 1979

Conducted a stream sediment sampling survey over areas underlain by Koolpin Formation. A statistical test on the results did not provide a meaningful interpretation. However, elevated Pb, Zn and Cu values were recorded at McCarthys, and to the west and north-west of McCarthys. Davies believed the elevated results were due to higher background content of some metals in the shale units and the higher metal content in the ironstone bodies.

CYPRUS 1988

Cyprus carried out a mapping and rock chip sampling survey (Miller, 1988) over EL 3008 and recorded some anomalous Pb, Cu and Zn in samples from carbonaceous cherty shales of Koolpin Formation and Wildman Siltstone. Maximum results recorded were 930ppm Cu, 1.14% Pb and 5060ppm Zn.

RENISON GOLDFIELDS 1987-1988

Vann (1988) reported on exploration carried out in three exploration licences, one of which was EL 5196 known as McCarthys East.

Mapping by Vann revealed a complex fold structure in association with the Spider Anticline. He identified a zone of weakly anomalous gold in the Spider anticlinal closure. The best result
recorded was 0.394 g/t over six metres. Assay quality control was poor, however, and repeat determinations were recommended.

Fitzgerald (1989) carried out follow-up sampling at the Spider prospect in the nose of the anticline. Exploration was for gold and 13 samples were taken from quartz saddle reefs in the Koolpin Formation. Only one sample recorded greater than 0.1 g/t, viz 1.5 g/t.

**DRIFFIELD MINING PTY LTD 1988**

Carried out rock chip sampling on four traverses at 500 m spacing north of the McCarthys Mine within EL 5847. No significant gold or base metal anomalies were reported.

**AZTEC MINING COMPANY LTD (NICRON RESOURCES PTY LTD) 1991-1995**

Carried out a comprehensive literature review and compilation of historical data (Verbeek 1991). Five anomalies with a further five ‘anomalous locations’ were generated by both the literature review of previous work together with additional soil, rock chip and stream sediment sampling. The EL’s being explored during this period were 7614, 7615, 7979, 7054 and 7584 which cover all of the ground now within EL22440.

Further stream sediment sampling was conducted on Pb-Zn anomalies. The anomalies were traced to outcrops of gossanous material within the Koolpin Formation. Extensive soil samples were collected over two gridded areas. All were -40# size fraction and analysed for Cu, Pb, Zn, Ag, As (AAS), Au (FACG) and Bi, Sn, W (XRF). The soil sampling outlined two distinct and strong lead anomalies within the EL’s confirming the stream geochemistry. A more subdued but strong zinc anomaly was also located. The zinc and lead values are not coincident. Elsewhere areas of weakly elevated copper were outlined (not coincident with Pb or Zn highs), while silver, arsenic and gold were generally below detection level.

To complement the stream and soil geochemistry, rock chip samples were collected. The programme concentrated on limonitic-siliceous-gossanous and potentially mineralised outcrops and in the vicinity of streams with highly anomalous Zn and Pb. All samples were analysed for the same suite of elements as the soil samples. Maximum metal values obtained were 3.77% Pb, 0.74% Zn, and 25.3 g/t Ag. Sporadic elevated values were also obtained in arsenic, tin and copper.

Geological mapping comprised coverage of the EL at 1:2,500 scale in addition to detailed costean mapping. This work revealed that most of the base metal mineralisation occurs in discordant, northerly trending gossanous limonitic-siliceous structures and concordant north-west trending linear limonitic features. Stockwork veining was noted in the Zamu Dolerite.

Costeanning was carried out by bulldozer to follow up elevated soil and rock chip geochemistry. 16 costeans were excavated to bedrock with the costean floors being ripped and samples analysed for Cu, Pb, Zn, As and Au. Significant Pb and Zn assays were returned from five costeans (11 – 15).

Six diamond holes (MCD1-6) were drilled to test structures anomalous in Zn, Pb and Au (see Butler, 1993 B) that may form part of a larger mineralising system. A total of 280 m RC precollar and 684 m of coring was completed. The precollars were grab sampled at 2 m intervals and
selected core was split. Analyses were conducted for Cu, Pb and Zn. Petrological descriptions were made of the core.

Drillhole MCD6 was collared in carbonaceous mudstone of the Koolpin Formation. Minor pyrite was present with some chloritic alteration. The lithology extended to 242m and was variously altered and bleached with the abovementioned mineralised breccias present. From 242m to EOH, a sulphidic meta-dolerite was intersected. Two principle alteration zones were sampled, 100.5-107m and 180.7-221m, the former comprised a sulphide-siderite-carbonate breccia within a bleached chloritic carbonaceous mudstone. The latter consisted of two sideritic breccia intersections and pyrite within a chlorite-actinolite-biotite alteration zone. Best intersections were 6.2m of 0.14% Zn from 202.8m and 2.7m of 0.145% Zn from 180.7m. Pb and Cu were not significant.

In 1994 rehabilitation work was carried out and a further thirty seven seven soil samples were collected to test a more recently identified stream geochemical Pb-Zn anomaly however results were not encouraging.

Due to the take-over of Aztec Mining Company Limited by the Normandy Poseidon Group, the decision was taken to cease exploration on the tenement. Consequently the ground was relinquished in 1995.

**NORTHERN GOLD N/L 1995-1998**

Held several licences in the area now covered by EL22440 during this period however, their work was fairly rudimentary and consisted mostly of data reviews and compilations, some satellite imagery analysis and a very limited soil sampling program.

### 8 WORK COMPLETED

#### 8.1 Year 1 - Data Compilation

Reports from previous mapping and exploration work conducted throughout the area since 1919 were reviewed. The following information was assimilated.

**8.1.1 Geology data**

Geological maps at scales of 1:250k and 1:100k were acquired from the NTGS however these are based on mapping activities undertaken in 1981. Several company reports also included geological maps based on their own mapping activities and interpretation of aerial photographs. The most detailed of these were by Renison Goldfields Pty Ltd (Vann, 1988) and Aztec Mining Company Ltd (Melville, 1993) over several areas of the two main anticlines at a scale of 1:2500.

**8.1.2 Sampling data**

A complete review of all previous geochemical sample results was undertaken in which a total of 2100 soils, 830 stream sediment and 1340 rockchip/ironstone from 8 companies in the period 1966 to 1995 were plotted to show zones of anomalous Zn, Pb and Au values.
Five anomalous zones, identified by previous explorers (Aztec, 1992 CR92/168) were reconfirmed but an additional 6, lower tenor anomalous areas were also highlighted.

8.1.3 Drilling Data

Drilling information was reviewed and on the whole found to be ineffectual in terms of thoroughly testing the economic mineralisation potential of the area.

8.1.4 Historic Geophysics

The NTGS Mary River aeromagnetic data was reviewed by the author and his findings were conveyed in a report included as an appendix to the first year report. The magnetic data appear to indicate three main categories of iron bearing South Alligator Group and immediately overlying and interfolded rocks: skarn adjacent to granite, pyrrhotitic carbonaceous shale and/or shale with chert/BIF sequences, and magnetite bearing greywacke and conglomerate.

8.2 Current Year - Geophysical Surveys

8.2.1 Magnetics and Radiometrics

In order to define iron rich horizons and, in particular, isolated pyrrhotite sources, a 526 line kilometre aeromagnetic and radiometric survey over the southern portion of the licence was completed in September 2005. Sensor height was 30 meters and line spacing was 40 meters in an east-west direction. The survey outline in relation to the licence area is shown in Enclosure 1. Specifications are contained in the logistics report presented as Appendix II and on 1:20,000 scale flight and contour plans presented as Enclosures 2 - 9 inclusive.

8.2.2 Processing and Observations

The final magnetic data (total field) was further processed to remove the effects of distortion due to the inclination of the Earth's magnetic field and large regional variations. This was achieved by applying a reduction to the pole filter (RTP) and then a first vertical derivative (1VD). The result of this process is to “sharpen up” the appearance of the anomalies, thereby giving a better representation of the near-surface geometry of the source, and to shift the peak of the anomaly so that it is centred directly above the true location of the source rock. Consequently what initially appeared to be one large anomaly on the eastern part of the survey area decomposed into three distinct features. (See Enclosures 4 & 5)

These three features appear to fall within the Koolpin formation at the apexes (fold nose) and on the flanks of the Spider and McCarthys anticlines (Figure 4). However it may also be the case that the sources are nearer the Koolpin/Zamu contact or indeed entirely within the Zamu dolerite. Modelling is required to fully understand the stratigraphic position of the magnetic bodies.

Numerous northerly to NNW trending linear features with suppressed magnetic character are apparent in the southern half of the Wildman Siltstone bordering the contact with the McCarthys Granite (Figure 4). These features may represent sheared zones since they have an appearance and orientation similar to shear zone that hosts the McCarthys Pb mineralisation.
Figure 4 – NTGS 1:100,000 geology showing structural features over 1VD RTP image. Yellow striped lines indicate possible shear zones.

9 PROPOSED PROGRAM FOR YEAR 3

Remote Sensing
High resolution 1m colour IKONOS satellite imagery will be acquired and orthorectified to facilitate greater location control for future on-ground activities and to tie in work from previous explorers. This will form the base-map on which all data will be related.

Geochemical Sampling
Additional, carefully collected, stream-sediment, soil and/or rock-chip samples will be obtained from drainage/areas that have been identified as anomalous but remain unexplained and from drainage and areas that stem from or surround the locality of the highly magnetic sources. Assays will be carried out for Au and the base metal suite.

Database Compilation
All surface geochemical sample results and geological mapping from previous exploration need to be spatially located and entered into a database/GIS system to facilitate more interactive analysis of the data. Once in a database form, various statistical manipulations can be performed to uncover important trends and correlations in the data.

Computer Modelling
The geophysical data obtained from the airborne survey will need to be further analysed and interpreted using various filtering and modelling techniques. The principle aim of this work will be to formulate a geologically realistic model for the source of the intense magnetic anomalies thereby determining if they have the potential to indicate significant systems of mineralisation.

Ground Geophysics
In the event that the preceding activities point toward the need for more detailed ground geophysical work then the option of applying techniques such as IP, EM and gravity will be considered. These methods, if employed, will have the objective of defining drill targets for the following year of work.
10 REFERENCES


APPENDIX I

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APPENDIX II

Airborne Survey Logistics Report
Logistics Report

for a

DETAILED AIRBORNE MAGNETIC, RADIOMETRIC AND DIGITAL TERRAIN SURVEY

for the

PINE CREEK PROJECT

carried out on behalf of

JIM KASTRISSIOS

by

(UTS Job #A728)

FAUNTLEROY AVENUE, PERTH AIRPORT
PO BOX 126, BELMONT WA 6984
Telephone +61 8 9479 4232 Facsimile +61 8 9479 7361
A.B.N. 31 058 054 603
# TABLE OF CONTENTS

1 GENERAL SURVEY INFORMATION .............................................................................. 3

2 SURVEY LOCATION ........................................................................................................ 3

3 AIRCRAFT AND SURVEY EQUIPMENT ...................................................................... 4
   3.1 SURVEY AIRCRAFT .................................................................................................. 5
   3.2 DATA POSITIONING AND FLIGHT NAVIGATION .................................................. 5
   3.3 UTS DATA ACQUISITION SYSTEM AND DIGITAL RECORDING ............................ 6
   3.4 ALTITUDE READINGS ........................................................................................... 6
   3.5 UTS STINGER MOUNTED MAGNETOMETER SYSTEM ...................................... 6
   3.6 TOTAL FIELD MAGNETOMETER ........................................................................ 7
   3.7 THREE COMPONENT VECTOR MAGNETOMETER ............................................. 7
   3.8 AIRCRAFT MAGNETIC COMPENSATION ......................................................... 7
   3.9 DIURNAL MONITORING MAGNETOMETER ....................................................... 8
   3.10 BAROMETRIC ALTITUDE .................................................................................. 8
   3.11 TEMPERATURE AND HUMIDITY ...................................................................... 9
   3.12 RADIOMETRIC DATA ACQUISITION ............................................................... 9

4 PERSONNEL .................................................................................................................. 10
   4.1 FIELD OPERATIONS ........................................................................................... 10
   4.2 PROJECT MANAGEMENT ...................................................................................... 10

5 SURVEY PARAMETERS ................................................................................................ 11

6 SURVEY LOGISTICS .................................................................................................... 12
   6.1 DIURNAL MAGNETOMETER LOCATIONS ........................................................... 12

7 DATA PROCESSING PROCEDURES .......................................................................... 13
   7.1 DATA PRE-PROCESSING ..................................................................................... 13
   7.2 MAGNETIC DATA PROCESSING ......................................................................... 14
   7.3 RADIOMETRIC DATA PROCESSING ................................................................. 15
   7.4 DIGITAL TERRAIN MODEL DATA PROCESSING .............................................. 16

APPENDIX A - LOCATED DATA FORMATS .................................................................. 17

APPENDIX B - COORDINATE SYSTEM DETAILS ......................................................... 19

APPENDIX C - SURVEY BOUNDARY DETAILS .............................................................. 20

APPENDIX D - PROJECT DATA OVERVIEW ................................................................. 21

APPENDIX E – ACQUISITION AND PROCESSING PARAMETERS .................................. 22
1 GENERAL SURVEY INFORMATION

In September 2005, UTS Geophysics conducted a low level airborne geophysical survey for the following company:

Jim Kastrissios  
Unit 8, 91 Ross Smith Ave  
PARAP, NT 0820

Acquisition for this survey commenced on the 5th September 2005 and was completed on the 6th September 2005.

2 SURVEY LOCATION

The area surveyed was located near Pine Creek in the Northern Territory. Survey boundary coordinates are provided in Appendix C of this report.

The survey was flown using the MGA94 coordinate system (a Universal Transverse Mercator projection) derived from the Geocentric Datum of Australia and was contained within zone 53 with a central meridian of 135 degrees. Details of the datum and projection system are provided in Appendix B of this report.
3 AIRCRAFT AND SURVEY EQUIPMENT

The UTS navigation flight control computer, data acquisition system and geophysical sensors were installed into a specialised geophysical survey aircraft.

The list of geophysical and navigation equipment used for the survey is as follows:

**General Survey Equipment**

- FU24 – 954 fixed wing survey aircraft.
- UTS proprietary flight planning and survey navigation system.
- UTS proprietary high speed digital data acquisition system.
- Novatel 3951R, 12 channel precision navigation GPS.
- OMNILITE 132 real time differential GPS system.
- UTS LCD pilot navigation display and external track guidance display.
- UTS post mission data verification and processing system.
- Bendix King KRA-405 radar altimeter.

**Magnetic Data Acquisition Equipment**

- UTS tail stinger magnetometer installation.
- Scintrex Cesium Vapour CS-2 total field magnetometer.
- Fluxgate three component vector magnetometer.
- RMS Aeromagnetic Automatic Digital Compensator (AADC II).
- Diurnal monitoring magnetometer (Scintrex Envimag).

**Radiometric Data Acquisition Equipment**

- Exploranium GR-820 gamma ray spectrometer.
- Exploranium gamma ray detectors.
- Barometric altimeter (height and pressure measurements).
- Temperature and humidity sensor.
3.1 **Survey Aircraft**

The aircraft used for this survey was a FU24 – 950 series fixed wing survey aircraft, owned and operated by UTS Geophysics, registration VH-UTR. The specifications are as follows:

**Power Plant**

- **Engine Type** Single engine, Lycoming, IO-720
- **Brake Horse Power** 400 bhp
- **Fuel Type** AV-GAS

**Performance**

- **Cruise speed** 105 Kn
- **Survey speed** 100 Kn
- **Stall speed** 45 Kn
- **Range** 970 Km
- **Endurance (no reserves)** 5.6 hours
- **Fuel tank capacity** 490 litres

3.2 **Data Positioning and Flight Navigation**

Survey data positioning and flight line navigation was derived using real-time differential GPS (Global Positioning System).

Navigation was performed using a UTS designed and built electronic pilot navigation system providing computer controlled digital navigation instrumentation mounted in the cockpit as well as an externally mounted track guidance system.

GPS derived positions were used to provide both aircraft navigation and survey data location information.

The GPS systems used for the survey were:

- **Aircraft GPS Model** Novatel 3951R
- **Sample rate** 0.5 Seconds (2 Hz)
- **GPS satellite tracking channels** 12 parallel
- **Typical differentially corrected accuracy**
  - 1-2 metres (horizontal)
  - 3-5 metres (vertical)
3.3 **UTS Data Acquisition System and Digital Recording**

All geophysical sensor data and positional information measured during the survey was recorded using a UTS developed, high speed, precision data acquisition system. Survey data was downloaded onto magnetic tape on completion of each survey flight.

Instrument synchronisation times were measured and removed in real-time by the UTS data acquisition system.

3.4 **Altitude Readings**

Accurate survey heights above the terrain were measured using a King radar altimeter installed in the aircraft. The height of each survey data point was measured by the radar altimeter and stored by the UTS data acquisition system.

- **Radar altimeter models**: King KRA-405 twin antenna altimeter
- **Accuracy**: 0.3 metres
- **Resolution**: 0.1 metres
- **Range**: 0 - 500 metres
- **Sample rate**: 0.1 Seconds (10Hz)

The digital terrain model is calculated by subtracting the terrain clearance (radar altimeter) from the GPS height (interpolated to 0.1 Hz), and as such the accuracy is constrained by the differentially corrected GPS position.

3.5 **UTS Stinger Mounted Magnetometer System**

The installation platform used for the acquisition of magnetic data was a tail mounted stinger. This proprietary stinger system was constructed of carbon fibre and designed for maximum rigidity and stability.

Both the total field magnetometer and three component vector magnetometer were located within the tail stinger.
3.6 **Total Field Magnetometer**

Total field magnetic data readings for the survey were made using a Scintrex Cesium Vapour CS-2 Magnetometer. This precision sensor has the following specifications:

- **Model**: Scintrex Cesium Vapour CS-2 Magnetometer
- **Sample Rate**: 0.1 seconds (10Hz)
- **Resolution**: 0.001nT
- **Operating Range**: 15,000nT to 100,000nT

3.7 **Three Component Vector Magnetometer**

Three component vector magnetic data readings for the survey were made using a Develco Fluxgate Magnetometer. This precision sensor has the following specifications:

- **Model**: Develco Fluxgate Magnetometer
- **Sample Rate**: 0.1 seconds (10Hz)
- **Resolution**: 0.1nT
- **Operating Range**: -100,000nT to 100,000nT

3.8 **Aircraft Magnetic Compensation**

At the start of the survey, the system was calibrated for reduction of magnetic heading error. The heading and manoeuvre effects of the aircraft on the magnetic data was removed using an RMS Automatic Airborne Digital Compensator (AADC II).

Calibration of the aircraft heading effects were measured by flying a series of pitch, roll and yaw manoeuvres at high altitude while monitoring changes in the three axis magnetometer and the effect on total field readings. A 26 term model of the aircraft magnetic noise covering permanent, induced and eddy current fields was determined. These coefficients were then applied to the data collected during the survey in real-time.

UTS static compensation techniques were also employed to reduce the initial magnetic effects of the aircraft upon the survey data.
3.9 Diurnal Monitoring Magnetometer

A base station magnetometer was located in a low gradient area beyond the region of influence of any man made interference to monitor diurnal variations during the survey.

The specifications for the magnetometer used are as follows:

- Model: Scintrex Envimag
- Resolution: 0.1 nT
- Sample interval: 5 seconds (0.2 Hz)
- Operating range: 20,000nT to 90,000nT
- Temperature: -20°C to +50°C

3.10 Barometric Altitude

An Air DB barometric altimeter was installed in the aircraft so as to record and monitor barometric height and pressure. The data was recorded at 0.10 second intervals and is used for the reduction of the radiometric data.

- Model: Air DB barometric altimeter
- Accuracy: 2 metres
- Height resolution: 0.1 metres
- Height range: 0 - 3500 metres
- Maximum operating pressure: 1,300 mb
- Pressure resolution: 0.01 mb
- Sample rate: 10 Hz
3.11 Temperature and Humidity

Temperature and humidity measurements were made during the survey at a sample rate of 10Hz. Ambient temperature was measured with a resolution of 0.1 degree Celsius and ambient humidity to a resolution of 0.1 percent.

3.12 Radiometric Data Acquisition

The gamma ray spectrometer used for the survey was capable of recording 256 channels and was self-stabilising in order to minimise spectral drift. The detectors used contain thallium activated sodium iodide crystals.

Thorium source measurements were made each survey day to monitor system resolution and sensitivity. A calibration line was also flown at the start and end of each survey day to monitor ground moisture levels and system performance.

- Spectrometer model: Exploranium GR820
- Detector volume: 32 litres
- Sample rate: 1 Hz
4 PERSONNEL

4.1 Field Operations

UTS Geophysics Survey Operator   R. Williams
UTS Geophysics Survey Pilots    M. Truu

4.2 Project Management

Jim Kastrissios      Angus McCoy

UTS Geophysics Perth Office   Barrett Cameron
5 SURVEY PARAMETERS

The survey data acquisition specifications for each area flown are specified in the following table:

<table>
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<th>PROJECT NAME</th>
<th>LINE SPACING</th>
<th>LINE DIRECTION</th>
<th>TIE LINE SPACING</th>
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<td>526</td>
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The total number of line kilometres of survey data collected over the survey areas specified in the above table was 526.

The specified sensor height for the magnetic samples is as stated in the above table. This sensor height may be varied where topographic relief or laws pertaining to built up areas do not allow this altitude to be maintained, or where the safety of the aircraft and equipment is endangered.

The coordinate boundaries for the survey areas flown are detailed in Appendix C.
6 SURVEY LOGISTICS

The base location used for operating the aircraft and performing in-field quality control and data processing of the survey data was Pine Creek in the Northern Territory. The aircraft was operated from the Pine Creek airstrip.

6.1 Diurnal Magnetometer Locations

The following table contains the approximate locations where the diurnal base station magnetometers were located for the survey duration.

<table>
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<th>Area Name</th>
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<td>51</td>
<td>Pine Creek airstrip</td>
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7 DATA PROCESSING PROCEDURES

7.1 Data Pre-processing

The raw survey data was loaded from the field tapes and the recorded data trimmed to the correct survey boundary extents. Any survey lines subsequently reflown were removed from the dataset.

At the commencement of each acquisition flight, all the instrumentation clocks were synchronized to local time, and the error and latency of each instrument in providing its data measurement calculated. The results of these latency measurements were recorded into a synchronization file, and the results used to assign GPS positions to the magnetic, radiometric and elevation data. As a result of the physical separation of the sensors, a small residual offset still exists between instrument timings.

To compensate for this residual parallax error, an adjustment was made to the instrument clocks. The magnetic and radar altimeter data was adjusted by 0.600 seconds, and the radiometric data was adjusted by 1.375 seconds for each flight.

The synchronized, parallax corrected data was then exported as located ASCII data.
7.2 Magnetic Data Processing

The diurnal base station data was checked for spikes and steps, and suitably filtered prior to the removal of diurnal variations from the aircraft magnetic data.

The filtered diurnal measurements were subtracted from the diurnal base field and the residual corrections applied to the survey data by synchronising the diurnal data time and the aircraft survey time. The average diurnal base station value was added to the survey data.

The X and Y positioning of the data was then checked for spikes before applying the IGRF correction. Any spikes in the positions were manually edited. The updated IGRF 2000 correction was calculated at each data point (taking into account the height above sea level).

This regional magnetic gradient was subtracted from the survey data points.

Tie line levelling was applied to the data by least squares minimisation, using a polynomial fit of order 0, of the differences in magnetic values at the crossover points of the survey traverse and tie line data.

In order to remove any residual long wavelength variations in the tie line levelled data along the traverse lines, polynomial levelling was then applied.

Final micro-levelling techniques were then selectively applied to the tie line levelled data to remove minor residual variations in profile intensity

Located and gridded data were generated from the final processed magnetic data.


### 7.3 Radiometric Data Processing

Statistical noise reduction of the 256 channel data was performed using the Maximum Noise Fraction (MNF) method described by Dickson and Taylor (1998). This method constructs a noise covariance model from the survey data, which is then decorrelated and re-scaled so that the model has unit variance and no channel-to-channel correlation.

A principal component transformation of the noise-whitened data is performed, and the number of components to be saved is determined by ranking the eigenvectors by signal-to-noise ratio. The signal-rich components are retained, and the spectral data reconstructed without the noise fraction. Typically, 32-42 MNF components are retained during this process.

Channels 30-250 only are noise-cleaned, as these contain the regions of interest and are not dominated by the lower end of the Compton continuum. The energy spectrum between the potassium and thorium peaks was recalibrated from the noise-cleaned 256 channel measurements.

The aircraft background spectrum and the scaled unit cosmic spectrum were then subtracted from the 256 channel data. This 256 channel data was then windowed to the 5 primary channels of total count, potassium, uranium, thorium and low-energy uranium. Dead time corrections were then applied to the data. Radon background removal was performed using the Minty Spectral Ratio method (1992).

The radar altimeter data was corrected to standard temperature and pressure, and height corrected spectral stripping was then applied to the windowed data. Height attenuation corrections based on the STP radar altimeter were then performed to remove any altitude variation effects from the data.

The corrected count rate data was then converted to ground concentrations for potassium, uranium and thorium (sensitivity coefficients are supplied in Appendix E).

Final micro-levelling techniques were then selectively applied to the tie line levelled data to remove minor residual variations in profile intensities. Located and gridded data were generated from the final processed radiometric data.
7.4 Digital Terrain Model Data Processing

The radar altimeter data was subtracted from the GPS altimeter data. The separation distance between the GPS antenna and the radar altimeter of 1.4 metres was subtracted from the digital terrain data.

The digital terrain data thus derived was tie line levelled and gridded. Tie line levelled data was then examined and selectively microlevelled to produce a grid without line dependent artifacts.

For further information concerning the survey flown, please contact the following office:

Head Office Address:

UTS Geophysics
Fauntleroy Avenue, Perth Airport
REDCLIFFE WA 6104

Tel: +61 8 9479 4232
Fax: +61 8 9479 7361

Postal Address:

UTS Geophysics
P.O. Box 126
BELMONT WA 6984

Quoting reference number: A728
# APPENDIX A - LOCATED DATA FORMATS

## MAGNETIC LOCATED DATA

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## RADIOMETRIC LOCATED DATA

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<td>URANIUM (RAW)</td>
<td>Counts/sec</td>
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<td>Counts/sec</td>
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<td>THORIUM GRND CONCENTRATION</td>
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GRIDDED DATASET FORMATS

Gridding was performed using a bicubic spline algorithm.

The following grid formats have been provided:
  • ER-Mapper format

LINE NUMBER FORMATS

Line numbers are identified with a six digit composite line number and have the following format - ALLLLLLB, where:

A       Survey area number
LLLL    Survey line number
0001-8999 reserved for traverse lines
9001-9999 reserved for tie lines
B       Line attempt number, 0 is attempt 1, 1 is attempt 2 etc..

UTS FILE NAMING FORMATS

Located and gridded data provided by UTS Geophysics uses the following 8 character file naming convention to be compatible with PC DOS based systems.

File names have the following general format - JJJJAABB.EEE, where:

JJJJ   UTS Job number
AA     Area number if the survey is broken into blocks
BB M   Magnetic data
      Radiometric data
      Total count data
      Potassium counts
      Uranium counts
      Thorium counts
      Digital terrain data
EEE   File name extension
      LDT Located digital data file
      FMT Located data format definition file
      ERS Ermapper gridded data header file
      Ermapper data portion has no extension
      GRD Geosoft gridded data file
APPENDIX B - COORDINATE SYSTEM DETAILS

Locations for the survey data are provided in both geographical latitude and longitude and Universal Transverse Mercator metric projection coordinate systems.

**AMG84**
- Coordinate Type: Universal Transverse Mercator Projection Grid
- Geodetic datum: Australian Geodetic Datum
- Semi Major Axis: 6378160m
- Flattening: 1/298.25

**WGS84**
- Coordinate Type: Geographical
- Semi Major Axis: 6378137m
- Flattening: 1/298.25723563

**MGA94**
- Coordinate type: Universal Transverse Mercator Projection Grid
- Geodetic datum: Geocentric Datum of Australia
- Semi major axis: 6378137m
- Flattening: 1/298.257222101
APPENDIX C - SURVEY BOUNDARY DETAILS

COORDINATES REPORT

Job ID code: A7280101
Client: Jim Kastrissios
Job: Pine Creek
Coordinates MGA94 Grid Zone: 53
Include Point: 0.0 0.00

Surround
178700.000 8477500.000
178700.000 8479900.000
186400.000 8479900.000
186400.000 8477500.000
APPENDIX D - PROJECT DATA OVERVIEW

Pine Creek Project

Total Magnetic Intensity

Radiometric Total Count

Digital Terrain Model
APPENDIX E – ACQUISITION AND PROCESSING PARAMETERS

Magnetic Data

Magnetic Processing Parameters

Pine Creek
IGRF date - 2005.60
IGRF mean value - 47070 nT
Magnetic inclination - -41.95 deg
Magnetic declination - 3.77 deg
Diurnal base value - 47100.00 nT

Radiometric Data

Height Attenuation Coefficients

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<td>Uranium</td>
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Cosmic Correction Coefficients

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Aircraft Background Coefficients

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Sensitivity Coefficients

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<td>Thorium</td>
<td>8.9 cps/ppm</td>
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Final Reduction - All data reduced to STP height datum 30m.
Jim Kastrissios - EL22440

UTS Airborne Survey
Thorium Contours

Scale 1 : 20000

Coordinate System: MGA Zone 53

Date 24-3-2006

Enclosure 8