# Falcon Minerals Limited

# Saxby Project

# EPM 13630

## Final Report

## For the Period

## 10 May 2002 to October 2012

Volume 1 of 1

| | |
|---|---|
| **Tenure Holder** | AngloGold Ashanti Australia Limited (51%) Falcon Minerals Limited (49%) |
| **Operator** | Falcon Minerals Limited |
| **Compiled by** | Ron Smit |
| **Date** | February 2013 |
| **Distribution** | Department of Mines and Energy Queensland |

# TENEMENT REPORT INDEX

| | |
|---|---|
| **PROJECT NAME** | Saxby |
| **TENEMENT** | EPM 13630 |
| **HOLDER** | Falcon Minerals Limited |
| **OPERATOR** | Falcon Minerals Limited |
| **REPORT TYPE** | Final Report |
| **REPORTING PERIOD** | 10 May 2002 to October 2012 |
| **AUTHOR** | R Smit |
| **MAP SHEETS:** | 1:250,000 Dobbyn (SE54-14) |
| | 1:100,000 Canobie (7059) |
| **PROJECTION** | GDA94 MGA Zone 54 |
| **MINERAL PROVINCE** | Mount Isa Inlier, Carpentaria Basin |
| **COMMODITY**: | Au, Cu, Ni |
| **KEY WORDS:** | Gold, Iron oxide-copper-gold, IOCG |
| **PROSPECTS** | EM conductor drilled |
| **FIELD WORK** | Ground TEM survey, Diamond drilling, airborne magnetic survey |

## SUMMARY

**Location:**
EPM 13630 is 180 km northeast of Cloncurry in northwest Queensland. It was part of the Saxby Project which included several adjoining exploration licences.

**Geology:**
Mesozoic sediments of the Carpentaria Basin unconformably overlie deformed and metamorphosed basement rocks of the Mt Isa Eastern Succession. The cover sequence is greater than 450m thick.

**Work Done:**
In 2007-2008, a ground TEM (SQUID) survey was completed. A conductor was identified and it was tested in June 2008 by drilling a deep mud rotary / diamond hole. The hole intersected basement at 502m and was terminated at a depth of 826m. An airborne magnetic and radiometric survey was flown in 2009 with 100m spacing between flight lines.

**Results:**
The hole intersected a meta-sedimentary rock package dominated by graphitic (+/- sillimanite-cordierite-pyrrhotite) schists with some calc-silicate rocks. No gold or base metal mineralisation was intersected.

**Conclusions:**
The SQUID EM conductor is likely to be the response from the thick interval of graphitic schist and that these rocks belong to the Eastern Succession of the Mt Isa Inlier.

The thickness of younger sedimentary cover rocks makes mineral exploration challenging and expensive and as a consequence no further work is recommended.

**Rehabilitation:**
The drill hole was plugged with cement and sumps backfilled.

# CONTENTS



## LIST OF TABLES



## LIST OF FIGURES



## LIST OF APPENDICIES

# 1. INTRODUCTION

EPM 13630 is approximately 180km north-northeast of Cloncurry and 190km northwest of Julia Creek in northwest Queensland (Figure 1). The tenement is in a flood plain zone between the Saxby and Cloncurry Rivers that feed into the Gulf of Carpentaria, NW Queensland, approximately 225km northeast of Mt Isa.

Access is only possible in the dry season, from the surfaced Julia Creek-Three Ways Road and along station tracks and fence line tracks. The project is 200km from the nearest rail line and 45km to bitumen road. Although the topography is generally flat lying, black soils make access in the wet season impractical.

This Final Report summarises all exploration activities completed on EPM 13630 during its term from May 2002 to October 2012. Activities involved a ground TEM survey, the drilling of one deep diamond drill hole and an airborne magnetic / radiometric survey. An Exploration Index Map is included as Figure 2.

**Tenure Information**

EPM 13630 was granted to Yardarino Limited on 10 May 2002 for a period of 5 years. In December 2002 Yardarino Limited changed its name to Falcon Minerals Limited (**Falcon**) and vested the Exploration Permit in that name. EPM 13630 formed part of the Saxby Project which included adjoining tenements.

Anglo American Exploration (Australia) Pty Ltd (**Anglo American**) farmed into the Saxby Project in November 2006 and formed the Saxby Joint Venture (**Saxby JV**). Anglo American earned a 51% interest in Saxby JV including EPM 13630 in 2008. Anglo American subsequently sold their rights and interests in the Saxby JV, including ownership in EPM 13630, to AngloGold Ashanti Australia Limited (**AngloGold**) in August 2009.

AngloGold was the principal Operator of the Saxby JV up until their withdrawal in February 2011. Falcon is the current operator of the tenement group. EPM 13630 was surrendered in October 2012.

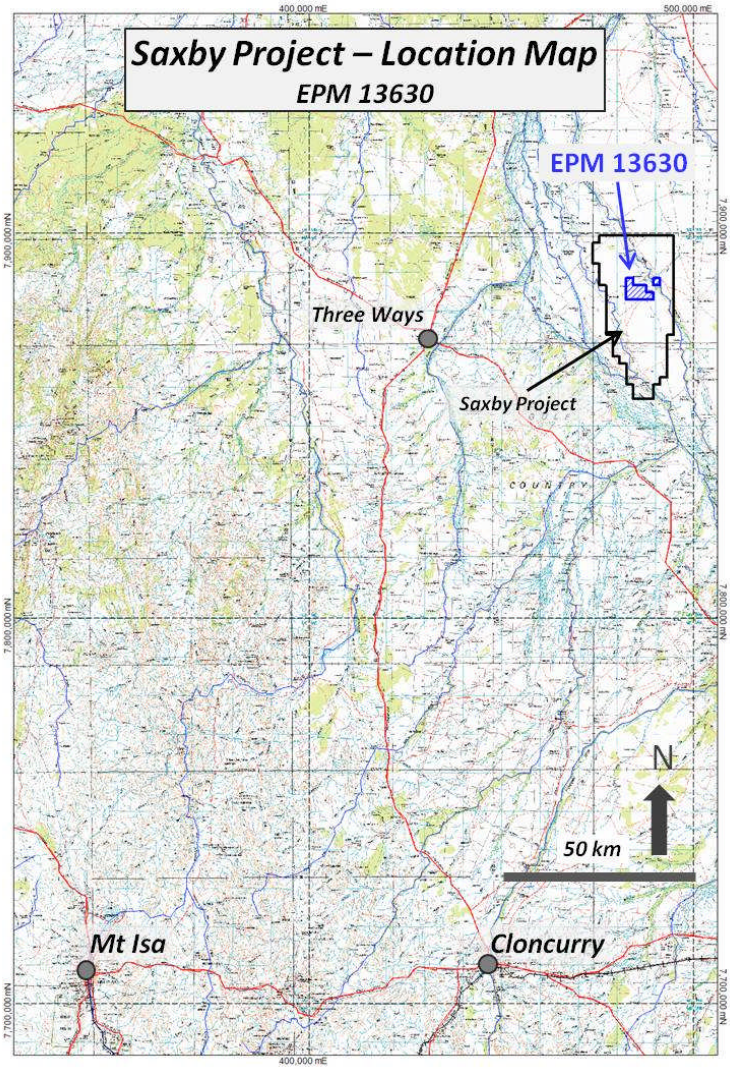



***Figure 1: Location of EPM 13630***

***Table 1: Sub-blocks of EPM 13630 (Normanton BIM)***

| Block | A | B | C | D | E | F | G | H | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2299 | | | | | | X | | | | X | X | X | X | | | X | X | X | X | | | | | | |

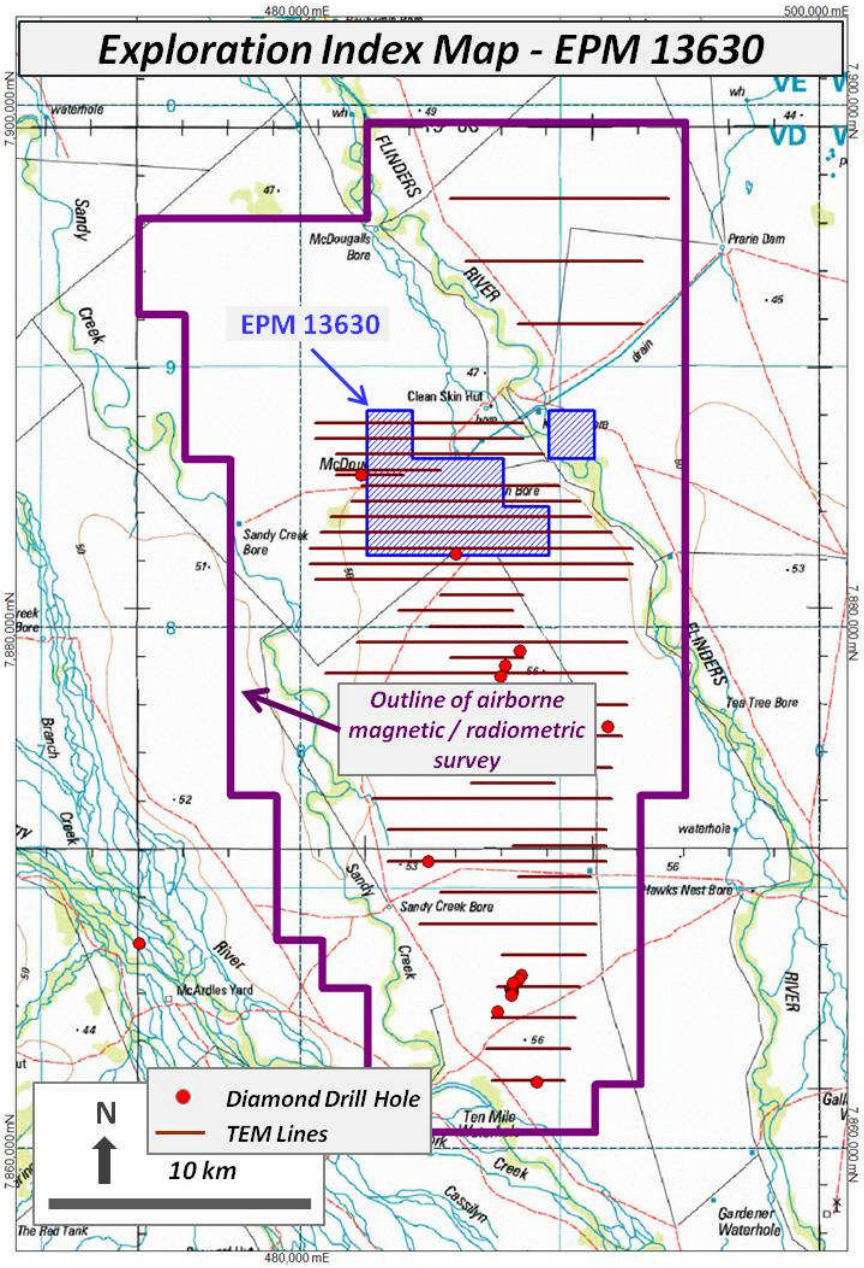



***Figure 2: Exploration Index Map EPM 13630***

# 2. GEOLOGY

### 2.1 Regional Geology

EPM 13630 lies within the Carpentaria Basin, which generally comprises 300m to 650m of Mesozoic and younger sediments. Consequently there is a lack of knowledge about the stratigraphy, structure and potential for mineralisation in the underlying basement rocks which are interpreted to be Proterozoic in age. Interpretation of regional magnetic and gravity data suggests that EPM 13630 is located over a Proterozoic basement high with bedrock similar to the Eastern Succession of the Mt Isa Province to the south and west (Figures 3). The Mt Isa Province hosts significant, world class resources of economic copper, lead and zinc mineralisation. The NNE trending magnetic belt on which Saxby is situated also hosts the Ernest Henry copper-gold deposit, approximately 140km farther to the south.

The Mt Isa Province is a Proterozoic metamorphic inlier in the NW of Queensland. It is a north-trending, complex, multi-stage crustal rift that has an outcropping area of 800km by 150-250km. Three episodes of crustal rifting have been recognised in the Mt Isa Inlier, at 1870Ma, 1790Ma and 1679Ma, resulting in volcanism, sedimentation and granite intrusion. This was followed by a major deformation and metamorphic event, the 1620-1540Ma Isan Orogeny, and by emplacement of fractionated granites along the eastern margin of the province at ~1500Ma.

### 2.2 Local Geology

The limited knowledge of the local geology of EPM 13630 has been generated by the interpretation of geophysical datasets (seismic, magnetics and gravity) and a small amount of previous drilling in the general area (21 holes within an area of >1000km$^2$). Previous drilling within the Saxby Project area suggests that the cover thickness ranges from 400m to 450m, but deepens to 630m towards the west. The tenements are situated above the eastern magnetic boundary of the interpreted northern extension of the Mt Isa Province. This boundary closely correlates with the major suture line between the Proterozoic Mt Isa Inlier in the west and Georgina basement rocks in the east. Seismic sections show that the cover to the east of the Saxby project area thickens rapidly to depths of 1200m.

Geophysical data in the Saxby area indicate that a number of large granitic bodies, similar to the ~1500Ma Naraku batholith to the south, may intrude the Proterozoic bedrock underneath the Mesozoic cover sequence (Figure 3). Previous drilling approximately 20-30km southwest of EPM 13630 encountered such granodioritic bodies. The regional gravity high on which the Saxby project area is situated is probably the result of various mafic-ultramafic intrusions. These were encountered in drill core 10-15km to the south of EPM 13630. These mafic intrusions are hosted in (graphitic) shales. From interpretation of geophysical data, the basement below EPM 13630 is comprised predominantly of Proterozoic meta-sediments and could also be comprised of granites and (younger) mafic-ultramafic intrusions.

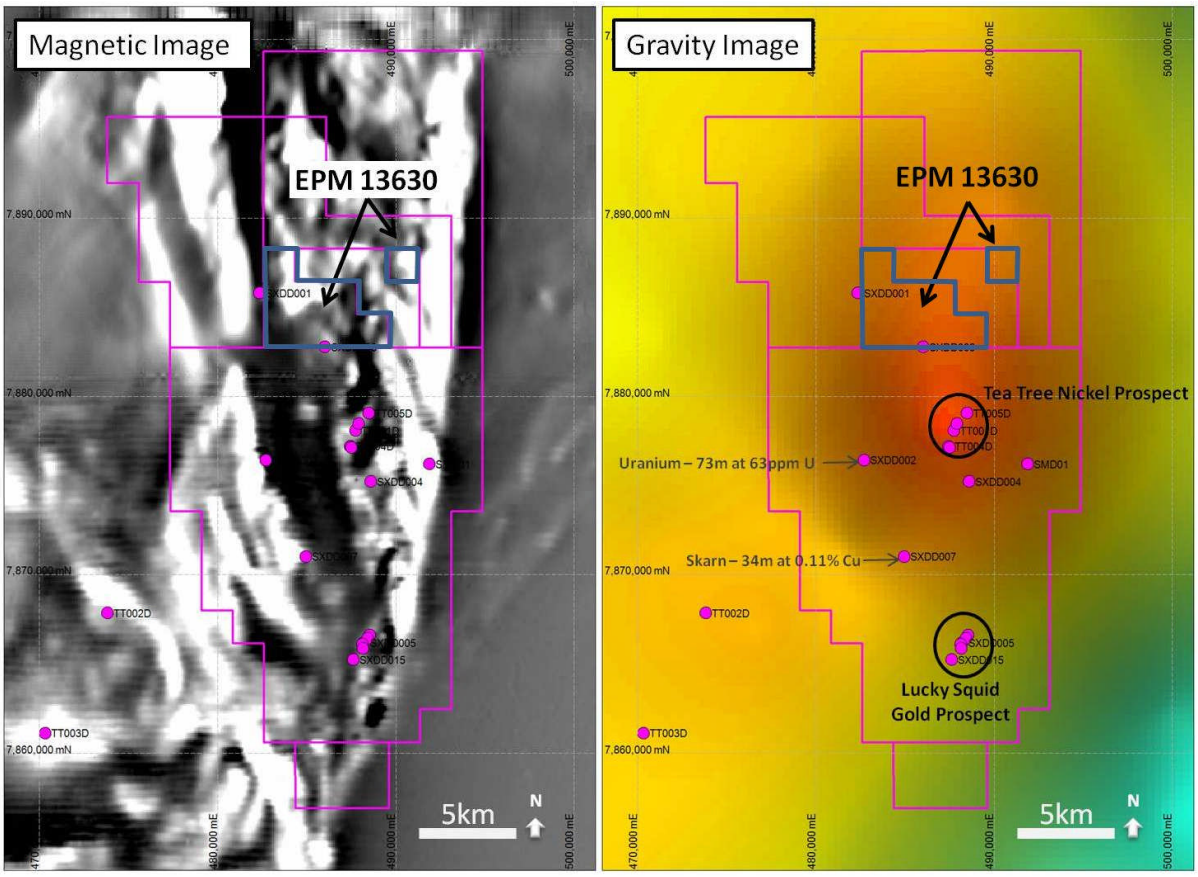



***Figure 3: Regional magnetic and gravity image showing historical drill holes***

## 3. EXPLORATION RATIONALE

The initial exploration target at Saxby was magmatic sulphide Ni-Cu-PGE mineralisation hosted within a large mafic-ultramafic intrusive complex. The mafic-ultramafic intrusive rocks intersected in the previous drilling completed by MIM and Falcon (outside EPM 13630) are interpreted to be part of a large, complex intrusion that is responsible for the regional gravity high at the Saxby Project. The textural variations, presence of magmatic sulphide and olivine-rich nature of the rocks all indicate the possibility for a Voisey's Bay or Noril'sk style of magmatic system to be present at Saxby.

The discovery of significant gold mineralisation on EPM 15398 in 2008, some 20km to the south of EPM 13630 changed the focus of exploration to gold.

## 4. PREVIOUS EXPLORATION

There have been some regional airborne geophysical surveys over EPM 13630 but there is no record of previous ground mineral exploration. The historical mineral exploration in the wider district is summarised below:

Previous exploration on the Saxby Project has used geophysics (airborne magnetic, ground gravity and ground electromagnetic surveys) to facilitate mapping of prospective units under deep cover followed by diamond drill testing of selected targets. Only 21 diamond holes in an area of 1000 sq km have been drilled.

The technical success rate has been high with diamond drill holes intersecting low-grade nickel-copper sulphides in gabbro-norite, anomalous uranium in pegmatoid-bearing metasedimentary rocks, elevated copper-rare earth elements in skarn and structurally-hosted gold at the contact between metasedimentary rocks and intrusive rocks.

**MIM Exploration (1992 to 1998) – Tea Tree Project**

MIM Exploration (**MIM**) was drawn to the area by the presence of large magnetic and gravity anomalies as observed in regional datasets. Their target was Ernest Henry style IOCG mineralisation. MIM completed a semi-regional airborne magnetic survey and a ground gravity survey. Five diamond holes were drilled to test selected targets. The depth of Mesozoic cover was shown to be in excess of 400m.

Drill holes that tested the main gravity high intersected gabbro, olivine gabbro and gabbro-norite. The mafic intrusive rocks contain varying amounts of sulphide, ranging from a background of trace pyrrhotite and pyrite to narrow intervals of semi-massive sulphide (pyrrhotite with minor pentlandite and chalcopyrite) that have clear magmatic textures. The best magmatic Ni-Cu sulphide intersection was 10.4m at 0.25% Ni and 0.28% Cu. This is known as the Tea Tree Prospect.

**Falcon Minerals (2002 to 2006) – Saxby Project**

Falcon acquired the ground in 2002 and drilled two diamond holes to further evaluate the potential for magmatic Ni-Cu sulphide mineralisation. One hole was drilled at the Tea Tree Prospect and intersected further low–grade Ni-Cu mineralisation (pyrrhotite >> pentlandite and chalcopyrite) associated with olivine bearing gabbro and gabbro-norite.

The other hole was drilled into an isolated magnetic high about 4.5km to the southeast of the Tea Tree Prospect. It intersected gabbro with locally abundant titano-magnetite. The gabbro was regarded as a more fractionated variant of the mineralised mafic intrusion intersected at the Tea Tree Prospect.

**Anglo American (2006 to 2009) – Saxby JV**

In 2006 Anglo American and Falcon formed a Joint Venture (JV) to explore the Saxby Project area for magmatic Ni-Cu sulphide mineralisation. Anglo American brought to the JV proprietary advanced EM technology with the capability to screen for conductive bodies under thick cover. The SQUID TEM survey covered an area of 250 sq. km and was successful in identifying several strong bedrock conductors.

Seven bedrock conductors were tested by drilling in 2008. Two of these holes (SXDD001 and SXDD005) were co-funded by the Queensland Department of Mines and Energy under the SMART Collaborative Drilling Initiative.

The source of the EM conductors is regarded in most cases as graphite-rich gneiss, although in some instances the presence of abundant sulphide (pyrrhotite) is responsible. No massive magmatic Ni-Cu sulphide mineralisation was intersected.

Nonetheless, the technical success rate was high with diamond drill holes discovering:

- elevated copper-rare earth elements in skarn (34m at 0.11% Cu with visible allanite);
- anomalous uranium in pegmatoid-bearing metasedimentary rocks (73m at 61ppm U);
- high-grade gold in altered tonalite (17m at 6.75g/t Au); and
- confirmed low-grade Ni-Cu sulphides in gabbronorite at the Tea Tree Prospect.

This drilling added substantial new knowledge about the bedrock geology and its prospectivity.

**AngloGold Ashanti (2009 to 2010) – Saxby JV**

In 2009 AngloGold Ashanti (AngloGold) bought Anglo American's interest in the Saxby Project. They completed a detailed airborne magnetic survey (100m line spacing) and then concentrated on the SXD005 gold discovery. Mineral exploration at this prospect involved a follow-up SQUID electromagnetic survey, an infill gravity survey and the drilling of five diamond holes. SXDD014 confirmed significant gold mineralisation close to the original discovery hole. This hole returned 15m at 9.09g/t Au from 701m. The prospect was named the Lucky Squid Gold Prospect.

**Falcon (2011 to present) – Saxby Project**

AngloGold withdrew from the Saxby JV in February 2011. Falcon drilled a further four deep diamond drill holes at the Lucky Squid Gold Prospect in 2012. The drill holes intersected broad zones of faulting and alteration characterised by anomalous copper and a few narrow gold intercepts (the best being SXDD016: 1m at 26.1g/t Au from 602m and SXDD017: 3m at 3.97g/t Au from 628m). These results did not meet expectations of substantial and wide extensions of gold mineralisation away from the initial discovery holes.

# 5. EXPLORATION COMPLETED DURING THE TERM

## 5.1 Exploration on EPM 13630 by Anglo American

### 5.1.1 SQUID EM Survey

A ground Transient Electromagnetic survey was undertaken using a Low Temperature Superconducting Quantum Interference Device as the EM sensor (**SQUID EM**) on the Saxby Project including EPM 13630.

For the Saxby Project survey, the first pass data was collected in 2007 on stations spaced 400m apart with 400m loops, measuring only the vertical component of the EM field. Preliminary lines were spaced 1.2km to 2.4km apart. The first pass survey identified some strong bedrock conductors and the original lines were followed-up in early 2008 with infill lines spaced 0.6km to 1.2km apart. The infill data was collected with a station spacing of 200m to 100m with 400m loops and measured both vertical and horizontal components of the EM field.

During 2007, ten survey lines were collected on EPM 13630. The lines consisted of 212 stations spaced 200 or 400m apart for a total of 78.2 line km. During 2008, one additional line of TEM data was collected on EPM 13630. The line consisted of 19 stations spaced 200m apart for a total of 3.8 line km of which 2.1 km is contained within EPM 13630.

The location of TEM lines is shown on Figure 4 and the digital data is attached in Appendix 1 (raw tem data and Emax conductivity depth images). The survey specifications for surveys completed in 2007 and 2008 are shown in Table 2. One strong conductor was detected within EPM 13630 and this was tested with a single diamond drill hole (SXDD003).

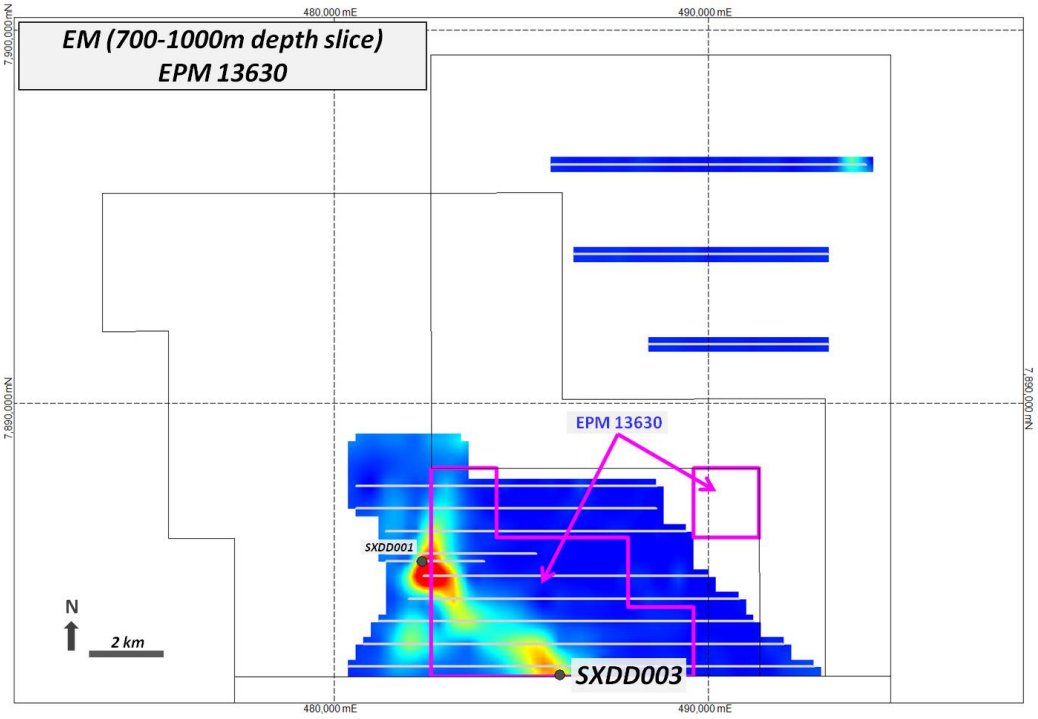



***Figure 4: EPM 13630, SQUID EM survey lines on conductivity depth image (700-1000m) showing location of diamond drill hole SXDD003***

***Table 2: SQUID EM survey specifications***

| **Year:** | **2007** | **2008** |
|---|---|---|
| Configuration: | In-Loop | In-Loop |
| Station Spacing: | 400m | 200m |
| Receiver: | SMARTEM | SMARTEM |
| Frequency: | 0.28Hz | 0.28Hz |
| Components: | Z, X | Z, X, Y |
| Sensor: | Low Temperature SQUID | Low Temperature SQUID |
| Transmitter: | GGT-30 | GGT-30 |
| Loop Size: | 400m | 200m |
| Loop Turns: | 1 | 1 |
| Current: | 18A | 28A |

### 5.1.2 Diamond Drilling

The SQUID EM conductor was tested by a single hole, SXDD003. The collar details are presented in Table 3 and a summary geological log presented in Table 4. The following digital files accompany this report as Appendix 2 – SXDD003 Drill Hole Data:

*Collar (SXDD003_Collar.txt)*
*Survey (SXDD003_Survey.txt)*
*Geology (SXDD003_Geology.txt)*
*Drill Assay (SXDD003_Assays.txt)*
*Geotechnical (SXDD003_Geotechnical.txt)*
*Mineralisation (SXDD003_Mineralisation.txt)*
*Structure (SXDD003_Structure.txt)*
*Alteration (SXDD003_Alteration.txt)*
*Core photographs (SXDD003_CorePhotographs.pdf)*
*Geological logging codes (SXDD003_GEO_Logging_Codes.pdf)*
*Cross-Section (SXDD003_Cross_Section.pdf)*

***Table 3: SXDD003 collar details (Projection GDA94 MGA Zone 53)***

| Hole_ID | Tenement | East | North | RL | Azimuth | Dip | Total depth | Depth to basement |
|---|---|---|---|---|---|---|---|---|
| **SXDD003** | EPM 13630 | 486017 | 7882778 | 60 | 45 | -60 | 826 | 502.1 |

***Table 4: SXDD003 - Summary Geological Log***

**SXDD003**

| | |
|---|---|
| 0 – 502m | Mesozoic Cover Sediments |
| 502 – 678m | Graphitic schist – 40% to 80% crystalline graphite with minor semi-massive pyrrhotite veins |
| 678 – 713m | Sillimanite-graphite schist with 10% to 20% pyrrhotite and minor chalcopyrite |
| 713 – 753m | Calc-silicate with intervals of diopside-rich skarn. Patches of up to 40% pyrrhotite with minor chalcopyrite |
| 753 – 811m | Graphite-cordierite schist with minor pyrrhotite-chalcopyrite-sphalerite veins |
| 811 – 826m | Calc-silicate intercalated with graphite-sillimanite schist |

**EOH**

SXDD003 was drilled by mud rotary down to 498m and the HRQ casing was reamed down to 499m. The basement started at 502.1m (down-hole) and the final depth of the hole was 826m. For the first 200m abundant graphite-rich schists in the hole proved to be a challenge for the drilling. After completion of the hole, SXDD003 was sealed (van Ruth plug emplaced in basement then cement backfilled) due to positive water flows out of the artesian aquifer hosted in the sandy basal units of the Mesozoic cover sequence.

**SXDD003 Geology**

The flat-lying sedimentary cover sequence consists of a thin sequence of Pliocene to Recent sediments that overly a thick sequence of Mesozoic age sediments of the Carpentaria Basin. The Carpentaria Basin sediments are dominated by a very thick monotonous mudstone-siltstone sequence and is characterised by a basal friable fine grained quartz sandstone formation. It is this basal sandstone formation that hosts the artesian waters.

The NQ diamond tail continued to a final depth of 826m. In very general terms the hole intersected a meta-sedimentary rock package dominated by graphitic (+/- sillimanite-cordierite-pyrrhotite) schists with some calc-silicate rocks (Figures 5,6 & 7). The modelled conductor is likely to be the response from the thick interval of crystalline graphite. Detailed logs, core photographs and a cross-section can be found in Appendix 2.


***Figure 5: Drill core photograph - SXDD003, 589m - Graphitic schist with up to 80% crystalline graphite, and minor feldspar/quartz***

***Figure 6: Drill core photograph - SXDD003, ~ 678m - Graphite-sillimanite schist with up to 20% pyrrhotite and minor chalcopyrite.***

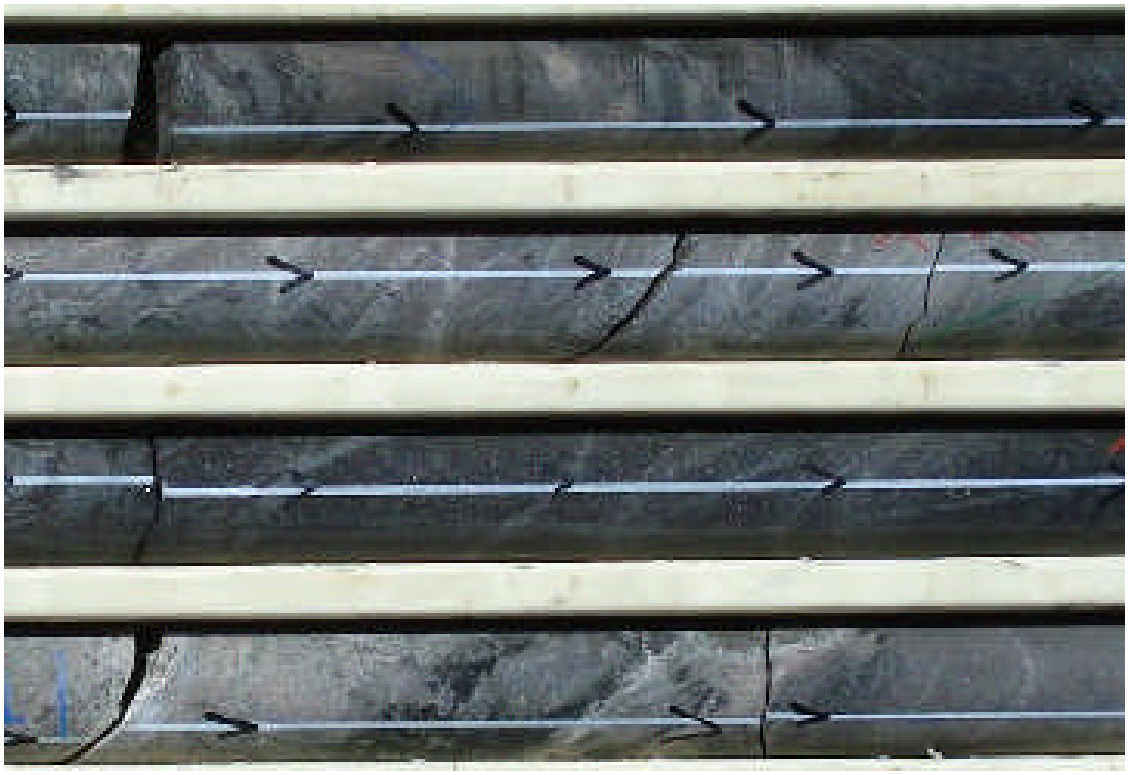


***Figure 7: Drill core photograph - SXDD003 ~ 811m - Calc-silicate gneiss, at times intercalated with graphitic schist.***

**SXDD003 Geochemical Analysis**

199 samples of NQ half-core were collected from the diamond tail. Au, Pd and Pt was analysed by ICP at ALS Laboratory. Ag, Al, As, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Fe, Hf, K, La, Mg, Mn, Mo, Na, Ni, P, Pb, Rb, S, Sb, Sc, Sn, Sr, Ta, Th, Ti, U, V, W, Y, Zn, Zr have been determined by acid digest and analysed by ICP at Acme Analytical Laboratories Ltd.

No significant zones of mineralisation were recorded. Digital assay results are attached within Appendix 2.

### 5.2 Exploration on EPM 13630 by AngloGold Ashanti

Further exploration by AngloGold on the Saxby JV prior to their withdrawal concentrated on the Lucky Squid Gold Prospect within EPM 15398 (approximately 20km south of EPM 13630). The only additional mineral exploration activity completed upon EPM 13630 was an airborne magnetic and radiometric survey.

### Airborne Magnetic and Radiometric Survey

The survey was commissioned and funded by AngloGold Ashanti and was flown by Thomson Aviation in late September 2009. The survey specifications were:

- Cesna 210 fixed-wing aircraft
- 090-270° flight lines at 100 metre line spacing, with 000-360° tie-lines at 1000m spacing
- Mean terrain clearance of 50 metres
- Geometrics G-822 Airborne Cesium Sensor (magnetics), 20Hz (~3.75m) sampling interval, 0.001nT magnetic resolution
- Radiation Solutions RS-500 Airborne Gamma Ray Spectrometer (radiometrics), 0.5 second (~35m) sampling interval.

A survey processing report by Baigent Geoscience is presented In Appendix 3. A reduced to pole (RTP) total magnetic intensity (TMI) image is presented in Figures 8.

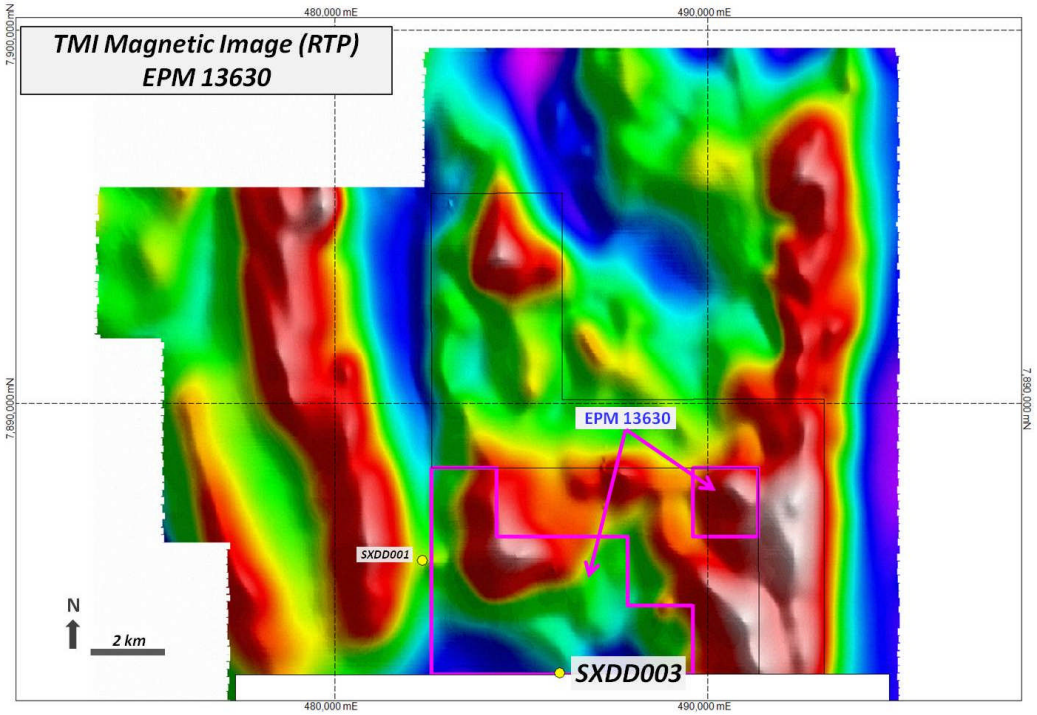



*Figure 8: Reduced to pole (RTP) total magnetic image showing location of SXDD003*

## 6. ENVIRONMENTAL MONITORING

The SQUID EM survey did not cause any land disturbance and had had no environmental impact. The drill hole intersected artesian water at the base of the cover sequence. To preserve the integrity of the aquifer a Van-Ruth plug was placed in basement and the remainder of the hole to near surface was sealed with cement. The drill sumps were back-filling and the drill site rehabilitated. A photograph of the rehabilitated drill site is presented as Figure 9.


***Figure 9: Drill site SXDD003 following rehabilitation***

## 7. CONCLUSION

The SQUID EM ground survey was successful in defining a strong basement conductor. Drilling of this conductor failed to locate sulphide mineralisation but did intersect graphite bearing litho-types which is the likely EM source.

The thickness of younger sediments makes mineral exploration of the basement challenging and expensive. As a consequence and taking in to account other exploration results by Falcon and it former JV partners in the district it was decided to surrender the tenement.

# APPENDIX 1

SQUID TEM Data

*refer to digital files*

# APPENDIX 2

SXDD003 – Drill Hole Data

*refer to digital files*

# APPENDIX 3

Airborne Magnetic and Radiometric Survey
Processing Report by Baigent Geosciences

BAIGENT GEOSCIENCES

# AngloGold Ashanti Ltd
# Saxby, QLD
# Geophysical Survey
# Processing Report

**September 2009**

# Table of Contents

# 1. Datum Specification

The output survey coordinates are based on the Geocentric Datum of Australia 1994 (GDA94), zone 54.

It has the following parameters:

| | |
|---|---|
| Projection name: | Map Grid of Australia |
| Datum: | Geocentric Datum of Australia (GDA94) |
| Reference Frame: | ITRF92 (International Terrestrial Reference 1992) |
| Epoch: | 1994.0 |
| Ellipsoid: | GRS80 |
| Semi-major axis: | 6.378.137.0 metres |
| Inverse flattening: | 298,257222101 |
| False Northing: | 10,000,000 m N |
| False Easting: | 500,000 m E |
| Scale Factor: | 0.9996 |

# 2. Parallax

Parallax corrections were applied as follows:

1. 3 fiducials (at 20 hertz) for magnetics and elevation data.
2. 0.5 seconds for radiometrics

# 3. Magnetic processing

## 3.1 Processing Flow

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 diurnal data was filtered with a second difference filter to identify and remove spikes of less than 0.05nT. A second smoothing filter, a 13 point moving average filter is used to reduce noise levels.

The filtered diurnal are then applied to the survey data by synchronising the diurnal data time with the aircraft survey time. The average diurnal base station value was added to the survey data.

An eighth difference filter was run on the raw magnetic survey data in order to identify any remaining spikes in the data, which were manually edited from the 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 IGRF 2005 (updated to (2009.71) correction was calculated at each data point taking into account the height above sea level using the gps altitude. This regional magnetic gradient was subtracted from the survey data points.

The data was then tie-line levelled and micro-levelled.

## 3.2 Compensation

The data was compensated post flight using a 16 term model based on the work done by C.D. Hardwick.

Magnetic compensation sequences were flown after acquisition completed and after routine maintenance was performed, as required. The resulting coefficients were used for post flight magnetic compensation:

| Aircraft | Date | Flight | StDev (UnC) | StDev (Cmp) | IR |
|---|---|---|---|---|---|
| **VH-JHF** | 14/09/09 | 1 | 0.234 | 0.024 | 9.79 |

UNC: Standard deviation of uncompensated TMI (nT)
CMP: Standard deviation of compensated TMI (nT)
IR: Improvement ratio (UNC/CMP)

A qualitative measure of the effectiveness of the compensation is to examine the standard deviation of the high passed total magnetic field before and after the compensation coefficients have been applied. The higher the improvement ratio the better the compensation model has removed the aircraft induced manoeuvre signal. This may not always the case, as a very clean aircraft will have a low improvement ratio. Also if the manoeuvres are smaller than specified then the IR ratio will be small. After reviewing the data, the compensation was deemed to be successful.

## 3.3 Magnetic Model

IGRF was removed using the gps altitude.

The magnetic model for the centre of the area is detailed below:

| | |
|---|---|
| Model | IGRF 2005 updated to 2009.71 |
| Declination | 6.24893 degrees |
| Inclination | -49.03170 degrees |
| Field strength | 49715.79 nT |
| Grid zone | 54 |
| Grid central meridian | 141.00000 degrees |
| Input latitude | -19.17332 degrees |
| Input longitude | 140.84889 degrees |
| Grid convergence | -0.04963 degrees |
| Grid magnetic angle | 6.19931 degrees |
| Secular variation | -0.01150 degrees |

## 3.4 Diurnal Base Value

The average diurnal base value was 49,513.14 nT

## 3.5 Tie Line levelling Method

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

The least squares tie line levelling process employs a two pass Gauss-Seidel iterative scheme. The essential steps in this process are:

In the first pass the tie lines were first adjusted to minimise, in the least squares sense, the crossover values with the traverse line values being held constant.

The second pass held the levelled tied line values constant, and minimised in the least squares sense, the crossover values with traverses.

The DC correction values to be applied to the traverse lines and tie lines were then applied to the magnetic data.

To reduce the effects of radar altimeter and gps errors on the recorded elevation data at the crossover points, data having a radar altimeter difference greater than 15 metres in a radius of 50 metres on the traverse or tie lines were excluded from the tying process.

## 3.6 Micro-levelling Method

Micro-levelling techniques were then selectively applied to the tie line levelled data to remove minor residual variations in profile intensity Selective micro-levelling was applied in order to leave unaffected any data having no residual levelling artefacts. Selective micro-levelling proceeds using the following steps:

Areas of interest that required micro-levelling were identified through the use of image processing visualisation.

Polygons were used to define areas requiring micro-levelling.

"Pseudo-ties" were constructed from the gridded data by extracting traverses from the grid normal to the flight direction.

Line dependent artefacts were removed from the pseudo lines using custom filters.

Crossover values were calculated between traverse lines and pseudo tie lines.

The traverse lines were adjusted in the pre-defined sections to minimise the crossover values.

This process was repeated in order to remove various wavelength line dependent artefacts from the pseudo-ties. The object of each micro-levelling iteration was to produce a smooth control surface to which the traverse lines are levelled. This control surface was provided through the use of "pseudo-ties".

## 3.7 Interpolation Method

The interpolation used is a minimum curvature algorithm. The algorithm is based on the worked published by Briggs 1974, Briggs I. C.: Machine contouring using minimum curvature. *Geophysics*. Vol. 39, No. 1. February 1974. pp. 39-48.

The algorithm has been modified to include a tension parameter based on the work published by Smith and Wessel Smith, W. H. F, and P. Wessel, 1990, Gridding with continuous curvature splines in tension, Geophysics 55, 293-305.

A tension factor of 0 was used to interpolate the data.

The mesh size for data interpolation was 25 x 25 metres.

# 4. Radiometric Processing

## 4.1 Processing Flow

The processing steps radiometric data were as follows:

1. Application of necessary parallax corrections to data
2. Check radar altimeter data for spikes
3. NASVD spectral smoothing

- Examine the output to determine the number of components required.
- Select 6 components for spectral reconstruction.

4. Standard 256 channel radiometric corrections:

- Dead-time correction performed on 256 channel data.
- Check if energy recalibration required
- Remove 256 channel aircraft and cosmic backgrounds from the data
- Remove background radon from window data using Minty's method (1996)
- Perform STP height corrected spectral stripping
- Perform STP height correction of window data to specified survey height (50m).

5. Tie line levelling(optional) and Micro-levelling

.

## 4.2 Window Energy Limits

The energy bounds for the windows were

| **Window Name** | **Energy Range (Mev)** |
|---|---|
| Potassium | 1.374 – 1.566 |
| Thorium | 2.416 – 2.799 |
| Uranium | 1.662 – 1.854 |
| Total Count | 0.414 – 2.799 |

## 4.3 Spectral Stripping Ratios

The stripping ratios used in the processing were:

| | |
|---|---|
| **Alpha** | 0.277 |
| **Beta** | 0.408 |
| **Gamma** | 0.776 |
| **a** | 0.045 |
| **b** | 0.001 |
| **g** | 0.000 |

## 4.4 Aircraft, Cosmic Backgrounds and Height Attenuation coefficients

| | Total Count | Potassium | Uranium | Thorium |
|---|---|---|---|---|
| **Aircraft Bkg** | 155.53 | 23.58 | 6.047 | 0 |
| **Cosmic Bkg** | 0.986 | 0,.0514 | 0.041 | 0.0549 |
| **Height Attn** | -0.007434 | -0.009432 | -0.008428 | -0.007510 |

The above values are for the windows only. During processing the equivalent 256 channel aircraft and cosmic backgrounds are removed.

## 4.5 Conversion to Ground Concentrations

| | Total Count<br>Cps to Dose rate | Potassium<br>Cps to Percent | Uranium<br>Cps to PPM | Thorium<br>Cps to PPM |
|---|---|---|---|---|
| **Conversion Factor** | 52.657 | 202.671 | 18.003 | 10.727 |

## 4.6 Tie Line Levelling

No tie line levelling was applied.

## 4.7 Micro-levelling Method

Micro-levelling techniques were then selectively applied to the tie line levelled data to remove minor residual variations in profile intensity Selective micro-levelling was applied in order to leave unaffected any data having no residual levelling artifacts. Selective micro-levelling proceeds using the following steps:

Areas of interest that required micro-levelling were identified through the use of image processing visualisation.

Polygons were used to define areas requiring micro-levelling.

"Pseudo-ties" were constructed from the gridded data by extracting traverses from the grid normal to the flight direction.

Line dependent artefacts were removed from the pseudo lines using custom filters.

Crossover values were calculated between traverse lines and pseudo tie lines.

The traverse lines were adjusted in the pre-defined sections to minimise the crossover values.

This process was repeated in order to remove various wavelength line dependent artefacts from the pseudo-ties. The object of each micro-levelling iteration was to produce a smooth control surface to which the traverse lines are levelled. This control surface was provided through the use of "pseudo-ties".

## 4.8 Interpolation Method

The interpolation used is a minimum curvature algorithm. The algorithm is based on the worked published by Briggs 1974, Briggs I. C.: Machine contouring using minimum curvature. *Geophysics*. Vol. 39, No. 1. February 1974. pp. 39-48.

The algorithm has been modified to include a tension parameter based on the work published by Smith and Wessel Smith, W. H. F, and P. Wessel, 1990, Gridding with continuous curvature splines in tension, Geophysics 55, 293-305.

A tension factor of 0 was used to interpolate the data.

The mesh size for data interpolation was 25 x 25 metres

# 5. Elevation Processing

## 5.1 Processing Flow

The processing steps for digital elevation data were as follows:

1. Application of necessary parallax corrections to data
2. Calculation of raw digital elevation data by subtracting the radar altimeter from the gps altitude
3. Tie line levelling
4. Micro-levelling

## 5.2 Tie Line levelling Method

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

The least squares tie line levelling process employs a two pass Gauss-Seidel iterative scheme. The essential steps in this process are:

In the first pass the tie lines were first adjusted to minimise, in the least squares sense, the crossover values with the traverse line values being held constant.

The second pass held the levelled tied line values constant, and minimised in the least squares sense, the crossover values with traverses.

The DC correction values to be applied to the traverse lines and tie lines were then applied to the magnetic data.

To reduce the effects of radar altimeter and gps errors on the recorded elevation data at the crossover points, data having a radar altimeter difference greater than 15 metres in a radius of 50 metres on the traverse or tie lines were excluded from the tying process.

## 5.3 Micro-levelling Method

Micro-levelling techniques were then selectively applied to the tie line levelled data to remove minor residual variations in profile intensity  Selective micro-levelling was applied in order to leave unaffected any data having no residual levelling artefacts.  Selective micro-levelling proceeds using the following steps:

Areas of interest that required micro-levelling were identified through the use of image processing visualisation.

Polygons were used to define areas requiring micro-levelling.

“Pseudo-ties” were constructed from the gridded data by extracting traverses from the grid normal to the flight direction.

Line dependent artefacts were removed from the pseudo lines using custom filters.

Crossover values were calculated between traverse lines and pseudo tie lines.

The traverse lines were adjusted in the pre-defined sections to minimise the crossover values.

This process was repeated in order to remove various wavelength line dependent artefacts from the pseudo-ties. The object of each micro-levelling iteration was to produce a smooth control surface to which the traverse lines are levelled. This control surface was provided through the use of "pseudo-ties".

## 5.4 Interpolation Method

The interpolation used is a minimum curvature algorithm. The algorithm is based on the worked published by Briggs 1974, Briggs I. C.: Machine contouring using minimum curvature. *Geophysics*. Vol. 39, No. 1. February 1974. pp. 39-48..

The algorithm has been modified to include a tension parameter based on the work published by Smith and Wessel Smith, W. H. F, and P. Wessel, 1990, Gridding with continuous curvature splines in tension, Geophysics 55, 293-305.

A tension factor of 0 was used to interpolate the data.

The mesh size for data interpolation was 25 x 25 metres.

# 6. Deliverable Items

The deliverable items included all digital data. The located data conformed to ASEG-GDF format and the gridded data was suppled in ERMapper format. The description of the located data is below.

There was one area processed:

Saxby

**Located data supplied in ASEG GDF**

| File name | Definition |
|---|---|
| *_magdtm | Magnetics and Elevation data |
| *_rads | Radiometric data |
| *_rad256 | Raw 256 channel data |

**Gridded data supplied in ER Mapper format**

| File name | Definition | Units |
|---|---|---|
| *_tmi | Final magnetic gridded data | nT |
| *_elev | Final dtm gridded data | m |
| *_tot | Final radiometric dose rate gridded data | nGy/hr |
| *_pot | Final radiometric potassium gridded data | percent |
| *_ura | Final radiometric uranium gridded data | ppm |
| *_th | Final radiometric thorium gridded data | ppm |

* denotes the area name

Also provided were grids of both areas combined

## 6.1 Magnetic and elevation Located Data file

```
COMM
COMM  Baigent Geosciences Pty. Ltd.
COMM  ----------------------------
COMM
COMM  LOCATED DATA
COMM  -------------
COMM Area  :   Saxby QLD
COMM Company Flown by:   Thomson Aviation Pty. Ltd.
COMM Company Flown for:  AngloGold Ashanti Ltd
COMM Company Processed:  Baigent Geosciences Pty. Ltd.
COMM
COMM AIRBORNE SURVEY EQUIPMENT:
COMM -------------------------
COMM
COMM Aircraft                          : Cessna 210 VH-JHF
COMM Magnetometer                      : Geometrics G822 Cesium  Vapour
COMM Magnetometer Resolution           : 0.001 nT
COMM Magnetometer Compensation         : Kroum, Post Flight
COMM Magnetometer Sample Interval      : 20 Hz, Approx 3.75 metres
COMM Data Acquisition                  : GeoOZ Model 2007
COMM Spectrometer                      : Radiation Solutions RS 500
COMM Crystal Size                      : 33 lt downward array
COMM Spectrometer Sample Interval      : 0.5 Seconds (approx 35 metres)
COMM GPS Navigation System             : Novatel 951R GPS Receiver
COMM
COMM
COMM
COMM
COMM AIRBORNE SURVEY SPECIFICATIONS
COMM
COMM Flight Line Direction             :    090 - 270  degrees
COMM Flight Line Separation            :          100  metres
COMM Tie Line Direction                :    000 - 180  degrees
COMM Tie Line Separation               :          1000 metres
COMM Terrain Clearance                 :       50 metres (MTC)
COMM
COMM
COMM Survey flown                      :        September 2009
COMM
COMM
COMM Flight path calculated from differentially
COMM corrected GPS Data using a Novatel 951R GPS Receiver.
COMM
COMM
COMM Grid notation refers to GDA/MGA Zone  54
COMM
COMM
COMM MAGNETIC DATA CORRECTIONS:
COMM -------------------------
COMM Diurnal variations removed
COMM IGRF(2005) updated to 2009.71 removed
COMM Average survey base station value added to datum
COMM
COMM RADIOMETRIC CORRECTIONS AND COEFFICIENTS:
COMM ----------------------------------------
COMM Spectral data preprocessed using NASVD
COMM Data has been corrected for aircraft and cosmic backgrounds.
COMM Height corrected to a constant datum of 50 metres,
```

```
COMM minimum height of 20 and a maximum of 300 metres.
COMM Data has also been corrected for radon using the method described by Minty
COMM and corrected for channel interaction.
COMM
COMM                    Tot.Count    Potassium   Uranium     Thorium
COMM Arcft Bkg            155.53        23.58      6.047         0
COMM Cosmic Bkg           0.986        0.0514      0.041       0.0549
COMM Height Attn         0.007434    0.009432     0.008428    0.007510
COMM CPS to equivalents    52.657     202.671     18.003      10.727
COMM
COMM
COMM STRIPPING RATIOS:
COMM ----------------
COMM   Alpha = 0.276,  Beta = 0.418, Gamma = 0.759,
COMM   a = 0.048,  b = 0.003,  g = 0.001
COMM
COMM  Field Name                     Format         Units     Null Value
COMM
COMM  BGS Job Number                a5
COMM  Line number                   a8
COMM  Flight number                 i4
COMM  Flight date                   a8
COMM  fiducial                       f12.1                        -999999.0
COMM  mga_east                       f10.2          METRES        -99999.00
COMM  mga_north                      f11.2          METRES        -99999.00
COMM  wgs84_lat                      f12.7          DEGREES       -99.000000
COMM  wgs84_long                     f13.7          DEGREES       -999.00000
COMM  mag_gammas                     f10.3          nT            -9999.000
COMM  diurnal_gammas                 f10.3          nT            -9999.000
COMM  igrf_gammas                    f10.3          nT            -9999.000
COMM  mag_level                      f10.3          nT            -9999.000
COMM  rad_alt                        f8.2           METRES        -999.00
COMM  gps_height                     f8.2           METRES        -999.00
COMM  dtm                            f8.2           METRES        -999.00
```

## 6.2 Radiometric Located Data file

```
COMM
COMM  Baigent Geosciences Pty. Ltd.
COMM  ----------------------------
COMM
COMM  LOCATED DATA
COMM  -------------
COMM Area  :   Saxby QLD
COMM Company Flown by:   Thomson Aviation Pty. Ltd.
COMM Company Flown for:  AngloGold Ashanti Ltd
COMM Company Processed:  Baigent Geosciences Pty. Ltd.
COMM
COMM AIRBORNE SURVEY EQUIPMENT:
COMM -------------------------
COMM
COMM Aircraft                        : Cessna 210 VH-JHF
COMM Magnetometer                    : Geometrics G822 Cesium  Vapour
COMM Magnetometer Resolution         : 0.001 nT
COMM Magnetometer Compensation       : Kroum, Post Flight
COMM Magnetometer Sample Interval    : 20 Hz, Approx 3.75 metres
COMM Data Acquisition                : GeoOZ Model 2007
COMM Spectrometer                    : Radiation Solutions RS 500
COMM Crystal Size                    : 33 lt downward array
```

```
COMM Spectrometer Sample Interval     : 0.5 Seconds (approx 35 metres)
COMM GPS Navigation System            : Novatel 951R GPS Receiver
COMM
COMM
COMM
COMM
COMM AIRBORNE SURVEY SPECIFICATIONS
COMM
COMM Flight Line Direction            :    090 - 270  degrees
COMM Flight Line Separation           :          100  metres
COMM Tie Line Direction               :    000 - 180  degrees
COMM Tie Line Separation              :          1000 metres
COMM Terrain Clearance                :       50 metres (MTC)
COMM
COMM
COMM Survey flown                     :        September 2009
COMM
COMM
COMM Flight path calculated from differentially
COMM corrected GPS Data using a Novatel 951R GPS Receiver.
COMM
COMM
COMM Grid notation refers to GDA/MGA Zone  54
COMM
COMM
COMM MAGNETIC DATA CORRECTIONS:
COMM -------------------------
COMM Diurnal variations removed
COMM IGRF(2005) updated to 2009.71 removed
COMM Average survey base station value added to datum
COMM
COMM RADIOMETRIC CORRECTIONS AND COEFFICIENTS:
COMM ----------------------------------------
COMM Spectral data preprocessed using NASVD
COMM Data has been corrected for aircraft and cosmic backgrounds.
COMM Height corrected to a constant datum of 50 metres,
COMM minimum height of 20 and a maximum of 300 metres.
COMM Data has also been corrected for radon using the method described by Minty
COMM and corrected for channel interaction.
COMM
COMM                    Tot.Count    Potassium   Uranium     Thorium
COMM Arcft Bkg            155.53        23.58      6.047         0
COMM Cosmic Bkg           0.986        0.0514      0.041       0.0549
COMM Height Attn         0.007434    0.009432     0.008428    0.007510
COMM CPS to equivalents   52.657     202.671     18.003      10.727
COMM
COMM
COMM STRIPPING RATIOS:
COMM ----------------
COMM   Alpha = 0.276,  Beta = 0.418, Gamma = 0.759,
COMM   a = 0.048,  b = 0.003,  g = 0.001
COMM
COMM  Field Name                    Format         Units     Null Value
COMM
COMM  BGS Job Number               a5
COMM  Line number                  a8
COMM  Flight number                i4
COMM  Flight date                  a8
COMM  fiducial                      f12.1                          -999999.0
COMM  mga_east                      f10.2          METRES          -99999.00
COMM  mga_north                     f11.2          METRES          -99999.00
```

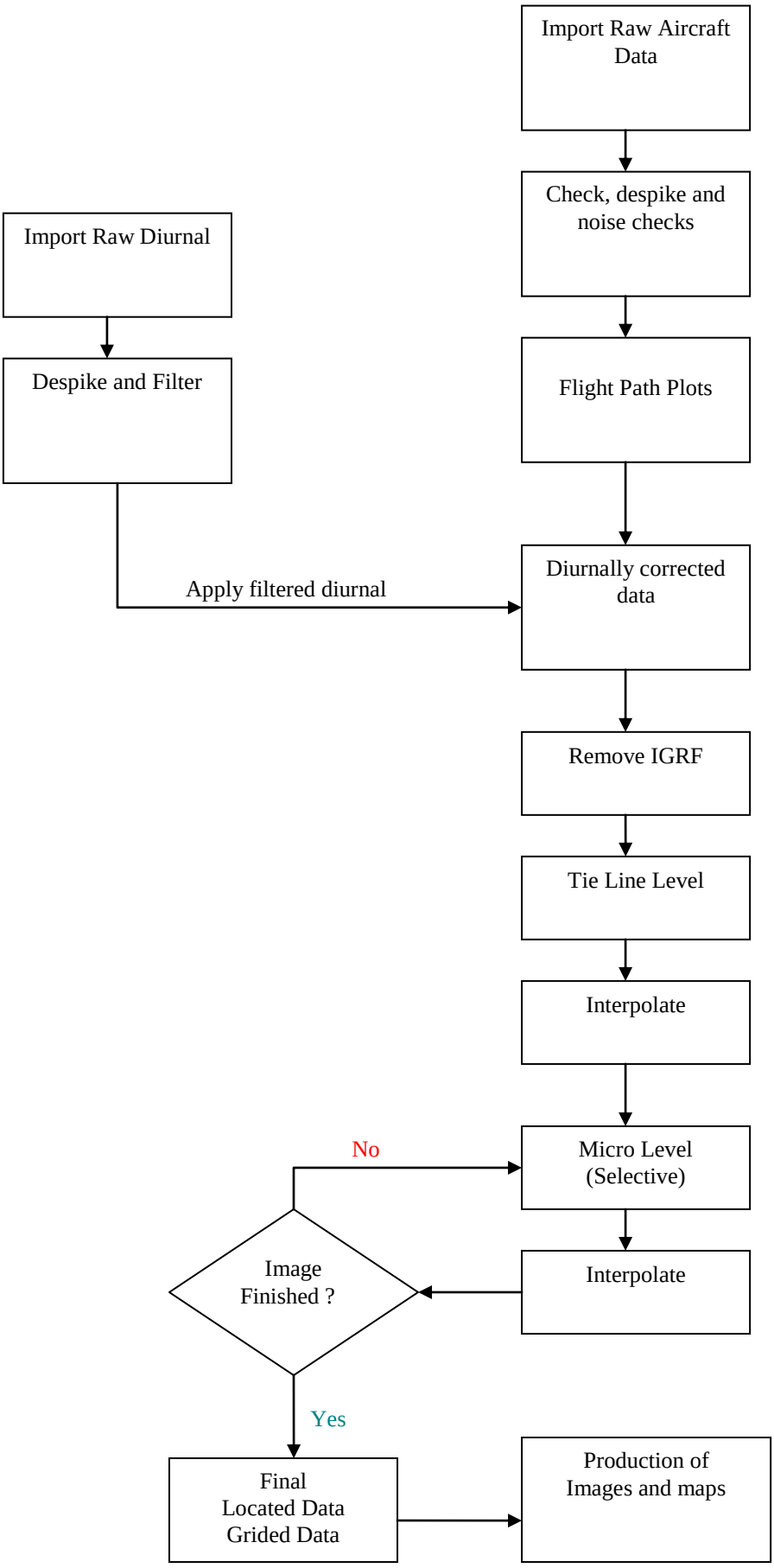
```
COMM  wgs84_lat                    f12.7          DEGREES        -99.000000
COMM  wgs84_long                   f13.7          DEGREES        -999.00000
COMM  rad_alt                      f8.2           METRES         -999.00
COMM  temp_air_deg_c               f5.1           DEG            -9.0
COMM  baro_pressure                f8.2           hPa            -999.0
COMM  gps_height                   f8.2           METRES         -999.00
COMM  live_time                    f6.0           MSEC           -9999
COMM  raw_tot_cps                  f8.1           CPS            -99.0
COMM  raw_pot_cps                  f7.1           CPS            -99.0
COMM  raw_ura_cps                  f7.1           CPS            -99.0
COMM  raw_th_cps                   f7.1           CPS            -99.0
COMM  cosmicd_cps                  f6.0           CPS            -999
COMM  dose_rate                    f10.4          nGy/h          -999.0000
COMM  pot_percent                  f9.4           PERCENT        -99.0000
COMM  ura_ppm                      f9.4           PPM            -99.
COMM  th_ppm                       f9.4           PPM            -99.000
```

## 6.3 256 Radiometric Located Data file

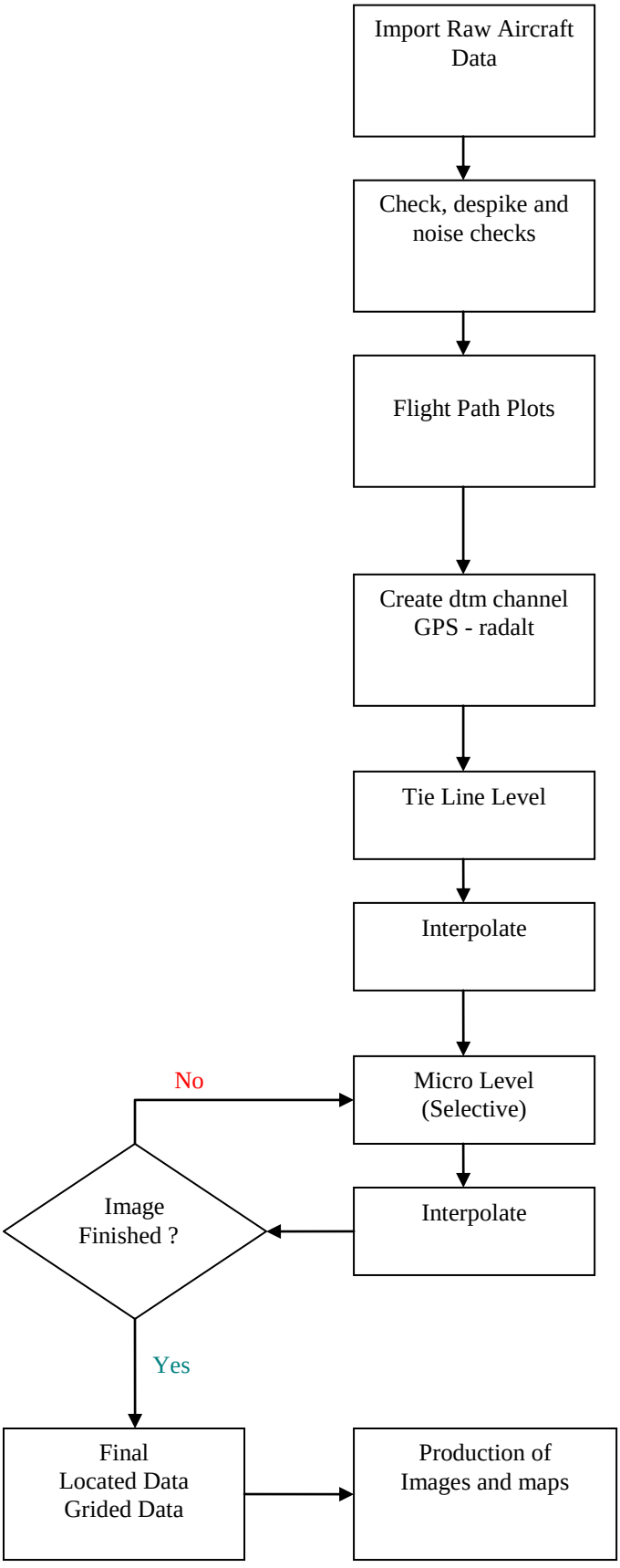
```
COMM
COMM  Baigent Geosciences Pty. Ltd.
COMM  -----------------------------
COMM
COMM  LOCATED DATA
COMM  -------------
COMM Area  :   Saxby QLD
COMM Company Flown by:   Thomson Aviation Pty. Ltd.
COMM Company Flown for:  AngloGold Ashanti Ltd
COMM Company Processed:  Baigent Geosciences Pty. Ltd.
COMM
COMM AIRBORNE SURVEY EQUIPMENT:
COMM -------------------------
COMM
COMM Aircraft                          : Cessna 210 VH-JHF
COMM Magnetometer                      : Geometrics G822 Cesium  Vapour
COMM Magnetometer Resolution           : 0.001 nT
COMM Magnetometer Compensation         : Kroum, Post Flight
COMM Magnetometer Sample Interval      : 20 Hz, Approx 3.75 metres
COMM Data Acquisition                  : GeoOZ Model 2007
COMM Spectrometer                      : Radiation Solutions RS 500
COMM Crystal Size                      : 33 lt downward array
COMM Spectrometer Sample Interval      : 0.5 Seconds (approx 35 metres)
COMM GPS Navigation System             : Novatel 951R GPS Receiver
COMM
COMM
COMM
COMM
COMM AIRBORNE SURVEY SPECIFICATIONS
COMM
COMM Flight Line Direction             :    090 - 270  degrees
COMM Flight Line Separation            :          100  metres
COMM Tie Line Direction                :    000 - 180  degrees
COMM Tie Line Separation               :          1000 metres
COMM Terrain Clearance                 :       50 metres (MTC)
COMM
COMM
COMM Survey flown                      :        September 2009
COMM
COMM
COMM Flight path calculated from differentially
```

```
COMM corrected GPS Data using a Novatel 951R GPS Receiver.
COMM
COMM
COMM Grid notation refers to GDA/MGA Zone  54
COMM
COMM
COMM MAGNETIC DATA CORRECTIONS:
COMM -------------------------
COMM Diurnal variations removed
COMM IGRF(2005) updated to 2009.71 removed
COMM Average survey base station value added to datum
COMM
COMM RADIOMETRIC CORRECTIONS AND COEFFICIENTS:
COMM ------------------------------------
COMM Spectral data preprocessed using NASVD
COMM Data has been corrected for aircraft and cosmic backgrounds.
COMM Height corrected to a constant datum of 50 metres,
COMM minimum height of 20 and a maximum of 300 metres.
COMM Data has also been corrected for radon using the method described by Minty
COMM and corrected for channel interaction.
COMM
COMM                    Tot.Count    Potassium   Uranium     Thorium
COMM Arcft Bkg            155.53        23.58      6.047         0
COMM Cosmic Bkg           0.986        0.0514      0.041       0.0549
COMM Height Attn         0.007434    0.009432     0.008428    0.007510
COMM CPS to equivalents   52.657     202.671     18.003      10.727
COMM
COMM
COMM STRIPPING RATIOS:
COMM ----------------
COMM   Alpha = 0.276,  Beta = 0.418, Gamma = 0.759,
COMM   a = 0.048,  b = 0.003,  g = 0.001
COMM
COMM  Field Name                    Format         Units     Null Value
COMM
COMM  BGS Job Number               a5
COMM  Line number                  a8
COMM  Flight number                i4
COMM  Flight date                  a8
COMM  fiducial                      f12.1                          -999999.0
COMM  mga_east                      f10.2          METRES          -99999.00
COMM  mga_north                     f11.2          METRES          -99999.00
COMM  wgs84_lat                     f12.7          DEGREES         -99.000000
COMM  wgs84_long                    f13.7          DEGREES         -999.00000
COMM  rad_alt                       f8.2           METRES          -999.00
COMM  temp_air_deg_c                f5.1           DEG             -9.0
COMM  baro_pressure                 f8.2           hPa             -999.0
COMM  gps_height                    f8.2           METRES          -999.00
COMM  live_time                     f6.0           MSEC            -9999
COMM  cosmicd_cps                   f6.0           CPS             -999
COMM  256 channel raw spectra    256f5.0           CPS             -9.
```

# 7. Magnetic Data Processing Flow Chart



# 8. Elevation Data Processing Flow Chart



# 9. Radiometric Processing Flow Chart