# EPM 14022- "NORTH MARY KATHLEEN"

# 2016 Annual Report

For the period ending 30th July 2016

# MARY KATHLEEN JOINT VENTURE PROJECT


*Prepared by:* *Chinalco Yunnan Copper Resources Ltd*
*Compiled by:* *Peng Sha*
*Date:* *1 August 2016*


*Distribution:* *Department of Natural Resources & Mines*
*Goldsearch Limited*
*Chinalco Yunnan Copper Resources Ltd- Brisbane Office*

# Contents



# Contents of Figures



# Contents of Tables



# Contents of Appendices

# 1. Compliance Statement

This report documents the work conducted on EPM 14022 for 12 months to 30th of July, 2016.

The activities carried out, comply with the statutory Programme of Works of the Exploration Permit. Exploration activities completed during the reporting period on EPM 14022 have consisted of mapping and a completion of a gravity survey.

# 2. Introduction

EPM 14022 is located in the eastern portion of the Northwest Queensland Mineral Province, an area prospective for base and precious metal occurrences and host to world-class deposits of copper, lead, zinc and silver at Mount Isa, copper-gold at Ernest Henry and Osborne and uranium and rare earths at Mary Kathleen.

On the 25th August 2009, Chinalco Yunnan Copper Resources Ltd ("CYU") entered into a Farm-In and Joint Venture Agreement with Goldsearch Limited ("GSE") to explore the Mary Kathleen Project. On the 9th June 2011 CYU advised GSE that it had met all its expenditure requirements to earn 70% equity. As of the 26th February 2016, CYU has secured a 100% interest in these tenements, subject to a 1.75% net smelter royalty held by GSE. In April 2016, an application of renewal for a further 5 years was lodged with the Department of Natural Resources and Mines and subsequently approved in May 2016.

CYU undertook the following field activities in EPM 14022 in the reporting period.

- Prospect mapping of Elaine South
- Data review
- Detail gravity survey

# 3. Location and Access

EPM 14022 comprises eleven sub-blocks and is located approximately 50 km East of Mount Isa in Far North Queensland (Table 1). Access to EPM 14022 is via the Barkly Highway from Mount Isa through to the turnoff to the historic Mary Kathleen Uranium Mine, then by maintained station tracks on Rosebud, Argylla Creek, Timberu and Rifle Creek Stations.

The tenements are located on the 1:250,000 Cloncurry map sheet, SF5402, and predominantly on the Mary Kathleen 1:100,000 map sheet, number 6856, with overlaps onto the Marraba 1:100,000 map sheet, number 6956, and Malbon 1: 100,000 map sheet, number 6955.

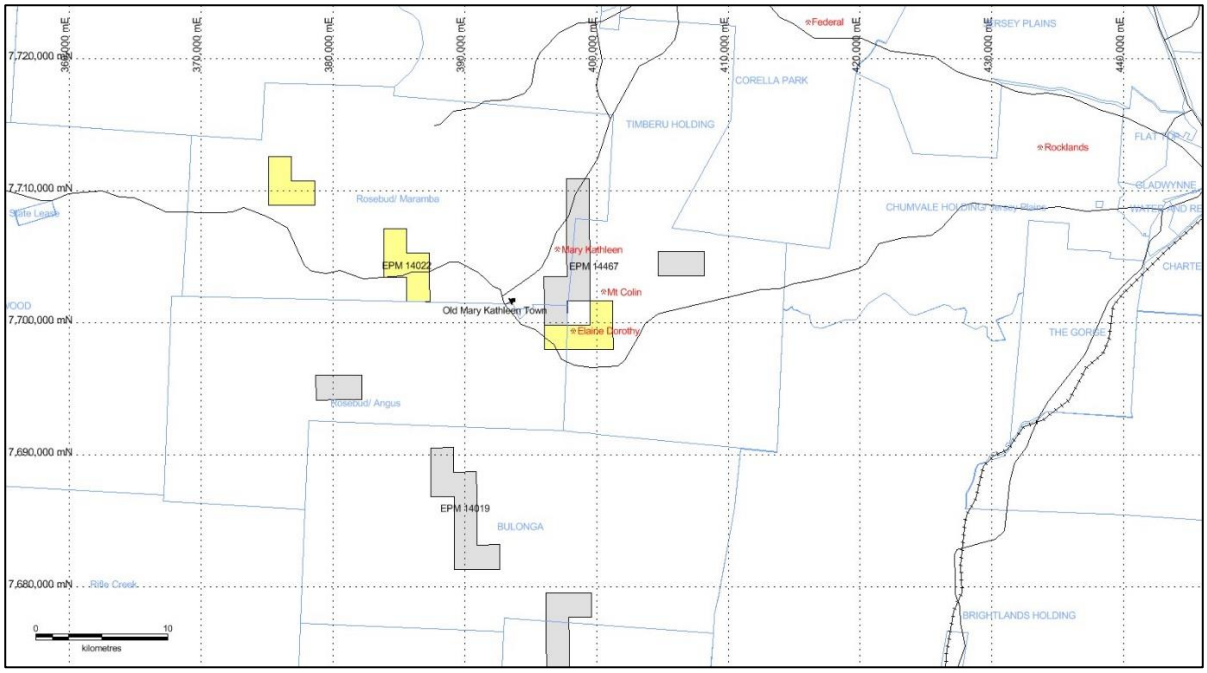


*Figure 1: EPM 14022 (yellow) location (Datum-MGA 94.Projection – GDA Zone 54)*

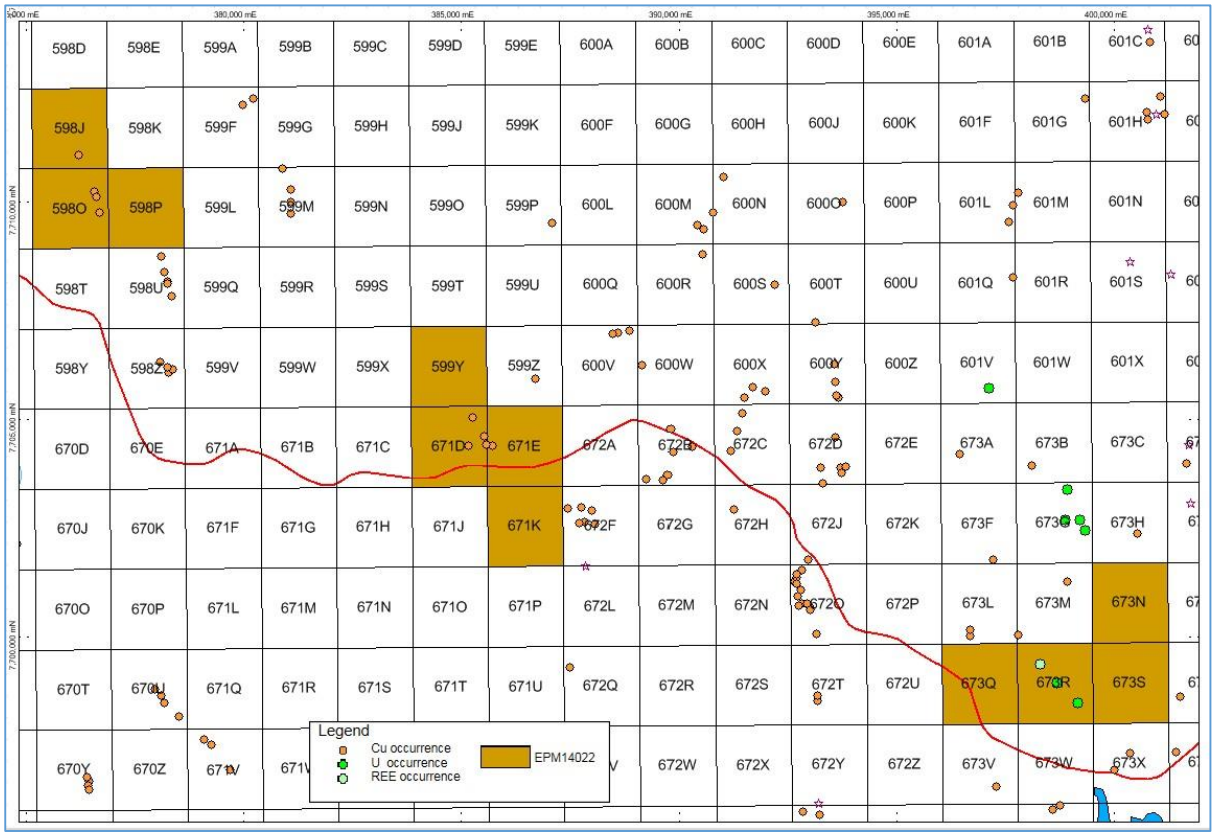


*Figure 2: EPM 14022 graticules (Datum-MGA 94.Projection – GDA Zone 54)*

## 4. Tenure

EPM 14022 was originally granted to Mount Conqueror Minerals NL ("MCM") and Central West Gold NL ("CWG") on the 31st July 2003 for a period of five years. The tenement was successfully renewed for a further three years until 30 July 2011. In 2012, the tenement was successfully renewed again for

a further five years until 30 July 2016. In April 2016, another renewal application was lodged with the Department and the renewal was granted for five years until 30th July 2021 (Table 1).

Goldsearch Limited ("GSE") signed a Heads of Agreement with MCM / CWG on the 29th July 2004 to manage and explore EPM 14022 and EPM 14019. MCM / CWG negotiated and signed a Native Title Low Impact Exploration Access Agreement with the Kalkadoon People on the 9th September 2004. This agreement was subsequently upgraded in March 2008 to allow "high impact" exploration.

On the 25th August 2009, CYU entered into a Farm-in and Joint Venture Agreement with GSE to explore their Mary Kathleen Project (renamed Mary Kathleen Joint Venture Project) including EPM's 14019 and 14022. On the 9th June 2011 CYU advised GSE that it had met all its expenditure commitments of A$1.5M to earn a 70% equity. Subsequently, on the 26th February 2016, CYU advised that it had secured a 100% interest in these tenements, subject to a 1.75% net smelter royalty held by GSE.

The tenement now comprises eleven sub-blocks, grouped into three areas covering approximately 35 km$^2$ (Table 1). The eleven sub-blocks are presented in Figure 2.

| TENURE TYPE | TENURE NUMBER | STATUS | DATE LODGED | DATE GRANTED | DATE EXPIRES | AUTHORIS | AREA (km$^2$) | SUB-BLOCK |
|---|---|---|---|---|---|---|---|---|
| EPM | 14022 | Granted | 31-Mar-2003 | 31-Jul-2003 | 30-Jul-2021 | CHINALCO YUNNAN COPPER RESOURCES LIMITED | 35.22 | 11 |

*Table 1: EPM 14022 current tenements detail*

| 1:250,000 MAP SHEET | BLOCK | SUB-BLOCKS |
|---|---|---|
| CLONCURRY | 598 | J, O, P |
| CLONCURRY | 599 | Y |
| CLONCURRY | 671 | D, E, K |
| CLONCURRY | 673 | N, Q, R, S |

*Table 2: EPM 14022 current sub-blocks*

## 5. Regional Geology and Mineralisation

EPM 14022 forms part of CYU's Mary Kathleen Project. The Mary Kathleen Project area occurs within the Mary Kathleen Fold Belt of the Eastern Succession and Kalkadoon Leichhardt Fold Belt of the Mid Proterozoic Mount Isa Inlier. The area comprises a complex mix of metavolcanic, meta-sedimentary and meta-intrusive rocks. Most metavolcanic and meta-sedimentary rocks belong either to the Argylla Formation or Corella Formation. Prior to deformation and regional metamorphism these rocks were extensively intruded by dolerite and granitoids, mostly between 1750-1730Ma during the Wonga Extension.

Most of rocks in the area were strongly deformed and folded during Isa Orogeny from 1600Ma to 1500Ma (D1 and D2). The most significant feature presenting in the tenement is the Mary Kathleen syncline, which is a tight, doubly plunging synform. Late faulting (post D2) is dominated by Northeast and Northwest oriented faults and has disrupted the project area. Most Northeast faults are sub-vertical strike slip faults with dextral movement sense. Three regional-scale Northeast faults cut the area, these being the Pilgrim, Cameron and Wonga Faults. Northwest faults are mostly sub-vertical with apparent dextral and sinistral offsets.

Documented copper occurrences are scattered throughout the entire Mary Kathleen Project area. Mineralisation is generally structurally controlled, with most occurrences localised within shear zones, such as Mary Kathleen Shear, or faults adjacent to regional-scale faults. Copper occurrences

of note within EPM 14022 include Elaine Dorothy, Hardway (partially on ML 2,760 held by another party) and the King Solomon line of historic workings.

EPM 14022 hosts a sequence of predominantly felsic metavolcanic Argylla Formation with some interbedded metamorphosed clastic sediments and bimodal volcanic rocks with minor carbonates. The Argylla Formation is overlain by 1740 - 1760 Ma Corella Formation, which forms a metamorphosed evaporite-carbonate-clastic sequence, containing marble, metapelites, metapsammites and some felsic metavolcanics, that has been extensively intruded by dolerites prior to the onset of the Isan Orogeny. The Corella Formation is cut by intrusive phases of the Wonga Batholith (1740Ma) and Lakeview Dolerite (1116Ma).

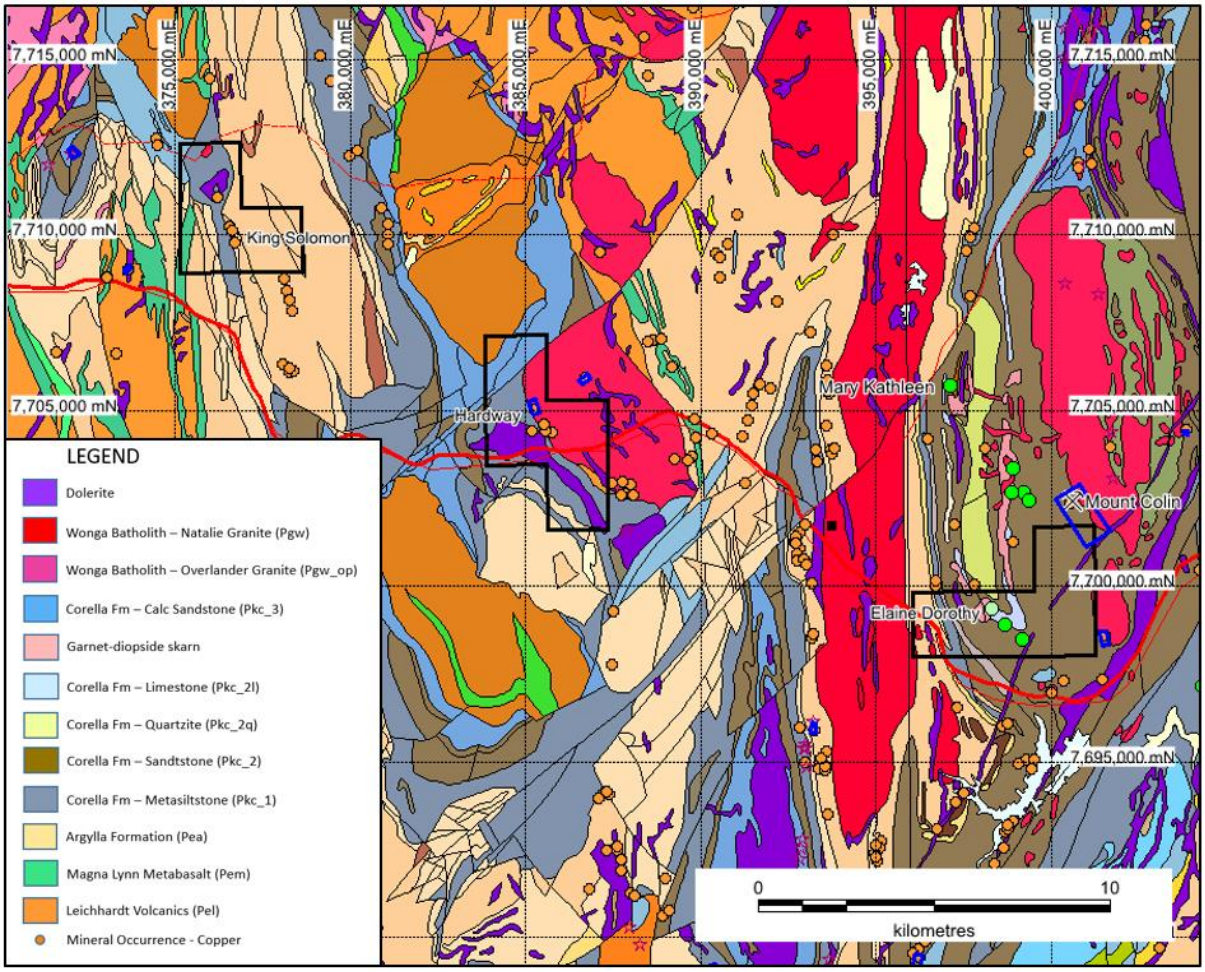


*Figure 3: EPM 14022 with 1:100k geology map (Datum-MGA 94.Projection – GDA Zone 54).*

## 6. Previous Exploration

Numerous previous exploration permits have been held over parts and/or all of EPM 14022. The majority of explorers have targeted base metals or uranium with only relatively recent emphasis on gold. The majority of exploration has been concentrated around the numerous old copper workings and uranium anomalies.

Nearly all explorers have conducted stream sediment sampling programs and localised soil and rock outcrop sampling programs which have yielded varying results. There have been a number of

significant soil Cu, Zn, Pb, U anomalies as well as Cu, Au and W stream sediment anomalism and Cu, U, Mo rock chip anomalies located. The majority of these are traceable to historic Cu workings and prospects or attributed to minor discontinuous quartz veining, shear zones, dolerite contacts or lateritic processes and are considered uneconomic. Key historic prospects on EPM 14022 include Elaine Dorothy and Hardway.

## 6.1 Elaine Dorothy

Most significant work in the Elaine Dorothy area was carried out by Western Nuclear and Mary Kathleen Uranium in variously re-pegged mining leases (MLs 4569, 5388, 5389, 5688, 5689, MLA 9085 - reports CR9295 and CR9958) and authority to prospect - A to P 1678. Exploration activities primarily focussed on exploring for uranium and included detailed geological and alteration mapping, a detailed scintillometer survey, percussion and diamond drilling, the latter mainly in the mid 1950's (Mineral Ventures NL) and again in the late 1970's - early 1980's (Mary Kathleen Uranium) testing garnetite alteration and scintillometer anomalies. This work outlined several large bodies of garnetite (rock containing >50% garnet) and three main areas of radiometric anomalism (3-4 times background) within the current EPM 14022 including the Elaine 1 (Elaine Dorothy), Elaine 2 and Elaine 3, located southeast of the Elaine Dorothy. The scintillometer anomalies coincide with airborne radiometric (uranium) highs.

Numerous diamond (prefixed: ED) and percussion (prefixed: EP) holes have been drilled along this line of mineralization. The intersections however were generally low grade. An early resource figure of 180,000t @ 0.56kg/t $U_3O_8$ was estimated (report CR9295).

GSE subsequently undertook a gamma-ray spectrometer sampling program alongside a detailed mapping project within the Elaine Dorothy prospect area. Survey readings varied from 0.03ppm U to 1401ppm U. Only 22 of the 640 readings reported higher than 15ppm while spot readings reaching 3000ppm U were noted in 30 cm wide zones. GSE also completed five drill holes to test the mineralised zone in the Elaine 1 area. Hole MKRC004 provided the highest readings of 151.3ppm U (0.015%) at 68m depth and 205.8ppm U (0.02%) at 84m depth.

In 2009, CYU entered into a Farm-in and Joint Venture Agreement with GSE and drilled three diamond holes (MKED001 – MKED003) at Elaine 1, totalling 334 metres to upgrade an exploration target (pre-JORC resource) to a JORC compliant Inferred Resource. Independent consultants, Hellman and Schofield Pty Ltd, defined a uranium-REE JORC Inferred resource of 83,000t @ 0.28kg/t U3O8 and 3200ppm TREO.

In 2010 – 2012 CYU undertook a series of follow up programs including petrographic studies of selected diamond core, field check mapping and ground scintillometer/soil geochemical surveys to track the potential surface expression of the uranium + REE mineralisation as well as follow up on a significant copper–molybdenite intersection returned from the bottom of CYU's MKED003 of 2m @ 0.32% copper and 964ppm molybdenum from 71m.

Field check mapping and surface scintillometer and Niton XRF sampling programs identified a new copper mineralized zone at Elaine that had no previous sampling or drilling. Follow up drilling of this target reported significant Cu and Co mineralisation as well as broad rare earth element +/- uranium mineralisation.

CYU subsequently completed 32 diamond drill holes for 14,120m and defined an Inferred Mineral Resource of 27.7 Million tonnes grading 0.53% copper and 0.08g/t gold for contained metal content

of 147,000t copper and 75,000oz gold (CYU ASX Release – 18 October 2012). Other work completed has included petrographic studies, an EH4 geophysical survey, a fixed loop EM (SAMSON) geophysical survey, metallurgical scoping test work, U-Pb dating and paragenesis studies as part of a 2012 JCU Honours Thesis.

### 6.2 Hardway

Little exploration activity appears to have been completed over the actual Hardway prospect area, i.e. the area immediately around the Hardway and Hardway Extended Copper deposits. Much of the previous exploration (e.g. EPM 3473, EPM 2357, EPM 1311) in this area focussed on the Pb-Zn potential of the black shales in the upper part of the Corella Formation north of the Wonga Fault and immediately north of the Hardway area. Actual work over the Hardway prospect is confined to some stream sediment sampling (EPM 9909) over the northern edge of the Hardway area but not actually on streams draining the Hardway deposits. Stream sediment assay data indicated a couple of gold and copper values of interest (max 5ppb Au, 267ppm Cu).

Three diamond holes were drilled by Australian Selection Pty Ltd in 1967 under an option on the Hardway and Hardway Extended leases (ML 5633, ML 5782 Cloncurry, report CR2377). Holes QH1 and QH2 were drilled at Hardway Extended and QH3 was drilled at the Hardway deposit. The holes intersected a metasedimentary sequence including metagreywacke, cherty shale, calcareous shale and impure limestone with zones of variable brecciation and silicification and with narrow dolerite dykes. Assays for QH2 were not available. QH2 was a redrill of QH1 (200' north of QH1) due to poor recovery in QH1. Only one assay was available for QH1 and reported 3' [304.5'-307.5'] @ 0.8% Cu, 0.29% Co and about 3g/t Au (2dwts). Up to 5% sulphides (pyrite, chalcopyrite, and pyrrhotite) were noted in some sections. The available assays on QH3 indicated an interval of 14.6' (4.45m) [350.5'-365.1'] @ ~0.64% Cu. Other intervals were also noted to have some mineralisation but no assay data is available.

Subsequent soil sampling by GSE defined multiple zones of shallow copper mineralisation over a 250m width within the 2.8km long soil geochemical Hardway zone. Drilling intercepted multiple zones of greater than 0.2% copper with a significant intersection of 49m @ 0.26% Cu. The mineralisation is associated with both extensive disseminated sulphides along with minor quartz carbonate veining and minor stockworks. The high copper values in drilling were associated with elevated cobalt (up to 0.24% Co), uranium (up to 74ppm U), phosphorus (>1% P) and yttrium (>500ppm Y).

### 6.3 King Solomon

Only very limited exploration activity has been reported in the King Solomon area. CYU carried preliminary prospecting of the area in 2014 and reported significant assay results over 1500m of strike up to 20.9% Cu, 1.74ppm Au, 3.2ppm Ag and 230ppm Co. Mineralization consists of calcite lodes and quartz veins hosting malachite and chalcocite.

## 7. Work Completed

### 7.1 Mapping

Mapping of the Elaine South prospect was undertaken in June 2015 over an area totalling ~2km$^2$. A preliminary geological map was reported in last year's annual report. The mapping area was subsequently extended further north of the original mapping area this year. The map presented in Appendix 3 is an outcrop map covering Elaine 1, Elaine 2 and Elaine 3 prospects.

The Elaine project area is underlain by rocks of the Corella Formation in the western limb of Mary Kathleen Syncline. The area is dominated by an extensive sequence of altered metasediments including garnet-pyroxene skarn, pyroxene hornfels, amphibole hornfels, schist and marble of the Corella Formation. Localised massive scapolite occurs to the south of Elaine and the area has been intruded by dolerite intrusives. Descriptions of the lithological units are summarised below.

- Marble: Marble is exposed in the eastern and northern part of the Elaine area. The marble has well-developed banding of alternating calcareous-siliceous layers and local graded bedding. Commonly, marble is extensively folded and slightly foliated. Vesuvianite and other high temperature metamorphic minerals are also present as the colourful layers.

- Quartzite: White fine to medium grained quartzite is exposed in the north of the Elaine. Bedding and cross bedding are still present in the quartzite. Quartz grains from quartzite are recrystallized to form an interlocking mosaic of quartz crystals. Younging direction can be recognized clearly. The quartzite near shear zones is strongly foliated. Diopside and foliated biotite can be recognized from the foliated quartzite.

- Metadolerite: The metadolerite is a medium to fine grained, dark rock consisting of subhedral amphibole, feldspar and pyroxene. Metadolerites are strongly altered and foliated in some localised areas and show a high degree of variation. Localised scapolite-bearing metadolerite and biotite-bearing metadolerite were mapped to the West of the Elaine 1 and 2 prospect. The transition zones between metadolerite and calc-silicate rocks are often dominated by amphibolite.

- Biotite (muscovite) Schist: Dark foliated biotite schist outcrops in the northern and western parts of the Elaine area. It normally contains fine to coarse grained, strongly foliated biotite, variable muscovite and amphibole. The percentage of biotite is variable (40%-90%). Bedding can be recognized in biotite schist outcrops located to the East of Elaine Hill.

- Pyroxene Hornfels: Pyroxene hornfels is widespread in the mapping area. The most significant characteristic of this rock unit is the rythmically banded texture. The predominant minerals of the pyroxene hornfels are fine grained white feldspar or scapolite and green pyroxene. Scapolite can be distinguished from feldspar by its high chlorine content, but it is very hard to tell the difference between the scapolite and feldspar in hand specimen. The banded appearance of the irregular/regular feldspar and pyroxene domains reflects original laminations/bedding within a sedimentary carbonate host rock. The pyroxene hornfels is strongly folded locally. Garnet is also a common associate mineral in pyroxene hornfels. The rock is classified as garnet skarn in areas where the garnet content exceeds 50%.

- Amphibole Hornfels: Amphibole hornfels has a similar texture to the pyroxene hornfels but the dominant mafic mineral is amphibole instead of pyroxene. Amphibole hornfels is distributed on the western side of the mapping area, close to metadolerite intrusives. Magnetite can be identified with amphibole hornfels occasionally. It is believed that it may contribute to the magnetite anomaly that located Southwest of Elaine.

- Garnetite: Garnetite is dominated by red-grey garnet (>50%). Bedding, banding, foliation may still be recognisable in the garnet skarn. Fine grained euhedral to subhedrel red garnets can be observed on the weathering surface of garnet skarn. The outcrop of massive garnet skarn is mostly located to the West of Elaine Hill and in Elaine 3 prospect. Retrograde skarn occasionally occur but most of garnet skarn are relatively fresh. Brecciated garnet skarn is exposed northwest of Elaine Hill and west of Elaine 3 prospect with brecciated pyroxene hornfels.

- Retrograde Amphibolite: Retrograde amphibolite is dominated by massive medium to coarse grained hornblende or tremolite with pyroxene, biotite and calcite. Most of outcrops are distributed in the North of Elaine near the biotite schist. Amphibolite is most likely retrograded from massive pyroxene skarn, which is the major host rock of copper mineralization at Elaine. Therefore, retrograde amphibolite is very important surface indication of the Elaine style mineralization.

## 7.2 Detail Gravity Survey

A semi-detailed gravity survey was conducted in September 2015, after a review of regional gravity data showed a strong gravity anomaly that corresponds with the soil Cu anomaly at Koppany prospect (EPM 14467) and Elaine Dorothy prospect (EPM 14022). The gravity data was collected using a combination of 250m and 500m stations, and was processed using the Geoscience Australia's Australian National Gravity Database Spherical Cap formula. In addition a terrain correction was applied to the data. The detailed gravity data shows a strong gravity anomaly coincident with garnet skarn and soil copper anomaly.

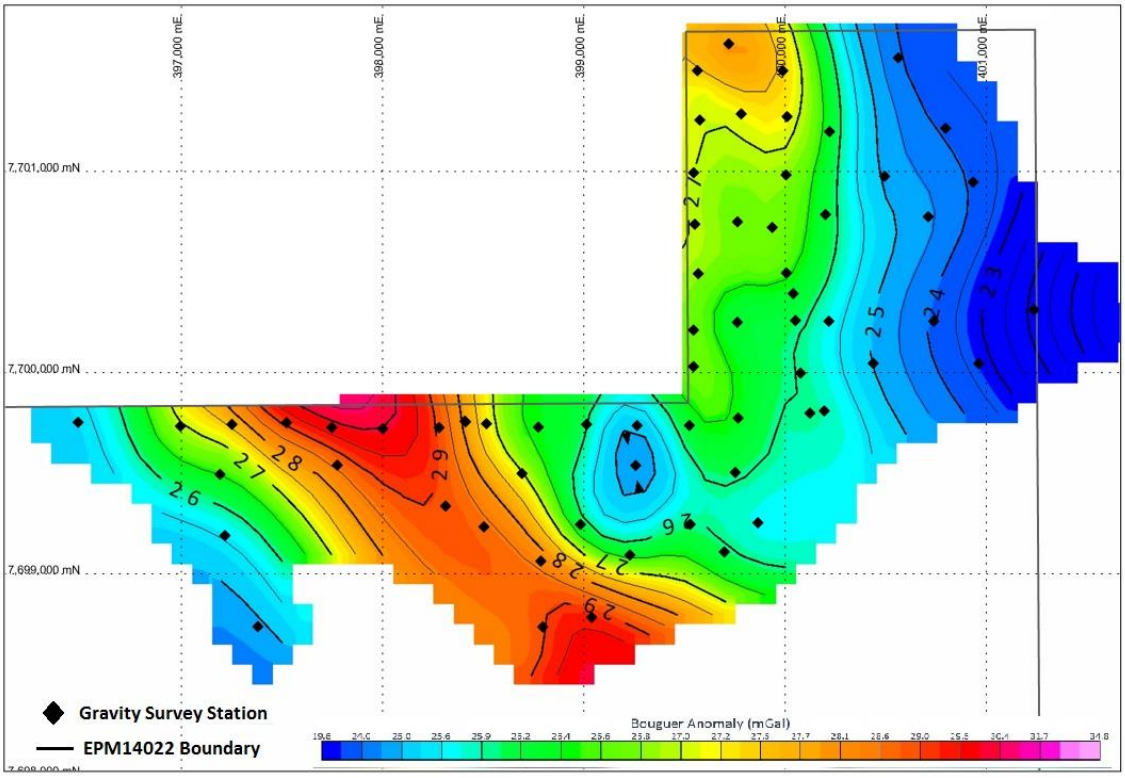


*Figure 4: Geoidal Bouguer Anomaly with the location of gravity survey stations (Datum-MGA 94.Projection – GDA Zone 54)*

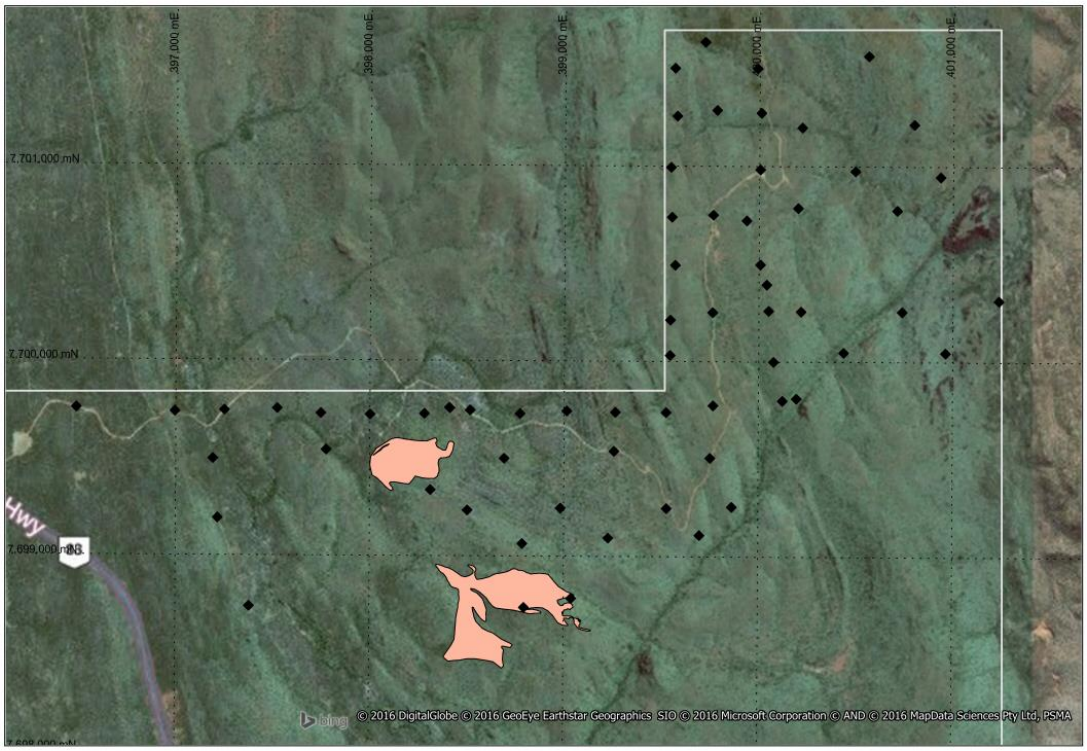


*Figure 5:Garnetite outcrops with the location of stations with the location of gravity survey stations (Datum-MGA 94.Projection – GDA Zone 54)*

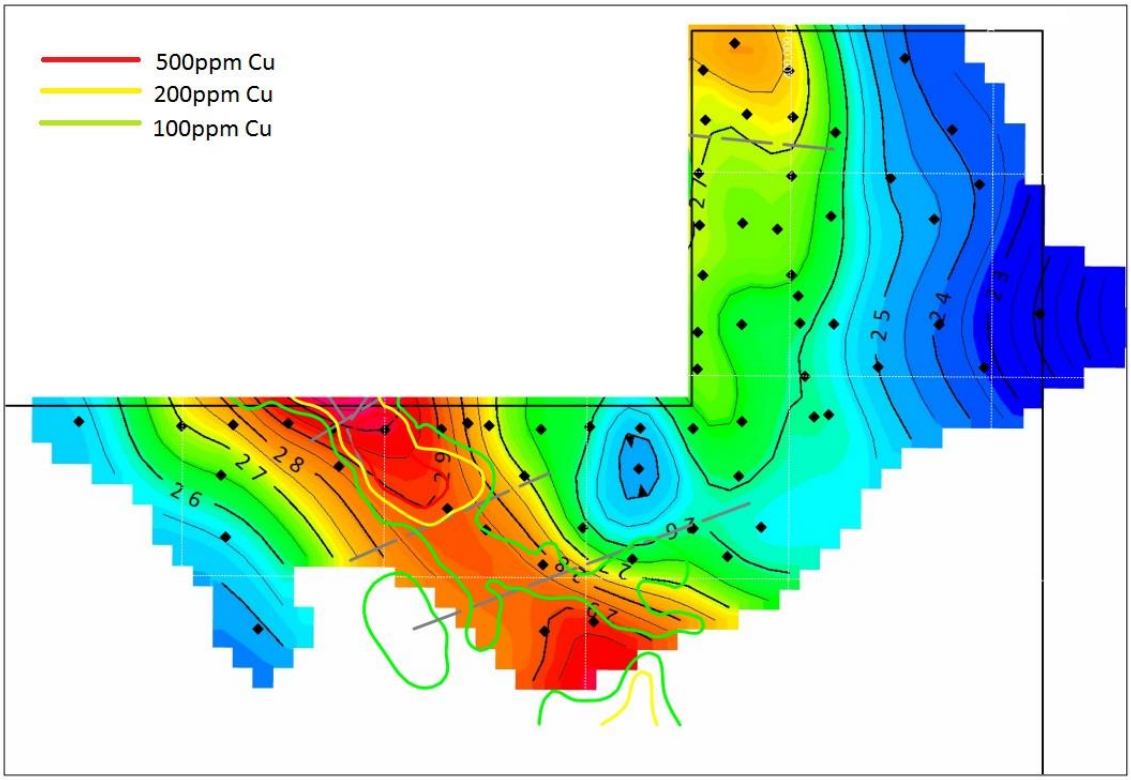


*Figure 6: Soil results over Elaine prospect with Geoidal Bouguer Anomaly (Datum-MGA 94.Projection – GDA Zone 54)*

## 8. Conclusions and Recommendation

EPM 14022 forms part of CYU's Mary Kathleen Project. The area comprises a complex mix of metavolcanic, meta-sedimentary and meta-intrusive rocks of the Argylla Formation and Corella Formation that have been intruded by dolerite and granitoids, mostly between 1750-1730Ma during the Wonga Extension. Copper occurrences of note within EPM 14022 include Elaine Dorothy, Hardway (partially on ML 2,760 held by another party) and the King Solomon line of historic workings.

In the current reporting period CYU has focussed on evaluating the magnetic anomaly and gravity anomaly of the Elaine prospect area. Reconnaissance mapping has determined that the magnetic anomaly occurs at the contact between metadolerite and amphibole hornfels.

In addition, the gravity anomaly has been confirmed by the detailed gravity survey. This survey has demonstrated that the gravity anomaly is closely associated with garnetite and the soil Cu anomaly. The gravity anomaly also suggests the potential for an extension to known mineralisation between Elaine Dorothy and the Blue Caesar prospect to the north. Further 3D geological modelling of the gravity anomaly and relogging of some Elaine drill holes are required in order to update of Elaine Dorothy model and potentially generate targets between Elaine and Blue Caesar.

Furthermore, a magnetotellurics geophysical survey is recommended. Mineralization and extensive skarn alteration in Elaine remains open at the depth, and it is possible that high grade copper and gold mineralization persists beneath the known mineralization system. A magnetotellurics survey may help to generate deep drilling targets at Elaine.

# 9. Proposed Work

- Data review and 3D modelling of Elaine
- Relogging some Elaine drill holes
- Magnetotellurics geophysical survey at Elaine
- Infill soil sampling at Elaine, Hardway and King Solomon prospects.