Final Report GR351 to 20th June 2017

EL 29837 29953 30076 30077 30078 30079 30080 30736 30737 30750 30751 30752 30753 30774 30775 30776 30812 30813 30822 30823 30836

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Neil Wilkins M.Sc

17th July 2017
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Table

Table 1 Exploration Licences
Ripple Resources is a fully owned subsidiary of Armour Energy Ltd. Armour has been exploring the gas and oil resources of the McArthur Basin, and has made a significant gas discovery in the Glyde sub basin.

Ripple has selected Exploration Licences within areas inside the Armour Energy permits, and has been cooperating with Armour in order to evaluate these ELs for their base metal potential.

This cooperation has involved modifications and extensions to the Armour program so that it has greater relevance for base metal exploration. Ripple and Armour are taking a basin – wide approach, using expensive large scale geophysical geochemical and geological studies in order to select the optimal targets for expensive deep drilling. Future work will become more separated.

Base metal exploration within many of these Licences is challenging because of the rugged topography and cover geology. Breccia hosted and stratiform mineralisation trends into the area from outcropping areas, the most notable being the Bald Hills - HYC trend and Western Emu fault. The imputed depths of mineralisation are believed to range from about 200m – 1000m, much of which is below the limit of airborne EM penetration.

Previous exploration by Amoco Minerals (and Petroleum) and by BHP RTZ and MIM relied on airborne EM as a target generating technique. Amoco found outcropping Barney Creek shales and breccias in what was named the Glyde sub basin. Subsequent drilling found little evidence of proximal hydrothermal sulphide deposition in the sub basin, although it did encounter gas flows. Very little is known about the Barney Creek formation away from the Amoco drillholes.

During Year 1, a Falcon airborne gravity and magnetics survey was flown, imaged and interpreted.

One gravity anomaly adjacent to the Emu fault was diamond drilled to 1275m in hole LP3. The hole was subsequently logged with downhole geophysics including IP. This hole was drilled into EPM 29837, but has strong implications for several of the ELs which are the subject of this report.

This hole intersected 75m of semi massive pyrite infill and replacements hosted by the Cooley Breccia member of the Barney Creek formation. It demonstrates that a significant hydrothermal sulphide system has mineralised the Barney Creek Formation in the area. Ripple has lodged further EL applications to better protect the extended target. A weakly mineralised and hydrocarbon rich hydrothermal breccia trends into the southern project area, where it is in contact with the McDermott and Wollogorang formations.

A CSIRO study of potential outside the Barney Creek formation has highlighted the prospectivity of the Wollogorang and McDermott formation. The project area contains extensive but covered areas of these formations to the south of the Glyde gasfield.

A program of leakage geochemistry drilling and geophysics was proposed. Much of this was a joint petroleum and minerals exploration effort with Armour Energy.

The 2016 program was deferred for a year because of the untimely death of Aubrey McLarendon, the ultimate source of Ripple funding. His estate has withdrawn from the program and other funding measures are now in place. This finance has been redirected mainly towards the development of gasfields in Queensland, as the Northern Territory has brought in a ban on exploration for unconventional resources. This means that it is now impossible to conduct a cooperative petroleum and minerals basin wide exploration program. The ELs were surrendered on 30th June 2017.
1.0 Introduction

Ripple Resources Pty Ltd was set up by DGR Global Ltd for the purpose of exploring for base metals within areas of the McArthur and Mount Isa basins that were being examined by Armour Energy Ltd for gas and oil. After the float of Armour Energy, Ripple Resources was sold to Armour at cost. Since that time, Armour has been providing funding and much of the operating resources for Ripple.

Modern concepts regarding the formation of sediment hosted base metal deposits have given new emphasis to the century old model that the metals were introduced along with hydrocarbons, either in conventional trap sites or within basin centred accumulations.

There was an opportunity to modify and extend the Armour program so that Ripple Resources could benefit from aspects of the petroleum evaluation which were relevant to base metals. Since that time changes that effectively suspended petroleum exploration in the NT have forced Armour and Ripple to mainly shift operations to Queensland. There is no longer the possibility of a combined mineral and petroleum program to help Ripple look for deeper mineral targets.

2.0 Location and Access

Fig. 1 Location and access

The ELs extend over 80 km in a north – south belt near the HYC mine at MacArthur River. Access is made to the project centre via the Tablelands Highway road to the Cape Crawford roadhouse and caravan park. Access further east is via the Merlin mine road or the Kiana road through Mallapunyah.
Many of the ELs are very difficult to access because of the scarps that form the edges of the Abner Range and the deeply crevassed Bukalara Plateau. Up to this time, a helicopter based at cape Crawford and hired by Armour Energy has been used to overfly the area.

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**Table 1 Exploration Licences**

The above exploration Licences have been combined into the Barney Creek Project Area 2, which allows for combined expenditure covenants reductions and reporting. EL30077 was surrendered last year.
4.0 Geology and Mineralisation

Most of the district is comprised of the prospective McArthur Basin. The formations of prime interest are the Barney Creek and adjacent/underlying Coxco dolomite member. The McArthur basin is more deformed and faulted in this district which is referred to as the Central Batten Fault zone.

Most mineralisation of note lies between the Coxco and the Caranbirini member of the Lynott Formation, but some bitumen – galena- sphalerite infills extend up as far up sequence as the Bessie Springs sandstone in the Roper Group and as low as the dolomitic shales of the McDermott formation. As a rule, the highlighted formations in Fig.2 contain mineralisation and hydrocarbon shows.

The economically significant lead zinc copper deposits are part of the Mt. Isa – McArthur metallic province, which is the most productive zinc district in the world. Locally, the HYC mine is the only producer, with a global resource of over 200 million tonnes of lead zinc with minor copper. New exploration by Rox Resources (Teck) has enhanced the nearby Myrtle and Teena deposits by means of deeper drilling with larger richer intercepts. They are typical of the basin hosted deposits which are normally richest in the structurally lowest sites, within the most organic dolomitic shales (Fig. 3).

Other zinc-lead copper deposit types are known, and are mainly of the porosity infill type, where hydrocarbons and metals have migrated into trap sites usually in solution breccias or decarbonated dolomitic shales. Locally, these include the Coxco, Cooleys and Ridge deposits. Century in Queensland is the largest known deposit of this type, and was until recently the world’s largest zinc producer. At Century, the stratiform sulphide mineralisation occurs in a matrix of live oil occupying secondary porosity sites, and adjacent smaller mines have produced pitch as well as silver lead. Renewed exploration at Walford Creek (in Queensland, close to the NT border) has discovered significant Mt. Isa style copper cobalt phases that overprint the silver lead zinc. This style is also present in breccias at Cooleys, but is not economically significant. (Fig. 4)
Fig. 2 Stratigraphic column highlighting target sequences

Fig. 3 Model – Basin hosted deposits
5.0 Exploration Completed

Within the ELs over the past three and a half years, Ripple compiled the previous exploration data, flew a Falcon Gravity survey jointly with Armour Energy, drilled a 1275m corehole, and undertook a basin wide Frogtech study. Samples of core from outside the ELs were also studied (CSIRO) for an evaluation of the SEDEX potential of the Wollogorang and McDermott formations.

5.1 Compilation of Previous Data

Previous exploration data from numerous sources was compiled with the purpose of identifying geochemical geophysical and geological targets. Several mineralised trends were identified and the strongest of these passed into the covered areas especially in EL 29837 and EL 30080 (Fig.5).

The younger fault structures within the project area can be seen on the public magnetic imagery, but strongly mineralised growth faults such as the Bald Hills fault which controls most of the mineralisation is subtle (Fig.6).

The previous drilling (Fig.7) has largely avoided the areas of cover within the project area. This is notably true along the extensions of the Bald Hill fault in EL 30080 and the Western Emu fault southwards in EL 29837.
Fig. 5 Compilation of previous work.

Fig. 6 Compilation on magnetic imagery (TMI)
5.2 Falcon Gravity Survey (2014 Annual Report)

A Falcon airborne gravity (and magnetics) survey was flown jointly with Armour Energy. This survey was trialling Falcon as a means of quickly determining structure and stratigraphy under cover. The rugged Bukalara Plateau presents severe logistical problems for seismic, and Falcon was seen as a cheaper alternative.

Modelling of known zinc deposits suggested that they should be recognisable as positive gravity features that are also non magnetic. The technique has limitations. Gravity cannot distinguish between dense carbonates (locally dolomite, ankerite and siderite) and sulphides. Similar trials immediately over the border in Qld have demonstrated that the strongest gravity features are paleohills at the base of the cover.

The area flown extended south east of the HYC mine, covering the Myrtle zinc deposit and the Glyde sub basin of Barney Creek formation (Fig.8). The Myrtle deposit was not clearly distinguished as a gravity feature, but the mineralised Western Emu fault can be seen as a gravity break extending SSE through EL 29837 and just west of ELs 30813 and 30753.

The most numerous strong gravity features apparently relate to areas of cumulatively thickest dolomite, such as outcropping Upper Lynott formation.
Hole Lamont Pass 3 (LP3) was percussion drilled and cased to 300.9 metres and then cored to 1275m. The collar location at GDA 94 631148E 8146460N, and the orientation vertical. A BOP and a safe flame outlet pipe was attached in case of gas flows.

The site was chosen for several reasons including accessibility. Geologically, the site was chosen because the stratigraphic location was clearly within the Donnegan member anhydrite concretion beds (Upper Lynott formation) – meaning the Barney creek and Coxco dolomite targets were within drilling capability, but outside the limit of airborne EM.

The location was also on gravity target D. From a petroleum point of view the site was chosen because if successful, it would have substantially increased the resource of gas known to lie along the Emu fault extension further south. The targets included shale oil/gas in the Caranbirini and HYC members, as well as the conventional gas in the underlying solution breccias.

A full log is attached as Appendix 2 – Annual Report EL 29837 2014.

Upon completion, a downhole IP survey was run in order to verify the lateral persistence of the major sulphide intervals. Additionally, cores from the Lynott to Coxco were measured for s.g. and analysed for suite of relevant metals.

The geophysical log is attached as Appendix 3 – Annual Report EL 29837 2014
The analyses are attached Appendix 4 and are combined with geophysics in Appendix 6 – same report.

The s.g. measurements are attached as Appendix 5 same report

A summary of the formations encountered (after review) is as follows:

0m – base of Donnegan Member Lynott formation

612m - base of Caranbirini member Lynott formation top of Reward

649m – base of Reward formation transition to dolomitic shales

681m - Barney creek formation base of dolomitic shales start of main Cooley breccia member

867m – Barney creek formation base of sulphidised Cooleys breccia ( no HYC or W fold members )

882m – base of solution cavities - old weathering surface on Emmerugga formation)

957m – base of Emmerugga dolomite - more solution cavities unconformity on Myrtle shale

1050m – base of Myrtle red and green shales transitional to thin bedded mixed algal dolomites and green grey shales at 1080m – Tooganninnie formation

1275m – ended in Tooganninnie formation

Fig.9 Location of LP3
Lamont Pass 3 intersected a Barney Creek paleo high where there was no deposition during HYC member time. The Cooleys breccia included slump and solution breccias in juxtaposition – an indication of proximity to an active growth fault.

Most importantly, 75 metres of hydrothermal sulphide infill and replacements were encountered in the Cooleys breccia. This was the densest section of core and the likely source of the gravity anomaly. This sulphide was very low in base metal anomalism, and is seen as a distal sulphide facies.

No major gas flow was encountered despite the thick section of shale oil and gas above the Cooleys, and the Coxco solution cavities below. My interpretation is that conventional gas and oil has seeped out updip and up fractures to subcrops on the margins of the Glyde and Amelia sub basins. This is therefore a relatively safe local area for drilling through the Coxco. Fractures high in the hole had abundant live oil, but under no pressure.

Fig. 10 Sulphides in LP3
5.4 Frogtech Basin Study (2015 Annual Report)

The purpose of the survey was to provide information that would allow structural interpretation of the areas obscured by cover, at the same time as identifying fault bounded sub basins that may host sulphide accumulations. Figure 11 shows a 3D image with some targets illustrated.

Frogtech uses geophysical geological and downhole information to generate an image of the basin structure. The pale colours are areas of shallow McArthur group, darker areas are deeper. The Emu fault system is clearly illustrated as are the other growth faults controlling sub basinal development.

The hydrothermal system along the Emu fault sets (it is more than one fault) is regionally extensive, but is only known from outcrops and drill cores that are comprised of rocks below the Lynott formation. The other fault systems have mineralised hydrothermal breccias but these have been poorly documented. A subtle ENE set is of prime importance in the MacArthur Basin and in the adjacent part of the Mt. Isa superbasin. These have been strongly highlighted in the HYC – Teena area.

Targets have been selected for drilling within the Barney Creek project area. These are all within the area of influence of the hydrothermal sulphides in that hole. The shallowest test would be sites B and C which are on the EL boundary. Ripple has an application over the adjacent blocks but this application is in competition with MMI who have had access to the Ripple data prior to their application.

![Tilted Frogtech image with targets](image-url)
5.5 Evaluation of the Wollogorang and McDermott Formations (2015 Annual Report)

A study was commissioned to examine drill cores from the McDermott and Wollogorang formations with the purpose of evaluating their mineral (and hydrocarbon) potential. This is CSIRO report EP151255 by Spinks Smid and Pages.

The McDermott core was from GSD7 which is just east of ELs 30822 30823 and 30078 outside the southern end of the project area. The Wollogorang formation was from DD91RC18 and 91 HC1 which are located well to the north east on Pungalina station.

Both holes exhibited features consistent with being located “near” to SEDEX style base metal deposits.

GSD7 contained ankerite-dolomite and potash alteration, carbonate nodules and lead zinc sulphides. The interval of most interest was intersected between 545m and 663m. This stratigraphic interval has thin tuff beds and intraformational breccias at the base indicating tectonic activity capable of forming mineralised sub basins. It is an analogue of the lower Barney Creek formation.

The Wollogorang formation was confirmed as having potential over two stratigraphic intervals near the middle of the formation.

Both formations contained anoxic sequences and weak mineralisation. If euxinic sub basins can be located then the more massive SEDEX style of mineralisation could be developed. As it is, these anoxic carbonate facies are prospective for breccia hosted copper and lead zinc adjacent to hydrothermally active faults.

6.0 Results and Conclusions

The Frogtech basin analysis has identified fault bound sub basins near the LP3 sulphide intersection. The depths to HYC equivalent targets are not favourable for most of these, but EM conductors and geochemical anomalism suggests that mineralisation may be much closer to the surface, perhaps in the Caranbirini member of the Lynott formation.

The most compelling area for deep exploration lies within EL30080, in what has been called the Watershed Basin. This syncline of Barney Creek formation lies along strike from the Teena W Fold Wickens Hill Emu HYC and Cooleys deposits (Fig.13).

The Amoco conductors along strike to the ENE of HYC and Cooleys along this trend remain to be confirmed as actually being Mainoru formation. A 300m hole would confirm this as either Mainoru or subcropping McArthur Group. (Fig.12)
Fig. 12 Targets Identified

Fig. 13 Barney Creek distribution around EL 30080 (Barney Creek Fm in brown)
7.0 Proposed Program

A comprehensive program of leakage geochemistry, geophysics and drilling was to be conducted as a joint effort with Armour Energy.

This cannot proceed due to the NT government ban on exploration for unconventional gas and oil. As the major resources are unconventional, their exploitation is seen as critical to justify to building of infrastructure in this remote area, even if the conventional resources are commercialised first.

Ripple has therefore surrendered all of its Exploration Licences apart from those with shallow targets more appropriately evaluated with normal mineral exploration (non petroleum) techniques.