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Subject: Rover JV Project – assessment following receipt of Archimedes data

EXECUTIVE SUMMARY

All available data covering the Adelaide Resources Limited (ADN) Rover tenements and surroundings has been compiled and assessed together with the recent preliminary 3D ACM magnetic data from Archimedes.

It is interpreted that the main ADN tenement (EL27372) covers a horst block of folded Paleoproterozoic Warramunga Formation (Fm) metasediments and ironstones flanked on either side by folded Ooradidgee Group metasediments, and locally by Hatches Creek Group metasediments, with all of these units unconformably covered by between 120m-200m of undeformed Paleozoic Wiso Basin sediments. Within EL27372 the area occupied by interpreted Warramunga Fm forms a 3km wide zone extending 28km WNW, and includes the 7 known ironstones (R1, R4, R11E, R11C, R14, R16 and R12). It is interpreted that the remaining portion of the tenement and all of EL27292 are not of interest as the Warramunga Fm, if present, is covered by magnetic (locally remanently magnetized) Ooradidgee Formation, as well as the Wiso Basin cover, probably rendering the target beyond detection at economic depth.

The reduced area of interest has several magnetic targets of interest that have been inadequately, or not drilled at all. Several promising undrilled targets have also been identified however it is it recommended that detailed gravity and deep IP surveying is selectively completed over the prospective corridor to better define basement structure prior to drilling.

The R4 target has been predominantly drilled parallel to cleavage which is interpreted to control the better gold grades targeting instead the ironstone which replaces bedding, and represents an immediate target. The R12 target has a similar potential size to the R1 ironstone yet has only been tested by 13 drill holes.

Success in the Rover JV will require a commitment to deep drilling.

INTRODUCTION

The Rover Cu-Au Camp comprises one major ironstone–hosted Cu-Au deposit (*Rover 1*), five smaller ironstone–hosted occurrences of Cu-Au (R4, R11C/E, R12, R14, *Explorer 142*), two barren ironstones (R16 and *Explorer 120*) and 2 Ag-Pb-Zn occurrences (*Explorer 108 and Curiosity*) all located within a ~40km long horst of deformed Warramunga Formation ± Ooradidgee Group metasediments (Fig.1). Deposits in *italics* lie within adjoining Westgold Limited (WGR – ex MLX) tenements

with the exception of the up-dip continuation of the western lode at *R1* which is held by ADN.



Figure 1: Location of the 2 ADN Rover tenements superimposed on Normandy 2001 geological interpretation (Clifford, 2001). Interpreted Warramunga Formation is coloured green, with Ooradidgee Group in beige, granite in pink and Wiso Basin in pale blue. Principal ironstone-hosted Cu-Au and Ag-Pb-Zn targets are shown as red squares, drilled targets without ironstone are shown as green dots and hollow dots represent undrilled targets. It should be noted that the Wiso Basin sediments actually cover the entire area, the light blue area simply representing the approximate location where this cover is deeper than 200m.

The entire horst block is covered by the Paleozoic Wiso Basin cover sequence comprising mainly dolomitic siltstones and dolomite with minor interbedded shales, muds and sandstones. The cover dips shallowly westward yielding cover depths varying from 120m in the east, to 200m in the west, of the tenement. Historical exploration was conducted in 3 phases interrupted during the period 1982-1995 when all EL applications were vetoed by the Traditional Owners. Initial exploration was completed by GeoPeko from the mid 1960s-1980s, Normandy Exploration in the 1990s-2000s and more recent work by ADN and WGR since 2007. All of the currently known mineralized ironstones were discovered by GeoPeko, and recent exploration has been predominantly of brownfields nature except for co-funded greenfields drilling completed in 2009 under the NTGS Bringing Forward Discovery initiative (Anderson, 2010, Stephens, 2010).

In comparison with the Tennant Creek Mineral Field (TCMF) the known ironstones within the horst block of folded Paleoproterozoic Warramunga Formation metasediments appear to be relatively better mineralized, with fewer barren ironstones, suggesting this line of lode may represent a more consistent target. Allied with the shorter exploration history, and extremely localized exploration activity away from the R1 and R4 targets, these factors imply this trend may have a higher prospectivity than similar structures in the TCMF proper.

TECTONIC INTERPRETATION

The Paleoproterozoic TCMF is separated from the Rover region by the Bluebush gravity high representing a Paleoproterozoic eruptive centre for the Ooradidgee Group (Donnellan, 2013). Although the predominant lithologies are of felsic magmatic origin (extrusive and intrusive), considerable thicknesses of mafic-intermediate lithologies (extrusive and intrusive) and exhalative sediments have been intersected in drilling (Page, 2010), and these are interpreted as the source of the gravity anomaly.

Recent passive seismic surveying completed along the Stuart Highway (70km E of R1, Fig. 2) revealed the presence of a 10km vertical step in the depth to the Moho at

the southern edge of the Warramunga Province, which is interpreted as a crustalscale fault or shear zone demarcating an old block boundary within the North Australian Craton (Sippl, 2016). This is coincident with the Bluebush area and the Kunayungku and Lake Surprise fault scarps which developed as a result of the 6.3-6.7 magnitude earthquake recorded at Tennant Creek on January 22nd 1988.



Figure 2: Regional geological setting of the TCMF (northeast) and Rover field (southwest) separated by the Bluebush area (red ellipse). The dashed magenta line represents the location of the interpreted 10km step in the Moho from 42-40km to 50km northwards coincident with the surface trace of the 1988 Kunayungku and Lake Surprise fault scarps (red lines).

It is proposed that this feature is the result of crustal underplating of the Warramunga Province during the Tennant Event, the mafic underplate being responsible for the generation of early voluminous granites (TC Supersuite) and lesser maficintermediate intrusives as well as the slightly younger bimodal Ooradidgee Group extrusives and pyroclastics (Fig.3).



Figure 3: Cartoon section from Rover to the TCMF showing the relationship of the various crustal elements and interpreted structures. Dashed fault traces are an alternate interpretation.

EXPLORATION CAVEATS

The Rover field has many similarities with the TCMF, but also some distinguishing peculiarities caused by the blanketing cover of Paleozoic Wiso Basin sediments. This cover represents a sterile physical spacer between the surface and the host Warramunga Fm replacing the weathered portion of mineralized ironstones hence the supergene enrichment and geochemical dispersion that is characteristic of TCMF ironstones is absent. In place of this secondary geochemical halo the basal dolomites of the Wiso Basin are enriched in copper proximal to the unconformity immediately above mineralization hosted within the Ooradidgee Group at the *Explorer 108* (5m-10m layer of >0.2%Cu at 170mBGL) and *Curiosity* prospects (Beckwith, 2008, Burke, 2013), and weak copper anomalism is present at the unconformity over the *Explorer 142* (210m BGL) and R12 (200m BGL) ironstone-hosted mineralization within the Warramunga Fm. Neither the R1 nor R4 ironstones intersect the unconformity.

The depth of the cover also limits the detectability of ironstone bodies using potential field techniques due to decreasing signal strength with depth. This in turn probably implies that only magnetite-dominant ironstones can be detected using magnetics and gravity, unless any potential hematite-dominant ironstones are very large bodies. The combination of lack of outcrop and thick younger cover means that the geological interpretation is entirely based on interpretation of the potential field data and this is where the Archimedes ACM 3D data cube is of extreme value. The disadvantages of the cover in potential field techniques however possibly present an unique advantage to electrical techniques. The Wiso Basin is an aquifer but appears to be almost transparent so that sulphide-rich systems below the cover can still be detected. WGR have successfully employed high powered Deep Penetrating IP at the *Explorer 108* and *Curiosity* targets through 200m of cover (Burke, 2013).

LOCAL GEOLOGY

The Rover region displays a more complete stratigraphic succession than the TCMF where the dominant lithologies are the ca 1862-1854Ma Warramunga Fm turbidites cut by felsic and lesser mafic intrusives of the ca 1854-1840Ma TC Supersuite. This is either due to a greater degree of uplift and erosion, or alternatively a thinner

sequence of overlying Ooradidgee Group within the TCMF. At Rover the host rocks are also interpreted to belong to the Warramunga Fm but intrusives of the TC Supersuite are lacking, being replaced instead by voluminous volcanics and volcaniclastic sediments of the overlying ca 1845-1840Ma Ooradidgee Group. These successions are unconformably overlain by sediments of the Paleoproterozoic Hatches Creek Group and by the Paleozoic Wiso Basin.

The current author supports the Normandy interpretation (Clifford, 2001) which honours the magnetics, placing the Rover camp within an inlier of Warramunga Formation overlain by, and structurally imbricated with, younger Ooradidgee Group lithologies. It is interpreted that the "inlier" is actually a horst as shown in Fig.4.



Figure 4: Cartoon section of the Rover area. Targets shown in italics are on adjoining WGR tenements and have been projected to show their relative stratigraphic location wrt the ironstones in the Warramunga Formation. Thin black lines are interpreted stylized bedding traces.

The dominant structures within the ADN tenement are upright north verging folds (450m-600m wavelength) cut by steep faults, some of which may represent rotated thrust faults. This setting is identical to that within the TCMF. Late NNW and NNE brittle faults occur locally as well as ENE faults (Fig.5). Shear links suggest there has been late sinistral movement between the major faults.

Inspection of Fig.5 shows the wavelength of the folds to the north of the interpreted Warramunga Fm is larger and at a different orientation to that within the Warramunga Fm, reflecting the polyphase history of the latter. To the south of the Warramunga Fm a series of minor parasitic folds (not shown but occurring between the series of WNW-trending axial planar faults between R26 and R8) delineate a large anticlinorium developed in Ooradidgee Group ± Hatches Creek group between the Warramunga Fm and the 1840Ma Granite (Fig. 4).



Figure 5: Same area as Figure 1. Background image is grey scale RTP-tilt magnetics. Hatched green area is interpreted to be underlain by the Warramunga Fm underneath the Wiso Basin cover and is smaller than that interpreted by Normandy, and the current interpretation extends the Warramunga Fm along the main WNW direction to Rover 15 and beyond. The area to the north and south of the hatched area is interpreted as Ooradidgee Group (beneath the Wiso Basin cover).

KNOWN MINERALIZATION

Tennant Creek-style ironstone hosted Au-Bi-Cu mineralization occurs at the **R1**, R4, *Explorer 142* targets and ironstones with anomalous geochemistry have been drilled at the **R11(E/C)**, **R14**, **R16** and **R12** targets, which are all located along 29km of strike of the same early WNW-trending thrust feature shown in Figure1. Another 8km further W along the same feature after it bends northward lie the *Explorer 108* and *Curiosity* Ag/Pb/Zn deposits. From east to west the spacing between the bold-type targets is 11km, 3.5km, 3.2km, 3.2km, 8.3km and 8.3km. Comparable periodicity along structures in the TCMF is 4km which may partly explain the perceived higher prospectivity at Rover.

The Au-Bi-Cu mineralization style in the Rover field is identical to that of the TCMF with Au located on the periphery and brecciated exteriors of magnetite-hematitejasper ironstones while Cu-Bi sulfides are also found here, as well as throughout brecciated ironstones. The ore zonation of basal Au succeeded upwards by Bi and Cu is present as documented in the TCMF, with <u>higher gold grades preferentially located at the base of ironstone bodies and within underlying magnetite-chlorite feeder structures</u>. Clearly **the target of drilling should always be the base of the ironstone**, but due to the vagaries of magnetic modelling (see ACM section below) this is more often than not located by iterative drilling rather than by model driven targeting.

The **R1 ironstone** dips steeply S (75°/191°) with gold developed at the eastern basal contact. ACM modelling shows the northern side of the ironstone to be extremely magnetic (see comment in ACM section below) and this region correlates with logged hematite shale and siltstone (Webb, 2009), possibly suggesting the iron enrichment to be of a metasomatic nature. Contrary to the 2015 Archimedes interpretation <u>ADN only possess the up-dip portion of the basal contact of the ironstone and hence the maximum reserve tonnage of the R1 orebody within EL27372 will be limited.</u>

The **R4 ironstone** is shallow with depth to top varying from 127m at the west to 245m BGL at the east, and its subhorizontal attitude is reminiscent of the West

Gibbet ironstone albeit with greater strike length (~500m, Drown, 2015). It is interpreted that the ironstone has replaced a permeable unit (sedimentary breccia) within a fold closure (cf. Gecko K44). Gold grades are controlled by the axial planar cleavage which dips steeply SW (69°/206°) similar to the Au ore at R1 (and as indicated by historical forward magnetic models) but the majority of drilling of the ironstone has been from North to South down dip of the cleavage targeting the largely barren ironstone. Only 9/48 holes drilled towards the north, with another 6/48 drilled vertically. It will be simple to test for gold at the base of, and under, the ironstones by drilling a carefully planned series of N-dipping holes.

The subvertical **R12 ironstone** has been intersected between 330m and 550m BGL although magnetic modelling suggests the ironstone may extend until at least 800m BGL. Because of the higher cover depth (210m) this target has only seen sparse drilling (10 holes and 3 wedges) covering 485m of strike, yet this ironstone has the potential to be a similar size to R1 which has received >267 drill holes!

GEOPHYSICS

The ADN tenements have been covered by detailed aeromagnetics (NOREX AMAG and Normandy HeliMAG) and locally by ADN semi-regional and detailed ground gravity surveys. A variety of imagery is available for interpretation.

<u>Magnetics</u> - A shaded RTP magnetic image shows the eastern part of EL27372 and all of EL27292 are covered by a very deep blue feature, outlined in yellow in figure 6 below. This area is interpreted as being reversely polarized due to strong remanent magnetization. Drilling by WGR in 2009 (Stephens, 2010) at the Rover 3E and Rover 5 targets encountered nothing but Ooradidgee Group felsic volcanics and pyroclastics without an apparent explanation for the strong magnetic source. When oriented rhyodacite core from the Rover 3E hole was measured for remanence it was discovered that the Koenigsberger ratio was typically in the range of 10–25 (viz. remanence is 10–25 times stronger than the induced component) suggesting that the magnetite content was enriched metasomatically (Austin and Foss, 2014). These same authors postulate that the lithologies may represent a felsic caldera within the Ooradidgee Group. Hence the Rover 3E target is a false positive target, and it is possible the Rover 3 target within EL27292 may be similar.



Figure 6: Same area as Figure 1. Background image is sun shaded RTP Magnetics. The dark blue reversely polarized area delineated by the yellow hatched line is interpreted to be affected by strong remanent magnetization, possibly linked with the emplacement of the Ooradidgee magmatism in the Bluebush area further NNE. The stars represent the Rover5 and Rover 3E targets drilled by WGR and mentioned in the text. The Rover 4 prospect lies very close to the reversely polarized area.

The area of the reversely polarized anomaly is large (30km NS x 20km EW) and extends from the Kunayungku and Lake Surprise fault scarps at Bluebush (Fig. 1) south almost to Rover 4. Historical forward modelling within the ADN tenements has been very successful in determining the location and orientation of the ironstone bodies at R12, R16, R14, R11 and R1 (mostly all steeply dipping south), yet at R4 two geophysicists separately interpreted a Steep S dip when the ironstone is actually subhorizontal. Could the magnetic properties of this target be influenced by its proximity to the zone of reverse polarization?

<u>Gravity</u> – Gravity coverage is incomplete however the Warramunga Fm represents a residual high ridge, with prominent highs near the R14, R11E, R21, R23 and R1 targets (Fig. 7) although this could also simply reflect shallower depth of cover (100m-130m). Detailed surveying at R4 detects the ironstone as well as an untested feature coincident with a linear magnetic feature (fault?) at Rover 4N. It is recommended that gravity be acquired covering the rest of the interpreted Warramunga Fm.



Figure 7: Plan of EL27372 showing residual gravity image overlain by positive TMI magnetic features (only top 50% of contours shown). The interpreted Warramunga Fm is outlined in green. Note the coincidence of the gravity ridge with TMI high extending ESE from Rover 37 to Rover1.

ARCHIMEDES ACM MODEL

Given the apparent excellent relationship between strongly magnetic data points from the trial 3D Automatic Curve Matching (ACM) model produced by Archimedes in 2008 and the R1 ironstone it was decided to request that the ACM model be completed for the entire HeliMAG dataset over EL27372. A preliminary ACM model has been received and another model is awaited which has been corrected for remanence locally where this is deemed to be an issue.

The Rover 1 ironstone responds identically to those in the Tennant Creek field, and is <u>not directly detected</u> by the ACM model, nor can the ACM data be used to delineate the ironstone in 3D as was expected. The **top of the ironstone and the northern margin** however do correlate with a strong Magnetic Susceptibility anomaly, similar to that observed for the Tennant Creek ironstones. Mellon (2016) explains this result as follows.

"The ACM processing uses 3 geophysical bodies in the curve matching procedure. Geophysical Dykes, Plates (thin sheets) and Edge (or boundary). The Geophysical

equations used allow the processing to determine the top of the geophysical body producing the magnetic anomaly. Some dimensions of the body such as half width and dip are also determined but <u>not the depth extent</u>. For a Dyke Model the depth extent is considered to be infinite, however, for practical purposes the base of the dyke is too far from the sensor to influence the calculation. From this we therefore expect that ACM will detect the Top of the ore bodies and there should also be results from magnetisation contrasts around the edge of the ore bodies and a few within the body. We would not be able to determine the base of the body as this is a contrast between a highly magnetic sources underlain by less magnetic rocks. Therefore ACM is not going to be able to resolve the base of the body".

The reason the northern margin of ironstones is highlighted may reflect the fact the ACM data is based on TMI data, rather than RTP or AS data which would reflect the true location of the centroids of the causative bodies. Archimedes have been requested to comment.

The Rover 1 cross section provided to Adelaide Resources by Archimedes in the preliminary 2008 assessment gave the impression that the magnetic body had a steep north plunge that continues into the Adelaide Resources tenement. This plunge is however only **apparent** caused by the vertical exaggeration of the section (V/H=5.02). At natural scale the magnetic units dip shallowly north while the Rover 1 ironstone dips steeply south into the WGR tenement.

Inspection of the plan view of ACM data at the sites of known ironstones in the Rover field, and within the Gecko and Susan blocks in the TCMF reveals they form a characteristic "star-shaped" pattern with at least 4 points. Two of the points are commonly almost coplanar and define the strike with the other 2 points located on the northern side, at 60° to the strike and each other. A fifth point may also occur to the south at 60°-90° to the strike (Figure 8).



Figure 8: Plan views of selected ironstones from the TCMF and Rover field showing the characteristic "star-shaped" pattern of the anomalous ACM data cube magnetic susceptibility data. Red and blue balls mark the location of prospects while rectangles show the strike of the ironstones. The data is all from 50m-spaced AMAG or HeliMAG surveys but it is clear that the Gecko data processing was different. Note also the larger scale of the images for Gecko and R4 where the ironstones have small strike length and subhorizontal attitude, compared to the others that have subvertical orientation.

In 3D view these points represent arches with their cross-over coincident with the top of the ironstone. Below the cross-over is a data void resulting from the inability of the ACM algorithm to determine the base of the ironstone body. This characteristic shape permits the screening of interpreted anomalies detected in other magnetic imagery. Ironstone bodies with small strike length and subhorizontal attitude produce weaker anomalies than steeply dipping bodies, reflecting the bias of the 3 theoretical geophysical bodies used in the Archimedes curve matching procedure (Figure 8).

It is concluded that the ACM data readily images stratigraphy and structure, and with careful analysis can reveal anomalies reflecting Tennant Creek-style hydrothermal magnetite>hematite ironstone bodies, however such anomalies are readily visible in most magnetic imagery and in most cases have been targeted historically. It was initially thought that the ACM data would permit the 3D delineation of magnetic ironstone bodies, and hence could be used to validate historical drilling and locate satellite bodies, but instead it is only able to locate the top of the ironstones. On the other hand the ACM data is unique for interpretation of structure in 3D and in an area where there is no outcrop and the host rocks are covered by between 80m-210m of Wiso Basin cover this is extremely important.

TARGETS WORTHY OF FURTHER WORK

Seven targets were recommended for further work by Chris Drown of ADN (personal communication, August 2015): R1N, 4 targets located North of R6, R8 and R13. In the current interpretation all of these targets except R1N fall outside the key area considered to be underlain by the Warramunga Fm, lying instead within the overlying Ooradidgee Group, which decreases their prospectivity. The R1N target has a very weak magnetic signal in the ACM model dissimilar to that of an ironstone and it is interpreted instead as a fluid conduit for chl-mt alteration but not an ironstone.

Previous target generation by Sexton (2009) has been re-assessed using the ACM data. With the exception of Rover 26, all of the targets classified as flat or shallowlydipping by Sexton (2009) lie within the Wiso Basin cover sequence and have not been considered. A total of 21 targets located predominantly within the interpreted Warramunga Fm have been ranked (including 6 new targets) and listed in the attached spreadsheet and are shown in Figure 9. <u>Six targets are considered as top priority</u> constituting known Au ±Bi-Cu anomalous ironstones that are considered to have been inadequately tested (R4, R11E, R11C, R12, R14 and R16). As mentioned above, the R4 target could be drilled as soon as holes have been planned to test for Au controlled by the steeply S –dipping cleavage. It is recommended that infill gravity and IP surveying be completed prior to drilling the other targets.



Figure 9: Location of proposed targets with interpreted geology on RTP tilt magnetic image.

EXPLORATION PROGRAM

The following tasks are recommended:

- Merge and level all ADN gravity datasets with existing NTGS regional data. Search third party exploration reports submitted to the NTGS to see if the WGR gravity data is available as open-file. If so combine with the ADN data.
- Complete semi-regional to detailed ground gravity survey over ADN tenement within the interpreted Warramunga Formation (Figure 7).
- Regular IP surveying along main prospective structure ("Line of Lode") to identify sulfide-bearing zones. It is suggested this be completed over the priority targets as a proof of concept initially.
- Relog select drill holes along the main prospective corridor (outside R1 and R4) paying particular attention to structural orientations wrt ironstones and shear orientations. If oriented core is available take samples and submit for physical property testing and magnetic remanence determination. The latter could be done in-house by Alastair Harvey. Key sections of selected drill holes from the R1, R1N, R2, R4, R11, R12, R14, R20 and R27 have been requested to be retrieved from the ADN core yard and transported to TC.
- Drill priority targets.

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