Second Year and Final Report

EL 30193 - Box Hole

For the Period 11 August 2015 to 10 August 2016

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Map References:  Huckitta    SF 5311
                 Arapunga    SF 6053

Target Commodities:  Base Metals
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ABSTRACT

EL 30193 was held by Mineral and Waterwell Drilling between 11th August 2014 and 10th August 2016. During this time previous work undertaken in the licence area was reviewed and compiled. At the end of the second year of tenure, EL30193 was relinquished, as a result of decision to focus available resources on several key projects.

Since its inception, the lease has had a number of names, including the Boxhole, Turkey Creek, Tomahawke and Dulcie projects. EL30193 was applied for, in order to investigate the potential for extensions along strike and at depth to the known zone of Pb-Zn mineralisation which occurs at the Kings Mine Workings, and extends for 6.5km along a discontinuous NNW strike.
1. INTRODUCTION

Exploration licence 30193 covers an area of 18 blocks (57km2) and was granted to Australian Mineral and Waterwell Drilling Pty Ltd on the 11th August 2014. EL 30193 was surrendered on 16th August 2016, at the end of the second year of tenure, due to a change in exploration priorities.

EL30193 is located approximately 250 kilometres northeast of Alice Springs. Access from Alice Springs is via the Stuart Highway, followed by the Plenty Highway, the Bundy Highway and then station tracks. Within the EL access is via tracks servicing the water bores and property, with washouts occurring during the wet season.

The topography is gently undulating; with nodule covered plains covering the south and eastern areas of the lease and low carbonate hills containing karst features over the northwest area of the licence. Two large seasonal creeks bordered by eucalyptus trees cross through the lease, Turkey Creek along the west and another creek along the east, with land dominantly covered by grasses, gidgee and low acacia scrub.

Figure 1 shows the location of EL30193.
2. GEOLOGY

2.1 Regional Geology

The licence is located within the Georgina Basin, which is part of the Centralian Superbasin (refer to figure 2). The Centralian Superbasin formed near the eastern margin of Rodinia as a single intracratonic depocentre, during the breakup of Rodinia in the Neoproterozoic (Kruse, et al., 2013).

During the Petermann Orogeny in the Neoproterozoic, the Officer Basin was separated from the Centralian Superbasin by older uplifted Proterozoic rocks of the Musgrave Province. The Centralian Superbasin was separated into the Amadeus, Georgina and Ngalia basins, at a later date, most likely during the Alice Springs Orogeny which occurred during the Silurian to late Carboniferous. These basins are related by age, tectonic features and sedimentary sequences, with all the basins containing a sandstone unit at the base, as well as evaporitic sequences near the base and glacial deposits from the Sturtian and Marinoan glaciations (Mackey, 2009).

The Georgina Basin was at the margins of major deformation events, with the major rift located to the south during the Neoproterozoic, and the Peterman Orogeny causing only minor uplift, followed by subsidence and deposition of 1500m of sediments (refer to figure 3). The dominantly stable deposition environment allowed basin fluids to react with the sediments, causing widespread alteration of limestone to dolomites, with periods of deformation in neighbouring areas, enabling movement of fluids. This environment provides opportunities for Pb-Zn Mississippi Valley Style mineralisation.

Within the Georgina Basin, Pb-Zn mineralisation is widespread, occurring within siliciclastic rocks of Neoproterozoic age through to carbonates and mixed carbonate siliciclastic rocks of Early Ordovician age. Lead and zinc mineralisation has been intersected at the Noranside, Trackrider, Boat Hill, Marqua and Mt Skinner prospects, within 4 different stratigraphic units. Significant Zn and Pb has also been intercepted 30km east of the lease, within oil well Baldwin 1, (Dunster, et al., 2007). A summary of base metal mineralisation intersected by drilling within the Southern Georgina Basin together is provided in tables 1 and 2, with a map showing the location of prospects and drill locations shown in figure 4.

Lead isotope data was obtained from galena present within host rocks of Neoproterozoic to Late Cambrian age within the Georgina Basin. The lead isotope data indicates that there was a single mineralising event, with the lead derived from crust of Paleoproterozoic age (1840-1780Ma) and mineralised from 420-280 Ma, during the Alice Springs Orogeny (Dunster, et al., 2007).
Figure 2. Map showing location of the Centralian Superbasin. (Kruse et al., 2013)

Figure 3. Map showing simplified tectonics of the Amadeus and Georgina Basin (Mackay, et al., 2009)
Table 1. Drillholes which have intersected base metal mineralisation, with depth, unit containing mineralisation and associated minerals. (Dunster et al, 2007)

<table>
<thead>
<tr>
<th>Drillhole</th>
<th>Depth (m)</th>
<th>Formation</th>
<th>Mineralisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baldwin 1</td>
<td>339, 343</td>
<td>Hagen Member of Chabalowe Formation</td>
<td>sphalerite</td>
</tr>
<tr>
<td></td>
<td>888.8-889.0</td>
<td>Arthur Creek Formation ‘hot shale’</td>
<td>galena, sphalerite</td>
</tr>
<tr>
<td>BMR Huckitta 7, 8</td>
<td>not specified</td>
<td>Arrinhunga Formation</td>
<td>scattered sphalerite (Draper 1978b)</td>
</tr>
<tr>
<td>BMR Sandover 1</td>
<td>833, 839</td>
<td>upper Arthur Creek Formation</td>
<td>sphalerite</td>
</tr>
<tr>
<td>Exold Huckitta 1</td>
<td>461.16</td>
<td>Arrinhunga Formation</td>
<td>galena</td>
</tr>
<tr>
<td>Maclntyre 1</td>
<td>814.5-815.0, 850</td>
<td>Thorntonia Limestone</td>
<td>galena</td>
</tr>
<tr>
<td>Mulga 1</td>
<td>132, 144</td>
<td>Arrinhunga Formation</td>
<td>galena</td>
</tr>
<tr>
<td>NTGS99/1</td>
<td>580-581, 586, 587-588</td>
<td>Thorntonia Limestone</td>
<td>sphalerite</td>
</tr>
<tr>
<td></td>
<td>589.5</td>
<td>Thorntonia Limestone</td>
<td>galena</td>
</tr>
<tr>
<td>NTGS02/1 (central basin)</td>
<td>328.5</td>
<td>Anthony Lagoon beds</td>
<td>galena, sphalerite</td>
</tr>
<tr>
<td>NTGS Elkedra 2</td>
<td>514</td>
<td>Arthur Creek Formation</td>
<td>galena, sphalerite</td>
</tr>
<tr>
<td>NTGS Elkedra 6</td>
<td>220, 240</td>
<td>Arrinhunga Formation</td>
<td>galena, fluorite</td>
</tr>
<tr>
<td>NTGS Elkedra 7A</td>
<td>165-170, 190, 290, 300</td>
<td>Hagen Member of Chabalowe Formation</td>
<td>galena, fluorite, sphalerite, galena</td>
</tr>
<tr>
<td></td>
<td>290, 300</td>
<td>Thorntonia Limestone</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Base metal Mines and Prospects, with units containing mineralisation specified, as well as associated minerals. (Dunster et al, 2007)

<table>
<thead>
<tr>
<th>Prospect/mine</th>
<th>GDA (mE)</th>
<th>GDA (mN)</th>
<th>Formation</th>
<th>Mineralisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box Hole Mine</td>
<td>579720</td>
<td>7529010</td>
<td>Arrinhunga Formation</td>
<td>galena, barite, sphalerite</td>
</tr>
<tr>
<td></td>
<td>579515</td>
<td>7530175</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>773744</td>
<td>7466090</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marqua area – Boat Hill Prospect</td>
<td></td>
<td></td>
<td>Thorntonia Limestone (formerly Arthur Creek Formation), Arthur Creek Formation (formerly Marqua Formation)</td>
<td>sphalerite, galena</td>
</tr>
<tr>
<td></td>
<td>628900</td>
<td>7569000</td>
<td>Arrinhunga Formation at contact with Tomahawk Formation</td>
<td>galena, pyrite</td>
</tr>
<tr>
<td>Oonuppirra area – Trackrider Prospect</td>
<td></td>
<td></td>
<td>now recognised as Tops Member of Central</td>
<td>galena, azurite, malachite, chalcopyrite</td>
</tr>
<tr>
<td>Mount Skinner</td>
<td>427600</td>
<td>7549470</td>
<td>Mount Sturt Formation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>429590</td>
<td>7542900</td>
<td>now recognised as Elsyah Formation (Mepunga Group)</td>
<td></td>
</tr>
<tr>
<td>Mount Skinner (drillhole CM84)</td>
<td>425621</td>
<td>7545790</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4. Map showing location of known base metal mineralisation and drill holes which have intersected mineralisation. (Dunster et al, 2007)
2.2 Local Geology

The Box Hole exploration licence contains rocks of the late Cambrian Arrinthrunga Formation, and comprises interbedded shale and carbonates with minor quartz sandstone dolostone, limestone, minor quartz sandstone, siltstone, shale, marl and conglomerates. The Arrinthrunga Formation includes the Eurowie Member sandstone and undivided carbonates, with the Eurowie Member underlying the carbonate unit.

The Arrinthrunga Formation conformably overlies units of the Chabalowe and Steamboat Formation, and where these are absent, the Arthur Creek Formation. Hunt 1 and DD92EC1, to the north of this licence contained units of the Chabalowe, but this unit was not intercepted within DD92TC1 which was drilled 200m NW of the Kings Workings at Box Hole.

At Box Hole, anomalous lead and zinc is associated with stratabound, stromatolitic dolostone of the late Cambrian Arrinthrunga Formation, and is considered to be related to MVT mineralisation. The mineralisation largely extends along NNW strike for 6.5km and is overlain by a stromatolitic unit several metres thick, with the Eurowie Sandstone Member directly below. Figures 5a and 5b show the stratigraphy, geology and location of the Kings Workings within Box Hole.

Galena, barite and minor sphalerite is associated with elevated Pb and Zn, and occurs within interstitial spaces of stromatolitic dolomite as well as within silicified stromatolitic dolomites as galena crystals ranging up to several centimetres in size.

Silicification is recorded in the 4 diamond holes, with strongest silicification present within the Kings Workings area. It is possible the silicification is unrelated to the mineralisation, instead related to diagenesis processes, replacing gypsum and or anhydrites.
Figure 5a. Stratigraphic Column (Penna, 2010)
Figure 5b. Map showing location of Kings Workings and mineralised outcrop. (Kruse, et al., 2013)
3. LITERATURE REVIEW

Extensive work has been undertaken in the area within or near EL30193, most of which has focussed on the Pb-Zn mineralisation outcropping in the Kings Mines Workings area, as well as primary sources to the alluvial micro diamonds found in the area. There is also an oil exploration licence covering a broad area surrounding and including this mineral exploration area. Figures 6a and 6b show the location of drillholes discussed below.

Lead sulphides were first found by W H King at Boxhole in 1959 within silicified dolomite. King sunk some shallow pits within outcropping mineralisation over a distance of 3km along strike, handpicking 15 tonnes of coarse grained galena. Grades of up to 66.1% Pb, 59 ppm Ag and 0.43% Bi were reported to have been mined.

Consolidated Zinc Enterprise Exploration (CZEE), later named CRA, completed 8 diamond drillholes in 1960, for a total of 439m, to test for westerly down dip extensions to the outcropping mineralisation. No significant mineralisation was intercepted, with CZEE concluding that mineralisation is mainly stratigraphically controlled, with minor mineralisation along faults in anticlinal axes.

From the late 1960’s, Vanadium Mining reviewed gravity and aeromagnetic data, and acquired 3 reconnaissance IP lines west of the Kings Mine area. Following assessment of geophysical data, the lease was relinquished.


IP and drilling was completed, with 9 RC holes drilled for total of 337m near outcropping mineralisation. No significant results were obtained.


A gravity survey, shallow percussion drilling and near mine geological mapping was completed.


Exploration targeted stratabound lead and zinc MVT mineralisation, within Cambrian carbonate rocks.

3 percussion holes drilled by Central Pacific in 1971 (WD4-6) were sampled for Cu, Pb, Zn, F, Ba, Ag as well as CaO, MgO, Fe, SiO₂ and Al₂O₃, with WD5 containing 6.6% Zn over 5m interval. Available gravity and aeromagnetic data was analysed in order to define the basement topography and fault structures. The geophysical information was combined with aerial photos, regional geological mapping and reconnaissance geological mapping along traverses to produce a map showing the geology and location of all drilling undertaken to date, at 1:25,000 scale.

4 Diamond holes (BHD 1-4) totalling 786.65m, were drilled within a 1600m square grid. BHD1 was assayed from 0-29m, and analysed for Zn, Pb, Ag and Cu with no significant results obtained. No sulphides were intercepted in any of these holes. This core is stored at Box Hole in a core shed.


Exploration focussed on an epigenetic base metal mineralisation associated with fault zones, rather than stratabound Pb, Zn MVT deposit, as has previously been targeted.
Figures 6a and b. Maps showing drillhole locations. 6a shows location of RAB drilling completed by Uramet in 2008 (shown in purple), from Magee, 2008, and 6b shows location of all other drilling in Box Hole area (Dunster, et al.,2007).
A geochemical survey was undertaken to determine the background and anomalous values for lead and zinc. Limestone, dolomite, calcarenite and carbonate rich arenite from the Arrinthrunga Formation were sampled along strike for 7km; from Box Hole Bore to the southern extent of the old Kings Mine workings, and analysed for Pb and Zn, with some samples also analysed for Cu and Ag. The lowest Pb and Zn levels were from the silica rich arenite, followed by the carbonate rich arenites (the dolomitic arenites), then the stromatolitic dolomites. Not including material containing visible sulphide mineralisation, ferruginous stromatolitic dolomites contained the highest Pb and Zn levels, ranging from 100-400ppm Pb and 100-1000ppm Zn. It was concluded that anomalous lead and zinc values ranging from 100-600ppm are a regional feature, not leading to ore grades unless structural or textural changes occur.

Barite was found to be an excellent indicator for Pb and Zn mineralisation, with nearly all high grade material also containing barite. Barite was present within the pore spaces of the stromatolites and as massive replacement of carbonates with increasing barite content.

Fluid inclusion studies were conducted to assess the source of the mineralisation. The fluid inclusion data indicates that the Pb and Zn was originally deposited in a low temperature environment (100-140°C) with moderate salinity, consistent with MVT mineralisation, but later remobilised and concentrated by high temperature fluids (400-500°C), with high salinity brines at estimated pressure of 700Bars, equivalent to 2600m of sediment cover possibly related to the Alice Springs Orogeny, followed by normal basin temperatures (85-105°C) and moderately saline brines.

The high temperature source could be from a post Cambrian porphyritic dolerite dyke mapped by Australian Anglo American in 1974, which could not be located by Plenty River Mining, who inferred that the dyke could have been covered by transported material during the torrential rains of 1975-76. From the geochemistry and fluid inclusion studies it was concluded that there is large, low grade mineralisation, hosted by stromatolitic dolomite, within stratiform and stratabound stromatolites. Economic grades of up to 10% Pb and 1% Zn were found, associated with fault structures intersecting shallow anticlinal structures.

Note - these fluid inclusion studies have not been corroborated elsewhere in the southern Georgina Basin, as difficulties have been encountered with collecting reliable fluid inclusions for study, due to carbonate and sulphate host minerals leaking along cleavage planes, minor veined material suitable for testing, and most of the secondary carbonates within pores spaces are related to the near surface movement of groundwater (Dunster, et al., 2007).

Pacific Oil and Gas (1990's).

Petroleum exploration was carried out, with a 493m petroleum well, Hunt 1, drilled 25km northeast of Box Hole. Hunt 1 intersected units now recognised as the Arthur Creek Formation, Thorntonia Limestone, Red Heart Dolostone, Mount Baldwin Formation and Neoproterozoic Mopunga Group, with the Arrinthrunga Formation, which hosts mineralisation at Box Hole not present (Penna, 2010). This well was analysed for 20 elements, with the highest levels of Zn, Ni, V, P and Ba intercepted within ‘hot shale’ units of the lower Arthur Creek Formation from 313-347.8 m depth.
EL 7596 Tomahawke Creek and EL7597 Elcoota Creek. CRA Exploration (1992-1993).

Exploration focussed on testing the potential for MVT base metal mineralisation. Magnetics and gravity data identified a prospective zone with a steep magnetic and gravity gradient, referred to as the Jinka Feature, which influenced sedimentation and movement of mineralised fluids during the Late Adelaidean and Cambrian. Geological mapping was undertaken, and 53 samples were collected for geochemical analysis, including ironstone (especially fault related), as well as chert, and altered carbonates. Within the central western region of EL30193, 2 rock samples contained anomalous base metal mineralisation;

Rock sample 2738083: a stromatolitic dolostone containing 1.78% Pb, 2700ppm Zn, 4400ppm Ba and 6.9ppm Cd and rock sample 2738084: a cherty, silicified dolostone containing 2300ppm Zn, 1606ppm Ba and 7.6ppm Cd.

The information obtained from the geochemical program were analysed together with the historic geochemical data, with two stratigraphic horizons identified as potential hosts for mineralisation; the sabkha facies of the Chabalowe Formation (now considered to be units of the Arthur Creek Formation) and the basal shoal/organic rich contact in the lower Arthur Creek Formation.

RC chips from seismic shot holes drilled during petroleum exploration were assayed and logged, with no significant results obtained.

Three RC precollared, vertical diamond drillholes were drilled; with DD92TC1 (386.8m) located within the current Box Hole licence area and DD92EC1 (359.6m), DD93TC2 (351.3m) located 28m NE and 45km SE of Box Hole respectively. All the drillholes were geologically logged and assayed (except for DD92TC1 which was not assayed), with no significant results.

DD92 TC1 was drilled 200m north west of the Kings Workings, targeting the sabkha facies of the Chabalowe Formation. From 0-362.14m, units of the Arrinthrunga Formation were intercepted, including dololutite, fine grained dolarenite, claystone and dolomitic siltstone, followed from 362.14-386.8m by units of the Arthur Creek Formation, including interbedded light grey calcilutite, dark grey carbonaceous mudstone. The Chabalowe Formation was intercepted within DD92EC1 from 38-244.4m, and also outcrops in the area of the Hunt 1 petroleum exploration oil well. The presence of the Arrinthrunga Formation within the Box Hole Bore area, and absence within the area of Hunt 1 and DD92EC1 indicates a facies change, from a sabkha environment in the area of Hunt 1 and DD92EC1, shifting to a peritidal environment to the south west. DD93TC2 was drilled to test for the basal shoal facies at the base of the Arthur Creek Formation.

Due to poor drilling results, it was concluded there is low probability of significant mineralisation within stratabound units adjacent to fault controlled mineralisation within the Arrinthrunga Formation.


Elkedra Diamonds focussed on searching for a primary kimberlitic source for the alluvial micro diamonds found in the area. Aeromagnetic data also indicated presence of 200km sediments overlying basement- considered prospective for diamond kimberlites.

Aeromagnetic data released by NTGS in 1999 was interpreted in conjunction with 1983 Huckitta East Survey by Duncan Cowan. The NTGS data displayed an anomaly located in a 2km by 1km square located just north of the Kings workings at Box Hole.
Uramet formed by Elkedra in 2007 to focus on exploring for minerals other than diamonds, with Uramet changing its name to Intercept Minerals in 2011.

Mapping, geochemical sampling, VTEM, IP and RAB drilling was undertaken.

In 2008, 458 rock chips and 541 soil samples were tested for base metal concentrations using a Niton portable XRF analyser, mainly over areas of known mineralisation. Rock chips contained up to 3%Zn and 1%Pb, not including results from samples with visible galena, and the soil samples contained up to 1330ppm Pb and 2093ppm Zn. The geochemistry of 116 vegetation samples was also measured, with anomalous Pb, Ag, Cd, and Zn consistent with known shallow mineralisation. Elevated base metal results occurred within vegetation located down dip from known surface mineralisation with one drill target added.

The VTEM (Versatile Time-domain Electromagnetics) survey, conducted in 2007, included measurement of magnetic data (helimag) and showed a correlation between conductive areas and areas of low gravity attributed to structure. Consultant Keith Jones utilised VTEM, helimag, and gravity data to infer stratigraphic units present below surface where outcrop absent. An IP survey was carried out in 2008, identifying several targets at depths ranging from 20-200m. A number of consultants were engaged to interpret the geophysical data and generate targets for the RAB drilling program.

94 RAB drillholes totalling 4155m were drilled in 2008, targeting prospective zones with expected depths of 75m or less. Some anomalous lead and zinc was intercepted, including 12m at 2.8% Zn, and 0.67%Pb from 17m, with 1m containing 14.7%Zn from 24m, and best lead intercept was 2m at 3.98%Pb and 2.8% Zn, (Kruse et el, 2013). Drill core from the 4 holes completed by BHP and and DDH92 TC1 was examined and gravimetric measurements taken of BHP core to measure the density differences between lithologies and assist interpretation of gravity data.

In 2010 MVT experts, CSA Global, were contracted to evaluate all data and provide recommendations. CSA considered that previous work extensively focussed on the outcropping mineralisation, with areas of shallow stratigraphy close to potential feeders remaining untested. Also possible that the surface mineralisation may have formed as a result of venting from a large mineralising system below, within more favourable host rocks, than the mixed carbonates and clastics present at shallow depths. Recommend main target to be replacement and hydrothermal karst mineralisation, possibly controlled by facies, evaporites and dissolution, dolomite as well as faults.

4. CONCLUSIONS

Further work including extending the soil sampling coverage using handheld XRF, mapping, looking at previous drilling and oil well drilling, as well as drilling to test shallow stratigraphy close to potential feeder zones, is required to assess the possibility of a significant mineralising system at depth, from which the Kings Workings may have mineralised.
5. REFERENCES


Mulholland, I., 2012. EL 28966, Box Hole, Northern Territory, Australia. Year 1 Annual and Final Surrender Report for the period 29 March 2012 to 21 August 2012.


