Confidential Commercial Information – Geophysics and Drilling Collaborations Final Report

Teck Australia

2nd of February 2016
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Declaration

To the best of our knowledge, this document conforms to the format outline for a Geophysics and Drilling Collaborations Final Report, as shown by the Northern Territory Geological Survey - Geophysics and Drilling Collaborations website.
SUMMARY

Teck Australia completed a 2D high resolution seismic survey over the Yalco project, which comprises EL25467 and EL29021. The objective of the survey was to collect detailed seismic profiles to a depth of ~3kms over the Emu Fault Corridor, situated on the western flank of the Yalco project, to gain critical geological parameters and therefore an improved understanding of the mineral potential of the prospective corridor. Two seismic lines were shot over the Emu Fault Corridor for a total of 22.5 line km over the period 7th to 16th October 2015.

Despite the world class McArthur River Zn-Pb shale-hosted massive sulphide deposit (SHMS) located only 60km to the south, the northern extension of the deposit controlling structure – the Emu Fault zone – has never been effectively explored. The seismic survey undertaken during 2015 is part of a multi-year strategy for advancing knowledge and better understanding the prospectivity of the Yalco area.

Seismic information is considered critical for the purposes of target generation and development where the permissive target stratigraphy occurs at >800m depth, thus restricting the use of conventional exploration methodologies. The survey produced good quality seismic data, which has resolved some of the key questions regarding the architecture of the Emu Fault Corridor in the Yalco area. Initial interpretations have indicated that BCF is at explorable depths, with sub-basin development consistent with other permissive sub-basin in the McArthur River Basin. Based on these preliminary results the Emu Fault Corridor is clearly an area of interest that will be evaluated further using the seismic and other complementary data sets.

Despite challenging and remote site conditions track clearing, the survey and subsequent rehabilitation were considered successful.
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1. INTRODUCTION

The Yalco Project is located ~20 km to the northwest of Borroloola and 40 km to the southwest of the port of Bing Bong in the Northern Territory (Figure 1). Vehicle access is via unsealed tracks that come off Robinson Road that runs between Borroloola and Bing Bong.

![Location Map](image)

Teck are exploring the project under an earn-in agreement with Marindi Metals Pty Ltd, formerly known as Brumby Resources Ltd, were Teck has the option to earn 70% of the project. The agreement was signed on the 2nd of May 2014.

Access to the project has been undertaken in consultation with the NLC, the native title claimants and pastoralists. Teck has a preexisting relationship with the community and other stakeholders as a result of exploration over the past four years on the Reward Zn-Pb project, approximately 60km to the south of Yalco.
2. REGIONAL CONTEXT

The McArthur Basin forms part of the extensive Palaeo-Mesoproterozoic sedimentary successions of the Carpentaria Province. The Batten Trough or Batten Fault Zone comprises the central tectonic element of the southern eastern margin of McArthur Basin which plays host to the world class McArthur River Mine (Figure 2). The stratigraphy of the southern McArthur Basin is divided into four major groups, which are, from oldest to youngest: Tawallah (dominated by sandstone with lesser fine grained clastics, dolomites and mafic volcanics); McArthur; Nathan (dominated by dolomite with lesser sands and silts); and Roper Group (dominated by sandstone with lesser fine grained clastics).

The McArthur Group (Figure 2) is further subdivided into the lower Umbolooga Subgroup and the upper Batten Subgroup. The upper most unit of the Umbolooga Subgroup is the Reward Dolomite, which is underlain by the Barney Creek Formation (ca. 1640±7Ma; Pietsch et al 1994). The Barney Creek Formation (BCF) is the primary host to the Zn-Pb mineralization at the world class McArthur River deposit and is considered to be the most prospective formation for stratiform Zn-Pb mineralisation in the Batten Fault Zone.

![Regional geology and stratigraphy of the McArthur Group](image)

The Yalco project contains part of the Northern extension of the Emu fault zone (Figure 3), which is a key NNW trending structural corridor implicated in the formation of SHMS Zn-Pb mineralisation at the McArthur River deposit. At Yalco, the Emu Fault Corridor consists of outcropping Reward and Lynott formations with the permissive target host (BCF) estimated at a depth of 800 to 1km below these units. Despite the prospectivity of this corridor only two drill holes have been collared into the corridor with neither effectively testing the host stratigraphy.
Figure 3 Simplified Outcrop Geology and interpreted structure of the Yalco project
3. PREVIOUS EXPLORATION

Historical Mining/Exploration

The Yalco Zn-Pb project comprises EL25467 & EL2902. A total of seventeen exploration companies have previously worked in the area covered by the project over a period of 35 years. A review of the available open file data indicates that the primary aim of these companies was the discovery of a McArthur River style Zn-Pb SHMS deposit. Lower order sub-basins containing Barney Creek Formation in proximity to the extensive regional Emu Fault zone were typically targeted. Other than two drill holes all of the drilling was completed on the eastern side of the Emu fault where BCF is shallower.

Numerous exploration techniques were used across the project area in small restricted campaigns including stream sediment and soil sampling surveys, gossan searches, a number of geophysical methods and drilling programs (Figure 4), which have ranged in depth form 110 metres to approximately 440 metres. Due to the predicted depth at which BCF occurs in the Emu Fault Corridor (>800m) it is considered highly unlikely that any historical exploration has effectively tested this zone.

Manganese exploration program was conducted in the eastern part of the tenements by BHP in 1995. Three holes (BCP009 – BCP011) were targeted on previously delineated TEM anomalies. BHP hole BCP009 intersected 6m@15% Mn (unwashed) from 30 – 36 m depth. This blind intersection was hosted within Cretaceous sediments overlying the Lower Proterozoic basement stratigraphy which host the Zn-Pb mineralization in this region.

In 1983 BHP Minerals drilled McA5 to test a localized gravity high near an outcrop of BCF. Detailed sampling of thin pyritic beds returned results up to 4.05% Zn and 1,500ppm Pb. In 1983 and 1984 BHP conducted a detailed EM survey around McA5, which identified a NW-SE trending conductive zone that paralleled the known strike of BCF. An additional hole along trend (McA16) returned weak anomalism in black shales of the Caranbirini Member (basal Lynott Fm.), with a maximum of 285 ppm Zn and 125 ppm Pb. The prospect was downgraded and no further work was carried out by BHP.

Shell conducted extensive RAB drilling around the margins of the Fandango sub-basin in 1982 (2,129m). Shell and AO drilled diamond holes BB1-BB6 in the mid 1980’s. Drill holes BB2, BB5 and BB6 are interpreted to have intersected BCF; the other three holes were collared in Emmerugga Dolomite. The prospect was deemed non-prospective and divested. Rio Tinto explored the Fandango prospect in 2002 and conducted a large HOISTEM survey and RC drilling program. Intense conductors identified by the HOISTEM survey on the margins of the sub-basin were drilled to try and determine if there were any anomalous base metal concentrations or thickened sections of pyritic shale. The best result was in RC02FAN006, which returned 69m at 1087 ppm Zn. Drilling indicated that the intense conductors were probably caused by thick clay profiles and strong weathering. The lack of conductors related to sulphide mineralisation and low levels of Zn in the Fandango area meant that the prospect was downgraded and divested.

Brumby was granted EL25467 in August 2007 and undertook a review of the available historical data and located the old BHP holes, which identified the Batten Creek Manganese Project. Once that area had been identified, Brumby undertook a Versatile Time Domain Electro-Magnetic (VTEM) survey over the area in July 2008 (Figure 4). The survey was undertaken to better define the extent of the known manganese mineralisation. A total of eleven near surface sub-horizontal manganese-clay target zones between surface and 80 metres depth were delineated by using data generated during the VTEM survey.

Exploration in the second year of tenure carried out by Brumby and consisted of interpretation of a VTEM survey flown the previous year over the Batten prospect and RC drill testing of two VTEM conductors.

Exploration by Brumby in the third year of tenure consisted of continued reinterpretation of the VTEM survey flown in year one over the Batten prospect and RC drill testing of three VTEM conductors, two were inferred to be related to surficial manganese mineralisation, north and south, and a larger deeper conductor possibly associated with SHMS Zn-Pb type mineralisation. In total Brumby has drilled 12 holes on the Yalco property for a total of 1,267 metres.

In summary historical exploration has failed to test the BCF for Zn-Pb SHMS mineralisation in the Yalco area. Significantly only two historical holes have been drilled into the Emu Fault zone by MIM (YN9701D, YN9702D) and these reached depths of 411m and 352m, with neither hole testing the BCF. The lack of drilling through this highly prospective zone is related to perceived depth to the target horizon, poor access, and a poor understanding of regional stratigraphy and structure and the role these play in localizing mineralisation.
Historical exploration reports covering the Yalco project include:

CR19740076; CR19790146; CR19800191; CR19810261; CR19820249; CR19830122; CR19830123; CR19830202; CR19840118; CR19840171; CR19850199; CR19850214; CR19860128; CR19860218; CR19860221; CR19860248; CR19920643; CR19930001; CR19940001; CR19940572; CR19940868; CR19950153; CR19950577; CR19950844; CR19950912; CR19960400; CR19960650; CR19970016; CR19970131; CR19980108; CR19990397; CR20030281; CR20040308; CR20050160; CR20060314.

Figure 4  Historical drill holes and geophysical survey lines
4. EXPLORATION CONCEPT

Teck’s exploration strategy is for the discovery of Tier 1 sediment hosted Zn-Pb sulphide deposits hosted in the basal portion of the BCF in localised sub-basins, which are formed through the interaction of major regional structures; both extensional normal and transfer elements. This model is based on the McArthur River deposit, which is the archetypal deposit in this region. Primary controls on the mineralisation at the McArthur River mine include the reduced facies of the basal BCF (Figure 5); major N to NW trending structures including the Emu Fault zone; and NE structures. The Teck exploration team has had recent success in exploring for SHMS systems with the discovery of the Teena Zn-Pb deposit approximately 8km west of McArthur River in 2013/2014.

The 2014 airborne magnetic and radiometric survey completed by Teck was the first data layer in building up a detailed structural framework of the Emu Fault corridor. This provided a framework for defining key transfer structures but cannot aid in understanding some fundamental questions regarding sub-basin architecture at the camp to deposit scale. Important targeting questions still remain, such as:

1. What is the nature and role of the two major faults that define the Emu Fault Corridor?
2. Does the fault on the western side of corridor represent a syn-depositional extensional fault?
3. What is the depth to host stratigraphy?
4. What internal variability is present within the Emu corridor at the 3rd order sub-basin scale?
5. What is the nature and significance of regional NE and NW trending faults?

Seismic reflection surveys are still not widely used in base metal exploration, primarily due to the cost. Teck employed seismic reflection successfully in Queensland on the Bluebush Project. Seismic reflection surveying is considered a critical exploration tool for “deep” targets out of exploration range by traditional methods such as EM or IP. It also provides the highest resolution method for defining and characterizing the architecture of basins along the primary controlling structures.

Figure 5 McArthur River model (cross-section) showing the low-moderate grade nodular carbonate zone peripheral to the central high grade laminated sphaleritic siltstone zone
5. DETAILS OF THE COLLABORATIVE PROGRAM

Teck acquired seismic reflection data over two transects (Figure 6 Fact geology and structure of the Yalco area showing the location of the two NTGS co-funded seismic lines across the Emu Fault corridor on EL25467 between the 7th and the 16th of October.

The seismic survey comprised two east-west oriented survey lines. Seismic line one was approximately 11.6 km long and seismic line 2 was approximately 10.9 km long.

The east-west line orientation was selected based on the approximately north-south orientation of the Emu Fault, which believed to be one of the key controlling structures for Zn-Pb SHMS mineralisation in the Batten Trough.

The length of line was based on forward modelling of the interpreted architecture of the corridor to yield optimal fold coverage to image interpreted steep structures.

Survey Specifications

Please refer to Appendix 1 for specifications of the survey.

Figure 6 Fact geology and structure of the Yalco area showing the location of the two NTGS co-funded seismic lines.
Deliverables
In addition to the operations and processing report outlining the survey operations, logistics, and processing techniques and parameters, the data will be provided as ASCII data in ASEG-GDF format, as shown in Table 1. All digital data will be provided in a data pack separate to this report.

Table 1 Digital data

<table>
<thead>
<tr>
<th>Acquisition Deliverables</th>
<th>Processing Deliverables</th>
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<tr>
<td>• Positioning (survey report, system, equipment, mapping)</td>
<td>• Raw shot gathers in SEGY format with geometry (shot and receiver X, Y, Z and station number) and first break pick time in the trace headers</td>
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<tr>
<td>• Data Acquisition Report (recording system, equipment, layout, energy source, instrument and noise tests, recording parameters, up hole tests, other surveys undertaken)</td>
<td>• Stacked sections DMO, post-stack migration, pre-stack time migration in SEGY format</td>
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<td>• Observers log</td>
<td>• Final velocity functions SEGY (interpolated) and ASCII (individual functions)</td>
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<tr>
<td>• Surveyors report</td>
<td>• GLI3D geometry and report files (.geo and .rpt)</td>
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<tr>
<td>• Navigation data; and</td>
<td>• Processing report</td>
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<td>• QC Field Operations Report</td>
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6. RESULTS AND INTERPRETATION

Results

The key objective of the survey was to obtain high resolution data that can be used to image the architecture of the Emu fault corridor. Interpretations based on this information can then be used to support targeting framework studies. Figure 7 Pseudo-colour images of seismic lines 1 (top) and 2 (bottom) and Figure 8 Greyscale images of seismic lines 1 (top) and 2 (bottom).

Both sections returned relatively good data, although there is a considerable amount of noise in the section from line one.
The key observations from the 2015 seismic sections are:

- Multiple reflectors are present in the first line more than in the second line, the reasons being are yet to be determined;
- Seismic has resolved the dips of the eastern and western strands of the Emu Fault Corridor;
- In addition these provide good correlation between structures observable in other data sets e.g. aeromagnetics, ground gravity and landsat imagery;
- Stratigraphic relationships in the Emu Fault Corridor at depths below 400m are discernable;
- Variations in sub-basin development along the corridor are discernable e.g. Stratigraphic dips and thicknesses;
- Data quality below 1500m in both images is relatively poor.

*Figure 8* Greyscale images of seismic lines 1 (top) and 2 (bottom)
Interpretation

Although the processing of seismic data is still being refined it is possible to develop an interpretation of the corridor. The interpretation of the seismic data to date has focused on producing a structural and stratigraphic framework that can be used to identify and support targets within the Emu Fault Corridor. One of the key objectives of this process was to determine the presence and depth of the Barney Creek Formation in both sections.

Figure 9 shows interpreted versions of the two seismic lines. Average regional thicknesses of major stratigraphic units were used as a guide to define boundaries as changes in acoustic impedance do not always occur at unit boundaries. The survey confirmed the presence of significant BCF at depths <1km.

Section one contains what is interpreted as a package of BCF bounded by the eastern and western strands of the Emu Fault Zone. There is a suggestion that stratigraphic units of the upper Umbolooga Sub-group are thicker in this corridor relative to equivalent stratigraphy on the eastern side of the fault corridor. Stratigraphy through here appears to be relatively flat lying and indicating the corridor experienced weak inversion.

Section two shows a widening of the corridor and variations in stratigraphic thicknesses e.g. BCF, Reward and Lynott Formations. There is a suggestion of dip towards the western strand of the Emu Fault zone not observed in the first line.

The depth of the target BCF and the apparent thickness changes offer a clear target area of interest and will be the focus of further work in 2016.

Figure 9 Interpreted seismic lines 1 (top) and 2 (bottom)
7. CONCLUSION AND RECOMMENDATIONS

The survey has produced good quality seismic data, which has resolved some of the key questions regarding the architecture of the Emu Fault Corridor in the Yalco area.

Initial interpretations have indicated the presence of BCF at economically viable depths. This dataset has provided the impetus to further explore the corridor for SHMS systems, while constraining the window of further investigation.

While the seismic data for the two lines is relatively clear, additional processing may yield better results and help to resolve structural and stratigraphic relationships below 1500m more easily, which in turn could have implications for the overall tectonic history of the Emu Fault Zone.
8. REFERENCES


## APPENDIX 1 SEISMIC ACQUISITION PARAMETERS

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<td>Erick Adam (Wolf Geophysics)</td>
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### Geophysics and Drilling Collaborations

#### Proposal Cover Sheet

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<th>Project title</th>
<th>Yalco Project</th>
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<tr>
<td>Applicant (Company Name)</td>
<td>Teck Australia Pty Ltd</td>
</tr>
<tr>
<td>Applicant ABN</td>
<td>35 091 271 911</td>
</tr>
<tr>
<td>Applicant postal address</td>
<td>Level 2, 35 Ventnor Ave, West Perth WA 6005</td>
</tr>
<tr>
<td>Contact officer</td>
<td>Mike Taylor</td>
</tr>
<tr>
<td>Contact phone number</td>
<td>08 9321 4936</td>
</tr>
<tr>
<td>Contact fax number</td>
<td>08 9321 4766</td>
</tr>
<tr>
<td>Contact email address</td>
<td><a href="mailto:mike.taylor@teck.com">mike.taylor@teck.com</a></td>
</tr>
<tr>
<td>Granted exploration licence number(s) where this proposal is to be undertaken</td>
<td>EL25467 and EL29021</td>
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<td>2D Seismic Reflection Survey</td>
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<td>Michael Taylor Manager, Exploration - Australia</td>
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<td>Signature of applicant</td>
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