Early Cave Management at the Carrapateena Sublevel Cave
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October 2018
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All figures are expressed in Australian dollars unless stated otherwise.
Compliance Statements

Carrapateena Production Targets Cautionary Statement

Production targets for Carrapateena are based on:

Probable Ore Reserves: 94%
Inferred Mineral Resources: 6%

There is a low level of geological confidence associated with Inferred Mineral Resources. There is no certainty that further exploration work and studies will result in the determination of Inferred Mineral Resources or that the production targets will be realised.

The Ore Reserve and Mineral Resource estimates underpinning the production targets were prepared by a Competent Person in accordance with the JORC Code 2012. The material assumptions used in the estimation of the production targets and associated financial information referred to in this presentation can be found in the Carrapateena Feasibility Study Update released on 24 August 2017, the Restated 2016 Carrapateena Mineral Resource Statement as at 18 November 2016 released on 9 December 2016, and the Carrapateena Ore Reserve Statement as at 4 August 2017 released on 24 August 2017.

Carrapateena Resources and Reserves

The information on the 134 Mt Carrapateena Mineral Resource in this presentation is extracted from the document entitled “Carrapateena Project Mineral Resource Statement and Explanatory Notes as at 18 November 2016" released on 9 December 2016 and available at www.ozminerals.com/media/asx. OZ Minerals confirms that it is not aware of any new information or data that materially affects the information included in the original market announcement and, in the case of estimates of Mineral Resources, that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. OZ Minerals confirms that the form and context in which the Competent Person’s findings are presented have not been materially modified from the original market announcement.

The information on Carrapateena Ore Reserves in this presentation is extracted from the document entitled “Carrapateena Project Ore Reserve Statement and Explanatory Notes as at 4 August 2017” released on 24 August 2017 and available at www.ozminerals.com/media/asx. OZ Minerals confirms that it is not aware of any new information or data that materially affects the information included in the original market announcement and, in the case of estimates of Mineral Resources, that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. OZ Minerals confirms that the form and context in which the Competent Person’s findings are presented have not been materially modified from the original market announcement.
Operations, projects and pipeline of opportunities
Carrapateena
Copper gold project

- One of Australia’s largest undeveloped copper deposits; regional South Australia
- Iron oxide copper-gold deposit located about 500 m below the surface
- Underground sublevel cave mine, initial 20 year mine life
- Infrastructure onsite includes a processing plant, tailings storage facility, airstrip and village
Early Cave Management at the Carrapateena Mine

Managing caving hazards – fines generation

Understanding the orebody and cover sequence material

Methodology used for modelling of fines ingress

Discussion on cave markers and their placement

Understanding and managing water ingress into the cave zone

Draw control decisions during ramp-up and mining
Carrapateena Sublevel Cave
Understanding the Cover Sequence

UCS: 114MPa
UCS: 87MPa
UCS: 50MPa
UCS: 90MPa
UCS: 141MPa
UCS: 121MPa
UCS: 34MPa
UCS: 125MPa
UCS: 80MPa
UCS: 121MPa Dolomite
UCS: 141MPa
UCS: 34MPa
UCS: 80MPa
UCS: 121MPa Dolomite
UCS: 125MPa
UCS: 80MPa
UCS: 121MPa Dolomite
UCS: 125MPa
UCS: 114MPa
Carrapateena Sublevel Cave

Cover sequence

/ Woomera Shale:
  – GSI 30
  – UCS 50MPa
  – UTS 7.5MPa
  – High clay fraction to fine grained silts

/ Lower Whyalla Sandstone
  – GSI 66
  – UCS 34MPa
  – UTS 2.5MPa
  – Small size aeolian sands
Carrapateena Sublevel Cave

Groundwater

- Tent Hill Aquifer: 1 L/s
- Whyalla Sandstone Aquifer: 7-8 L/s
Carrapateena Sublevel Cave

Early cave management

/ Mud rush conditions:
  – fine material
  – water
  – trigger

/ Carrapateena:
  – Mud forming material (fine fragmentation)
    Woomera Shale
    Lower Whyalla Sandstone
  – Water (rainfall or ground water)
    Tent Hill Aquifer
    Lower Whyalla Aquifer
  – Triggering mechanism (uneven draw or seismic event)
Estimating fines generation

Site test

Impact (energy)
Estimating fines generation

Site test

Impact (energy)

Self similar (Awachie 1983)
- Each size fraction of fines can be described by a family of curves
Estimating fines generation

Site test

/ 22 rpm
/ Height drop 0.4m
/ 5 minutes = energy dropping from 44m = 0.12 Kwh/tonne
Estimating fines generation

Site test

/ Self similar relation ship holds for our test work
/ At low energies breakage is linear
Estimating fines generation

Site test results

% Rock Broken down to <1mm Material

Minutes Material in Cement Mixer
Estimating fines generation

Site test results

% Rock Broken down to <1mm Material

Minutes Material in Cement Mixer

0% 10% 20% 30% 40% 50% 60% 70% 80%

0 5 10 15 20 25

Mid Upper shale
Shale Upper
Shale Lower
Lower Whyalla
Conglomerate
Ore
Estimating fines generation

Site test results

% Rock Broken down to <1mm Material vs Minutes Material in Cement Mixer

- Shale
- Conglomerate
- Ore

- Mid Upper shale
- Shale Upper
- Shale Lower
- Conglomerate
- Ore
Estimating fines flow

Site test results

Lower Whyalla Sandstone

Woomera Shale

P A G E 1 8 /
Further work

/ Markers
   – Calibrate cave flow
   – Predicting/calibrating fines propagation

/ Rock Properties
   – Further testing
   – Woomera Shale

/ Management Plans
   – Operational Readiness
   – Trigger Action Response Plans
Markers
Planned instrumentation

/ Elexon smart markers
/ Elexon cave tracker markers and beacons
/ Metso ore tracker markers
/ Grade and lithology markers
Rock categorisation

Further work

/ Cover sequence will break up more than the ore
/ Fine material propagates faster
/ If unmanaged, this will be a problem
/ Further test work and monitoring
Data collection

Further work

Data collection during production:

/ Marker data
/ Mineralogical makeup
/ Fragmentation
/ Water balance
/ Track water through cave
/ Pumping data, rainfall data correlation
/ Cave geometry and subsidence zone
**Further work**

Development of trigger action response plans

/ **TARPS**  
/ **Draw control**

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### Material size > 5cm (M)

<table>
<thead>
<tr>
<th>Wetness/water content</th>
<th>M &gt; 70% (coarse)</th>
<th>30% &lt; M &lt; 70%</th>
<th>M &lt; 30% (dominated by fine grain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 8.5% (dry)</td>
<td>A1</td>
<td>B1</td>
<td>C1</td>
</tr>
<tr>
<td>8.5~11% moist</td>
<td>A2</td>
<td>B2</td>
<td>C2</td>
</tr>
<tr>
<td>≥ 11% wet</td>
<td>A3</td>
<td>B3</td>
<td>C3</td>
</tr>
</tbody>
</table>

Green = any loader. Yellow = any loader with supervision. Red = automated loader

Deep Ore Zone wet muck classification (Widijanto et al. 2012)
Carrapateena Sublevel Cave

Cave management

/ Potential Risk: fines generation
/ Potential Risk: mud rush
/ Monitoring
   – Markers
   – Ongoing testing
   – Management plans
Thank you