



Aurora Tank Gold

Excellent Column Leach results point to Heap Leach pathway

Marmota Limited (ASX: MEU) ("Marmota")

Background

- Marmota previously carried out **bottle roll** metallurgical tests to provide an estimate of gold recoveries that may be achievable by processing ore **through a mill**. The bottle roll tests for Aurora Tank ore consistently returned excellent gold recovery rates over 90% ¹ [ASX:MEU 30 Oct 2017 and 20 Aug 2018] .
- If favourable metallurgical conditions exist, it is also sometimes possible to commercially process ore *without the expense* and complications of a mill, using instead a much simpler cheaper **heap leaching** process. The trade-off is that gold recoveries using a heap leach can be much lower than via using a specialised mill, while the upside is that the cost of building and/or operating a mill can be avoided. A **column leach** test is used to estimate gold recoveries from a **heap leach** process.

First Column Leach Test yields excellent gold recoveries

- Marmota is very pleased to announce that the first **column leach** test, carried out by Bureau Veritas, using diamond core ore sampled from Aurora Tank, has **returned excellent gold recoveries of 83%** ... which is considered very high by industry standards for column leach metallurgy.
- **Figure 1** summarises the leach performance over time.

¹ Phase 2 combined gravity recoverable gold and cyanide leaching tests.

Gold recoveries vs Time

Column Leach Performance

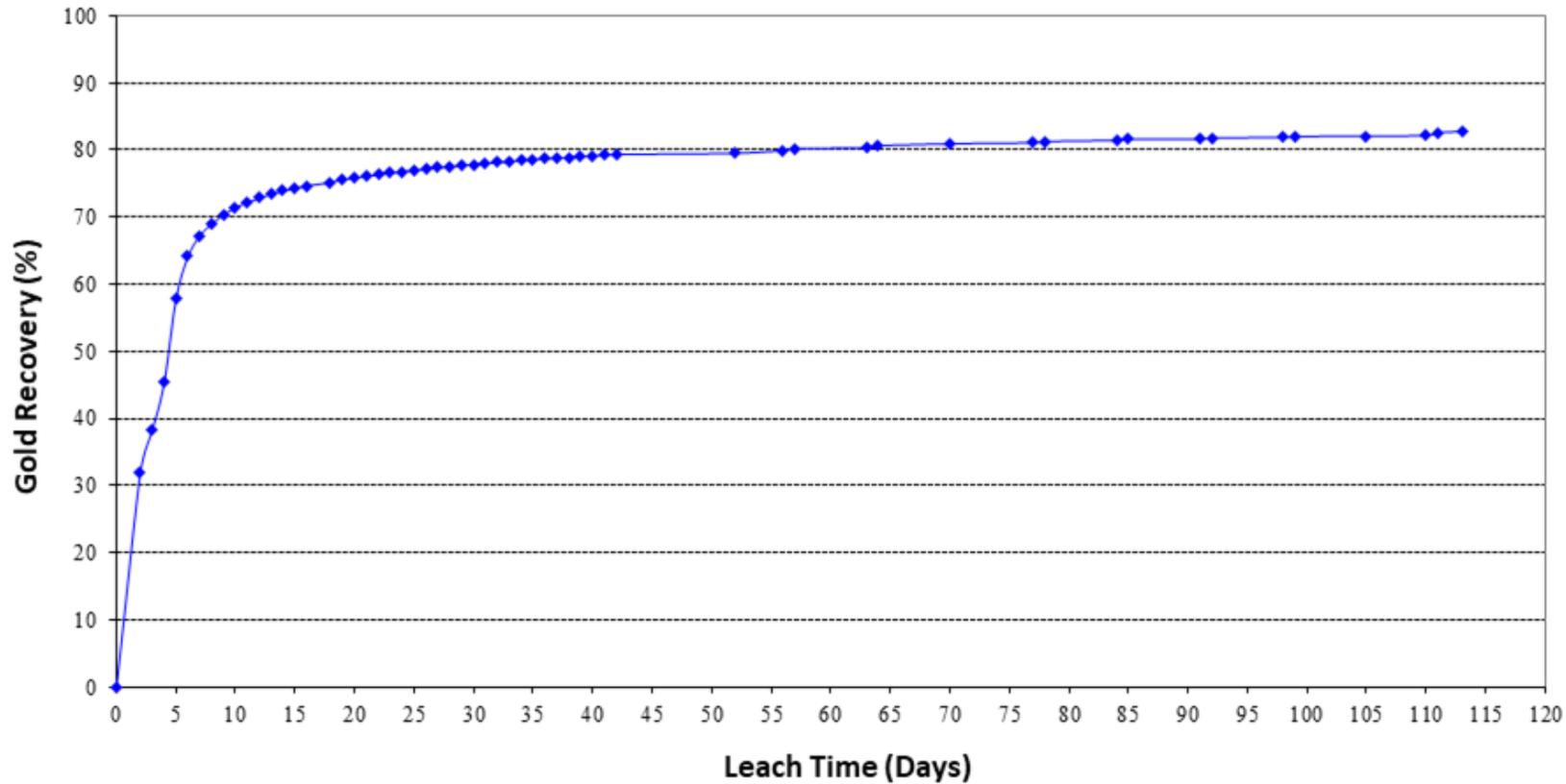


Figure 1: Column Leach Gold recoveries (with 9kg binder) vs time

HIGHLIGHTS

- Initial column leach tests have shown that Aurora Tank gold is readily recoverable by cyanide leaching of ore
- Gold recovery over 80% is considered very high by industry standards for gold heap leach operations
- The amenability of gold recovery at Aurora Tank by heap leaching methods is considered likely to be feasible
- Further scope:
 - a) Tests have *not yet been optimised for crush size*
 - b) Recoveries appear to be still increasing when the test period terminated

Background: Metallurgical Analysis on Aurora Tank ore

Phase 1 metallurgy

- Marmota reported excellent results from its Phase 1 metallurgical testwork at the Aurora Tank Gold discovery in October 2017 [ASX:MEU [27 Oct 2017](#)]. The three samples tested from the June/July 2017 percussion drilling program gave gold recoveries of 94 to 97% in **bottle roll** tests.
- To enable detailed metallurgy, a six-hole diamond drill program was carried out in November 2017 [ASX:MEU [20 Nov 2017](#)] to collect core.

Phase 2 metallurgy

- Results of the Phase 2 metallurgical test work [ASX:MEU [20 Aug 2018](#)] showed that gold particles are generally fine grained in the 5-50 micron size range and **bottle roll** tests on variable grind sizes gave recoveries of 89 to 92%.
- Phase 2 'intermittent bottle roll' tests on coarse samples gave recoveries of 82-89% suggesting that heap leaching is an option worth investigating at Aurora Tank.

Phase 3 metallurgy

- Phase 3 metallurgical **Column Leach** testwork is reported here.

Aims of Column Leach Testwork

Aims of the column leach testwork were to investigate the amenability of a typical sample of Aurora Tank mineralisation to gold recovery by heap leaching methods. On the prepared sample, a series of tests were conducted including: bulk leach extractable gold (BLEG), particle size distribution, percolation and column leaching.

Results of Column Leach Testwork

Sample preparation

The sample was a reasonably representative composite of 80kg of remaining quarter diamond drill core from the six diamond holes drilled in November 2017 [see [Fig. 2](#): holes numbered 1 to 6], with head assay of 1.93g/t. The composite sample was crushed to pass through a relatively coarse 12.5mm sieve and homogenised. All testwork was carried out by Bureau Veritas Laboratory in Adelaide.

Bulk leach extractable gold (BLEG)

A BLEG test was performed on a pulverised sample to indicate the maximum leachable gold and to show if there was unrecoverable or refractory gold. The BLEG test showed a gold recovery of 90%.

Particle size distribution

A particle size distribution and size-by-size gold analysis was performed on both the head (original sample) and residue (after leaching) samples. As expected, this showed that the maximum recovery occurred in the finer fractions and the poorest recovery in the coarser size fractions.

Percolation tests

Percolation tests measure the ability of leach solution to percolate through the sample. The addition of a Portland Cement binder was used in pre heap leach pelletising with the aim to improve percolation rates. Three tests were performed with varying binder concentrations: (a) no binder, (b) 3 kg/t binder, and (c) 9 kg/t binder. The best two results were with no binder and with 9 kg/t binder addition. These conditions were used for the two column leach tests completed.

Column leaching tests

Due to the relatively small sample sizes, 150mm diameter columns were filled to an initial height of one metre. The tests were set at a solution application rate of 10 L/h/m². After the first 10 days of operation, the results showed a recovery of approximately 60% for the no binder column and approximately 70% for the 9 kg/t column. Final recoveries were 76% and 83% for the no binder column and 9 kg/t column respectively. Cyanide consumptions were 2.9 kg/t and 4.1 kg/t respectively.

Column leach performance for the 9 kg/t binder column is shown in [Figure 1](#).

All column leach tests were conducted with a common coarse crush size of 12.5mm.

The tests have not yet been optimised for varying the crush size.

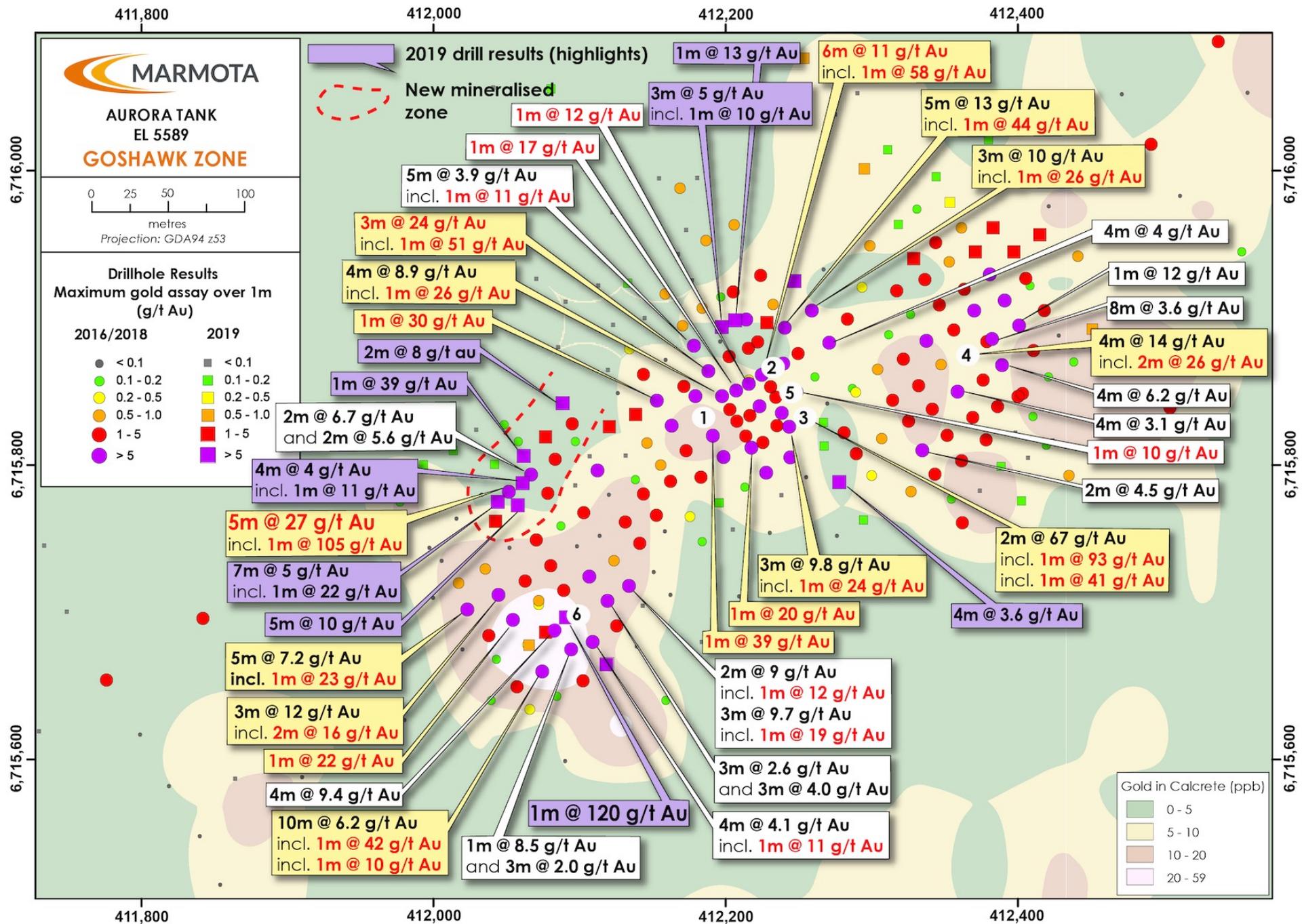


Figure 2: Aurora Tank: Location of Metallurgical Samples (numbered 1 to 6) + Best downhole gold results

Implications of Column Leach Testwork

The Column Leach test program has shown that gold in the ore samples tested is readily leachable. Gold recoveries over 80% for column leach tests are considered very high by industry standards for gold heap leach operations.

Further column leaching testwork may further optimise the results and should consider:

- The effect of different crush sizes (including not crushing the ore at all)
- The effect of particle size on gold recovery, and
- The effect on recovery on samples from different parts of the orebody

Comment

Marmota Chairman, Dr Colin Rose, said:

“ Marmota has been investigating the optimal pathway to production at Aurora Tank. The excellent column leach test gold recoveries suggest that Aurora Tank is amenable to low-cost low-capex heap leach techniques. A heap leach would mean that Marmota would not need to construct a mill, nor share revenue with external parties for toll treatment in a mill. This is a highly desirable outcome for both the Company and our shareholders. ”

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About Marmota Limited

Marmota Limited (ASX: MEU) is a South Australian mining exploration company, focused on gold, copper and uranium. Gold exploration is centred on the Company's dominant tenement holding in the highly prospective and significantly underexplored Gawler Craton, near the Challenger gold mine, in the Woomera Prohibited Defence Area. The Company's copper project is based at the Melton project on the Yorke Peninsula. The Company's uranium project is at Junction Dam adjacent to the Honeymoon mine.

For more information, please visit: www.marmota.com.au

Competent Persons Statement

Information in this Release relating to Exploration Results is based on information compiled by Dr Kevin Wills, who is a Fellow of the Australasian Institute of Mining and Metallurgy. He has sufficient experience which is relevant to the styles of mineralisation, metallurgical testwork and types of deposits under consideration and to the activities being undertaken to qualify as a Competent Person as defined in the 2012 Edition of the "Australasian Code of Reporting of Exploration Results, Mineral Resources and Ore Reserves." Dr Wills consents to the inclusion in this report of the matters based on his information in the form and context in which it appears.

Where results from previous announcements are quoted, Marmota confirms that it is not aware of any new information or data that materially affects the information included in the relevant 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.

APPENDIX 1

JORC Code, 2012 Edition – Table 1 report

Section 1 Sampling Techniques and Data

(Criteria in this section apply to all succeeding sections.)

Criteria	JORC Code explanation	Commentary
Sampling techniques	<ul style="list-style-type: none"> <i>Nature and quality of sampling (e.g. cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling.</i> <i>Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.</i> <i>Aspects of the determination of mineralisation that are Material to the Public Report.</i> <i>In cases where 'industry standard' work has been done this would be relatively simple (e.g. 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (e.g. submarine nodules) may warrant disclosure of detailed information.</i> 	<ul style="list-style-type: none"> 6 diamond drill holes were drilled to collect HQ3 core samples from the Goshawk prospect area in November 2017. Quarter core samples were collected for initial assay at 1m average intervals using a brick cutting saw. Sample length only deviated where it was required to compensate for core loss. Metallurgical samples for column leach tests were collected from intervals of interest by sampling of remnant core that was left after the sample assaying work was carried out.
Drilling techniques	<ul style="list-style-type: none"> <i>Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).</i> 	<ul style="list-style-type: none"> Drill method consists of HQ triple tube at an inclination of 60 degrees. Hole diameters are 149 mm.
Drill sample recovery	<ul style="list-style-type: none"> <i>Method of recording and assessing core and chip sample recoveries and results assessed.</i> <i>Measures taken to maximise sample recovery and ensure representative nature of the samples.</i> <i>Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.</i> 	<ul style="list-style-type: none"> Core was logged and sample recovery estimated on site by a geologist. Qualitative assessment of sample recovery was recorded. Additional measures were used in the field to try and improve recovery including but not restricted to the use of muds to firm up core. Sample recoveries were low at intermittent intervals and core loss is reported. It is likely that some mineralised intervals were not recovered.

Criteria	JORC Code explanation	Commentary
Logging	<ul style="list-style-type: none"> • Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies. • Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography. • The total length and percentage of the relevant intersections logged. 	<ul style="list-style-type: none"> • All samples were geologically logged by the on-site geologist. The holes have not been geotechnically logged. • Geological logging is qualitative. • Core Trays were photographed at the completion of the exploration program prior to core cutting. • 100% of any previously reported intersections have had geological logging completed.
Sub-sampling techniques and sample preparation	<ul style="list-style-type: none"> • If core, whether cut or sawn and whether quarter, half or all core taken. • If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry. • For all sample types, the nature, quality and appropriateness of the sample preparation technique. • Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples. • Measures taken to ensure that the sampling is representative of the in situ material collected, including for instance results for field duplicate/second-half sampling. • Whether sample sizes are appropriate to the grain size of the material being sampled. 	<ul style="list-style-type: none"> • Initial sub-sampling techniques, prior to metallurgical sampling were as follows: • 1m (average) samples averaging 1 kg were collected for laboratory assay. ¼ core samples were collected by cutting with a brick saw. • Laboratory sample preparation includes drying then pulverizing of submitted sample to target of p80 at 75 um. • No samples checked for size after pulverizing failed to meet sizing target in the sample batches relevant to the report. • Samples were digested for both Aqua Regia and Fire Assay. Both control and duplicate samples were introduced by the Company, while the laboratory completed repeat assays on various samples. • Standard samples were also introduced into the sample stream by the laboratory. • Both Company and laboratory introduced duplicate samples indicate acceptable analytical accuracy and precision. • Laboratory analytical charge sizes are standard sizes and considered adequate for the material being assayed.
Quality of assay data and laboratory tests	<ul style="list-style-type: none"> • The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total. • For geophysical tools, spectrometers, handheld XRF instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc. • Nature of quality control procedures adopted (eg standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (ie lack of bias) and precision have been established. 	<ul style="list-style-type: none"> • Bureau Veritas Minerals in Adelaide was used for analytical work. Samples were analysed in the following manner: <ul style="list-style-type: none"> ○ Aqua Regia Digest. Analysed by Inductively Coupled Plasma Mass Spectrometry for Au, Ag, As, Cu, B and S ○ Fire Assay was Analysed by Inductively Coupled Plasma Mass Spectrometry for Au • For laboratory samples, the Company analysed each sample using two different digest methods and the same analytical method to determine precision of results. The laboratory introduced additional QA/QC samples (blanks, standards, checks) at a ratio of greater than 1 QA/QC sample for every 10 drill samples. • Both the Company and laboratory introduced QA/QC samples which indicate that acceptable levels of accuracy and precision have been established.
Verification of sampling and assaying	<ul style="list-style-type: none"> • The verification of significant intersections by either independent or alternative company personnel. • The use of twinned holes. • Documentation of primary data, data entry procedures, data 	<ul style="list-style-type: none"> • A Company geologist has checked the calculation of the quoted intersections in addition to the Competent Person. • No adjustments have been made to the assay data.

Criteria	JORC Code explanation	Commentary
	<p>verification, data storage (physical and electronic) protocols.</p> <ul style="list-style-type: none"> • Discuss any adjustment to assay data. 	
Location of data points	<ul style="list-style-type: none"> • Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation. • Specification of the grid system used. • Quality and adequacy of topographic control. 	<ul style="list-style-type: none"> • Drill hole coordinate information was collected using a digital GPS system with an autonomous accuracy of +/-0.5 metres utilising GDA 94 Zone 53. • Area is proximately flat lying and topographic control uses SRTM 90 DEM.
Data spacing and distribution	<ul style="list-style-type: none"> • Data spacing for reporting of Exploration Results. • Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied. • Whether sample compositing has been applied. 	<ul style="list-style-type: none"> • Drill holes were advanced along traverses setup perpendicular to the orientation of the geochemical anomaly.
Orientation of data in relation to geological structure	<ul style="list-style-type: none"> • Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type. • If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material. 	<ul style="list-style-type: none"> • Drill lines were orientated to cover previously drilled mineralisation and traverses crossed the width of the mineralised zone, therefore a sampling bias should not have occurred.
Sample security	<ul style="list-style-type: none"> • The measures taken to ensure sample security. 	<ul style="list-style-type: none"> • Metallurgical Samples were cut and transported to the laboratory by Marmota and Challenger Geological Services staff.
Audits or reviews	<ul style="list-style-type: none"> • The results of any audits or reviews of sampling techniques and data. 	<ul style="list-style-type: none"> • No audit of data has been completed to date.

Section 2 Reporting of Exploration Results

(Criteria listed in the preceding section also apply to this section)

Criteria	JORC Code explanation	Commentary
Mineral tenement and land tenure status	<ul style="list-style-type: none"> Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings. The security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area. 	<ul style="list-style-type: none"> Aurora Tank (EL 5589) is 100% owned by Marmota Limited. EL 5589 is located approximately 100 km southwest of Coober Pedy in South Australia. There are no third-party agreements, non-government royalties, historical sites or environmental issues. Exploration is conducted within lands of the Antakirinja Matu-Yankunyjatjara Native Title Determination Area. The tenement is in good standing.
Exploration done by other parties	<ul style="list-style-type: none"> Acknowledgment and appraisal of exploration by other parties. 	<ul style="list-style-type: none"> Exploration in the Commonwealth Hill region has been carried out by a number of exploration companies previously including; <ul style="list-style-type: none"> Kennecott Explorations (Australia) Pty Ltd (1968-69) Dampier Mining Co. Ltd (1978-79) Afmeco Pty Ltd (1980-83) Stockdale Prospecting Ltd (1986-87) SADME (1996-97) Minotaur Gold NL (1993-99) Redport Ltd (1997-2002) Apollo Minerals (2013-15)
Geology	<ul style="list-style-type: none"> Deposit type, geological setting and style of mineralisation. 	<ul style="list-style-type: none"> The Goshawk zone of Aurora Tank is situated in the Christie Domain of the western Gawler Craton. The Christie Domain is largely underlain by late Archaean Mulgathing Complex which comprises of meta-sedimentary successions interlayered with Banded Iron Formations (BIF), chert, carbonates and calc-silicates. Marmota is targeting Challenger-style Late Archaean gold whilst being open for occurrence of a variety of other mineralisation styles which may also exist in the tenement area.
Drill hole Information	<ul style="list-style-type: none"> A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes: <ul style="list-style-type: none"> easting and northing of the drill hole collar elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar dip and azimuth of the hole down hole length and interception depth hole length. If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case. 	<ul style="list-style-type: none"> Drill hole locations are shown on Figure 2 of the attached announcement

Criteria	JORC Code explanation	Commentary
Data aggregation methods	<ul style="list-style-type: none"> <i>In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (eg cutting of high grades) and cut-off grades are usually Material and should be stated.</i> <i>Where aggregate intercepts incorporate short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.</i> 	<ul style="list-style-type: none"> Any assay intersections are calculated by simple averaging of 1 m assays. In situations where core loss occurred within mineralised intervals, weighted averages have been applied. No metal equivalents are reported.
Relationship between mineralisation widths and intercept lengths	<ul style="list-style-type: none"> <i>These relationships are particularly important in the reporting of Exploration Results.</i> <i>If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.</i> <i>If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (eg 'down hole length, true width not known').</i> 	<ul style="list-style-type: none"> Drill coverage is not currently considered sufficient to establish true widths due to uncertainty regarding mineralisation dip and strike. Mineralisation intersections are downhole lengths; true width is unknown.
Diagrams	<ul style="list-style-type: none"> <i>Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported. These should include, but not be limited to a plan view of drill hole collar locations and appropriate sectional views.</i> 	<ul style="list-style-type: none"> See Figures in release attached.
Balanced reporting	<ul style="list-style-type: none"> <i>Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.</i> 	<ul style="list-style-type: none"> Cut-off of 1.0 g/t gold was applied in reviewing assay results and deemed to be appropriate at this stage in reporting of exploration results. Reporting is considered balanced.
Other substantive exploration data	<ul style="list-style-type: none"> <i>Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.</i> 	<ul style="list-style-type: none"> See attached ASX Release. Geological observations are included in that report. Preliminary metallurgical testwork was previously carried out. This consisted of 48 hour cyanide leach bottle rolls which were sampled for assay at intervals of 2, 6, 24 and 48 hours. The solid tailings were filtered, washed and dried and submitted for assay. Results were plotted on gold recoveries versus leach time graphs. The metallurgical work reported in this release was column leach testing and associated tests.
Further work	<ul style="list-style-type: none"> <i>The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large-scale step-out drilling).</i> <i>Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.</i> 	<ul style="list-style-type: none"> Marmota is currently reviewing results from this testwork and considering additional work programs including new diamond drilling of mineralised zones to collect additional metallurgical samples for more detailed analysis.