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Jebel Ohier Cu-Au Porphyry project

Mineral Resource Statement

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QMSD Mining Co. Ltd (QMSD)
Red-Sea Hills state
Rep. of the Sudan

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Arethuse Geology Sarl, Aix en Provence, France

1. Introduction

ARETHUSE GEOLOGY (ARETHUSE) was requested by QMSD to carry out a maiden Mineral Resource Estimate (MRe) of the Jebel Ohier Cu-Au porphyry deposit in accordance with classification criteria defined by *Definition Standards for Mineral Resources and Mineral Reserves Guidelines* adopted by CIM utilized by NI 43-101. The Jebel Ohier porphyry Cu deposit (JO PCD) is at a preliminary Resource exploration stage.

2. Geological context and model

The JO PCD is located on the Block 62 exploration license in Red Sea State, Sudan, 200km west of Port Sudan. The block is underlain by the highly prospective and underexplored Neoproterozoic Arabian Nubian Shield (ANS). The ANS is an accretionary orogenic belt made up of a series of predominantly juvenile intra-oceanic island arcs and micro-continental masses, which extend along both sides of the Red Sea to Ethiopia and Yemen. In the JO prospect area, the geology is characterized by volcano-intrusive units, which range in composition from (sub-alkaline) gabbroic to granodioritic-dacitic. This ore-forming porphyry complex was emplaced into an older (pre-mineralization) andesitic to dacitic, and in places tuffaceous, volcanic sequence.

The presence of Cu oxide mineralization at JO was initially described by Bureau de Recherches Géologiques et Minières (BRGM) in the 1980's, and then subsequently by Anglo-American and the Geological Research Authority of Sudan (GRAS). QMSD licensed the property in April 2013, commencing systematic exploration over Block 62 later the same year. Since 2014 QMSD has carried out a detailed trenching and drilling program, coupled with extensive road-cut sampling and surface mapping, on the JO PCD and satellite bodies. The maiden MRe incorporates the results from the first 20 core (DD) holes with a typical depth of 500m, and 85 Reverse Circulation (RC) holes with a typical depth of 180m. Trenches and road-cuts were sampled by way of continuous chip/channel sampling along marked lines. The assay data were used for geological and mineral deposit modelling purposes but were not deemed sufficiently robust for grade interpolation.

A 3D model of JO has been developed by QMSD and their Consultants:

- Mineralization is associated with two distinct centers which show well-developed alteration halos;
- Alteration patterns suggest a vertical zonation from a potassic high-temperature core at depth to a mineralized stockwork zone nearer the surface, as well as lateral alteration zones from high-temperature potassic to lower temperature sericitic and propylitic.

The main alteration and mineralization zones have been simplified as follow:

- Domain 1: high density core of A, B and sulphide-only C veins, surrounded by;
- Domain 2: lower density network of A, B and sulphide-only C veins ± anhydrite veins;
- Domain 3: below Domains 1 and 2, grades generally below 0.1% Cu with the mineralization present as predominantly disseminated chalcopyrite/pyrite accompanied by anhydrite veining;
- Domain 4: diminishing sulphide contents, magnetite and biotite present;
- Laterally, a barren quartz-silica-pyrite zone (with D veins) is present.

Three distinct diorite intrusive phases related to the mineralization event have been logged:

- 'ID': pre-mineralization, highly mineralized and altered;
- 'ID2': syn-mineralization, moderately mineralized and altered;
- 'ID2?': post-mineralization, barren.

Most of the Cu mineralization is associated with chalcopyrite, in veins or disseminated, although bornite is present locally in the richer parts of the deposit.

Weathering has oxidized the deposit to a depth of 50m to 150m. The oxidation process has altered the chalcopyrite mineralization to chrysocolla, which has been redistributed across the oxide zone. There is no clear supergene enrichment zone although there are indications in places of grade enrichment between the upper oxide and lower sulphide zones.

The whole system has been intruded by a series of barren, intermediate to mafic dykes, with a variety of textures and compositions. These dykes are oriented NE or NW (for practical modeling purposes all dykes were considered as being related to the same event). A number of attempts were made to wireframe the dykes but these were unsuccessful owing to insufficient data. For Resource estimation purposes a probabilistic approach was adopted and dyke proportions within each block were estimated by way of indicator kriging. This allowed for the true proportion of ore and waste for each domain to be determined, without having knowledge of the exact position of dyke material within each block. The proportion estimated by indicator kriging was considered a better and more practical approach than a biased 3D interpretation based on a sparse exploration dataset.

Dyke proportions within the sulphide zone were estimated at 49% using this process. The dykes in the oxide zone have been mineralized owing to remobilization of ore elements during weathering – consequently, dyke proportions in the oxidized zone were not estimated as this material was included in the Resource estimate. ID2? lithologies were modelled together with the later mafic dykes, again for practical purposes.

3. Field work review

Exploration practices were reviewed during site visits by Arethuse principal Remi Bosc in 2015, 2016 and 2017. Remi Bosc is a Member of the European Federation of Geologists and is independent from QMSD. Remi Bosc is a “Qualified Person” as set out in NI 43-101. An investigation of the data (in conjunction with the site visits) confirmed the prevailing geological PCD model.

Drilling of both RC and DD holes was undertaken in line with industry standards. Drillholes are carefully set-up and continuously monitored. The holes are scrutinized for depth and deviation, sample quality, and conformity with the geological target being sought. Drilling operations are supervised by a trained and experienced rig geologist, under the supervision of a Senior Geologist. Drill sites were visited several times by Arethuse’s competent person and processes and procedures were deemed adequate for the MRe.

Drillholes, trenches and road-cuts were continuously sampled, and all samples were correctly recorded prior to submission for assay. The sample preparation and sample management workshop is well organized and streamlined to a very high standard.

Duplicates, standards (CRMs) and blanks are inserted into the sample stream with sufficient frequency to ensure full compliance with QAQC requirements. Sample duplicates are archived, and core boxes are stored in a well-established storage system. Coarse rejects of core samples are kept for QAQC purposes.

Samples are submitted to ALS Romania for assay via a robust sample-chain-of-custody process. Initially samples were assayed by way of ICP after aqua regia dissolution. From May 2017 the assay method shifted to a four acid attack followed by ICP analyses as this method was determined more efficient. Au was assayed by fire assay with atomic absorption or ICP finish.

Reference points for topographical surveys were established by a Khartoum-based surveying company in 2015. The DTM was completed by processing stereoscopic satellite imageries using a well-regarded service provider. Drill collars, trenches and road-cuts were subsequently surveyed using the same reference points.

Core logging was initially undertaken using standard lithology coding and description techniques but was progressively superseded by a custom-designed Anaconda-style logging procedure. All RC holes and earlier DD holes have been re-logged to Anaconda standards. Structures and geotechnical data are systematically logged.

Data are collected on paper logs, and provided to a site-based database geologist for input into the database. All paper logs are scanned and archived both physically and digitally. Data are sent daily to Khartoum, and then from Khartoum to Doha. Two database managers independently verify the data for accuracy and consistency. The data is then sent to an external database manager (CSA Global, Australia) via a secure channel who perform advanced database checking and store QMSD's data in a Datashed database. Data handling is of a very high standard and the data are securely managed.

Standard Operating Procedures covering all aspects of the exploration process have been comprehensively documented and the procedures are closely followed by field staff.

4. QAQC

The whole QC process is closely monitored by QMSD's exploration manager, as well as by the Database Managers and CSA. QAQC reports are produced monthly.

CRM accuracy plots from CSA were checked by the Qualified Person. Most show good accuracy with little or no bias. The variance around the expected value is generally very low. A few CRM issues were identified but these were related either to sample mislabeling, or as being too close to the detection limit to be significant. Duplicate samples were mostly field duplicates. No material QC failures were reported from these samples.

In 2016, QMSD conducted a one-off check assay program using Perth-based Bureau Veritas. The check assay program confirmed the quality of the original assays. In addition, QMSD implemented a twin-hole drilling program – RC-RC and RC-DD. Results were comparable for both Cu and Au and the outcome of the drilling confirmed assay results and geological interpretations.

Downhole surveys have been systematically undertaken since the commencement of the Phase 2 RC and Phase 1 DD drilling campaigns. The surveys showed some discrepancy with the initial collar compass setup readings. A second probe brought to site confirmed the first deviation probe readings. Consequently, all early RC and DD drillholes that were not surveyed were verified by the probes at a depth of 5m. The initial compass readings proved to be erroneous and these were subsequently corrected.

5. Data analysis, variography and Resource estimation

Arethuse used 2m composites of DD and RC samples for Resource estimation purposes. Correlation matrices were computed using the 2m composites in order to test the potential for cross-variography. A much stronger correlation was noted in the sulphide zone compared to the oxide zone confirming the mobility of elements during the oxidizing process. There is good correlation between Cu and Au, and also between Mo, Ag and Co. Consequently, the main ore element grades (i.e. Cu and Au) were estimated by way of ordinary kriging and co-kriging of the five well-correlated elements. Ag, Mo and Co grades and contents were also estimated, but were deemed too low to be reported in the Resource statement.

Multivariate variographic analysis was conducted on composited samples allowing for the use of co-kriging techniques. Experimental variograms were calculated separately for each domain: D1, D2 and D3. The nugget effect was determined using the downhole variography and anisotropic experimental variograms were then generated in 3D XYZ space. Based on the variogram map computed on Cu, a principal orientation of N050 (roughly parallel to the dominant dyke direction) was chosen for the variogram analysis. The modelled variograms were all spherical, with two nested structures and a nugget.

For D1 and D2 oxide an anisotropic variogram model was computed with ranges of 120m/35m/35m for the first structure and 450m/350m/70m for the second structure. For D1 Sulphide an anisotropic variogram model was computed with ranges of 115m/50m/55m for the first structure and 500m/70m/500m for the second structure. For D2 Sulphide an anisotropic variogram model was computed with ranges of 130m/35m/125m for the first structure and 350m/350m/500m for the second structure. For D3 Sulphide the available data only allowed for the modelling of omnidirectional variograms with structure ranges of 40m and 180m, respectively.

Grades were estimated within domains D1, D2 and D3 using co-kriging or ordinary kriging when possible, and by inverse-square distance elsewhere. Grades were estimated using 2m composited samples from drillholes only. Trench samples were not used for grade estimation as the sampling, although carefully carried out, carried a high variability risk, compared to drillhole samples, and the surficial samples were likely to be affected by weathering thereby impacting the integrity of the assay results.

Unmineralized dyke proportions were estimated using indicator kriging. All samples identified as mineralized (ID and ID2) were ascribed an indicator of 1, and unmineralized dykes a value of 0. Variographic analysis of this indicator was performed. Kriging of the indicator then provided the probability to have ore or waste within each block and also provided the proportion of mineralized material present within each block.

Kriging Neighbourhood Analysis was used to determine the best parameters for interpolation, i.e. size of blocks, number of informing samples, discretization of blocks, etc. Kriging and co-kriging ellipsoids were defined by the modelled variograms and co-variograms. Discretization of blocks for the interpolation was 5m x 5m x 5m which was consistent with block and composite sample dimensions.

The drill spacing at JO is approximately 150m x 150m. A block size of 50m x 50m x 10m was chosen in order to adequately cover the drill grid. A 10m block height was considered representative of a likely mining unit.

Search ellipsoid dimensions conformed to the variographic ranges and the drilling grid. Interpolation was undertaken in two consecutive runs of increasing size: co-kriging was used in the first pass, and any blocks not ascribed a grade were then informed through a standard inverse-squared distance interpolation.

Block model validation was completed in four steps. Visual validation showed general coherence between the drillhole data and the resulting block model. A block model versus composited samples' statistical validation showed a good similarity between the dataset distributions. A one pass inverse-square distance interpolation was carried out and the results compared to the kriged grades. The resultant histograms showed a good comparison. Finally, swath plot validations of block averages against sample averages gave a similar conclusion. The validation process concluded that the estimation process was robust with a reasonable degree of confidence.

The JO PCD is of economic interest for its Cu content, with Au credits, and possibly credits from other elements such as Mo. In 2015, QMSD engaged CSA Global to supervise preliminary metallurgical test work. Results suggested that flotation of sulphide would yield good recoveries and concentrate grades. Tests also suggested that heap-leach of oxide ore would be a viable option.

6. Fundamentals and reliability of the geological and Resource models

The fundamentals of the geological and Resource models and the reliability thereof are summarized below:

- QMSD exploration practices are carried out to a high standard utilizing well-trained, careful geological staff;
- Samples are partly processed on site. RC samples are split at the drill site while core splitting and crushing is undertaken at the core yard;
- Samples are shipped to ALS Romania, an accredited and certified laboratory, for pulverizing and assaying;
- All assays are controlled by a robust, comprehensive and well-defined QAQC program and the results captured in an industry-standard database managed by an independent consultant, CSA Global;
- QAQC results are monitored on an ongoing basis. No fatal flaws were observed and Arethuse concurs with QMSD and CSA Global that the QAQC results obtained indicate that the sample assay results should accurately reflect the sample grades;
- The QC analysis confirmed the reliability of the sampling, sample preparation and assay procedures, and the applicability of the chosen analytical methods;
- All fieldwork is permanently supervised by senior staff, and the database reflects the high quality of this work;
- The data flow and the database are of good standing;
- Sample recovery is not considered an issue;
- Only DD and RC holes were used for the estimate;
- Density has been assigned using the median within each domain, in line with the level of Resource confidence and the relatively low variability of density measurements, especially in the sulphide zone;
- The topography and collar surveys were performed according to professional standards. Downhole deviation measurements are acceptable;
- The base of oxidation runs subparallel to the topography;
- Geological continuity of the porphyry deposit has been well demonstrated;
- Samples have been composted to 2m intervals;
- 3D-modelling is supported by a detailed and valid geological model, backed by expert studies;
- Interpolation quality has been based mainly on kriging variance and the availability of informing samples for each block;
- Block model validation was done visually and using swath plots on average mass units of ore – in all cases good results were returned.

7. Reasonable prospects for eventual economic extraction

JO is located in a region where there is no tradition of large scale base metal mining, complicating the estimation of mining costs (to satisfy the Resource requirement for eventual economic extraction). However:

- Size, Resource cut-off grade (0.2% Cu) and average Cu grades with some Au credits are comparable with medium size porphyry projects around the world;
- Mining in the northern part of Sudan is gaining traction, with the concomitant development of infrastructure such as port facilities and water distribution, and the availability of technical equipment and human resources;
- Preliminary metallurgical tests returned positive results;
- The two porphyry centers at JO are largely outcropping, and although no preliminary pit has been designed they are expected to have a low stripping ratio;
- Early ore will contain the highest grades;
- Significant exploration upside exists in the vicinity of JO that could further enhance the project economics.

8. Resource statement

Remi Bosc considers the project fundamentals sufficiently robust to imply, but not fully verify, geological and grade continuity. Therefore, it is the author's opinion that most of the deposit should be classified as an Inferred Resource in line with the definitions and recommendations set by NI43-101 and CIM. The Inferred classification implies that a majority of the Resource could be upgraded to Indicated level with continued exploration. The margins of the deposit have not been fully delimited. Spacing between drill fences is not sufficient to definitively delineate dyke margins. The level of classification means that the Resource will not support a mine design as per the definition of Reserves given by CIM.

Parts of the deposit have been classified as "Exploration Potential" where there is insufficient confidence to determine geological and grade continuity. Exploration Potential relates to mineralization with insufficient data to estimate a Mineral Resource and should not be mistaken as such.

Jebel Ohier Mineral Resource estimate - effective date 31 December 2017, cut-off 0.2% Cu (NI 43-101):

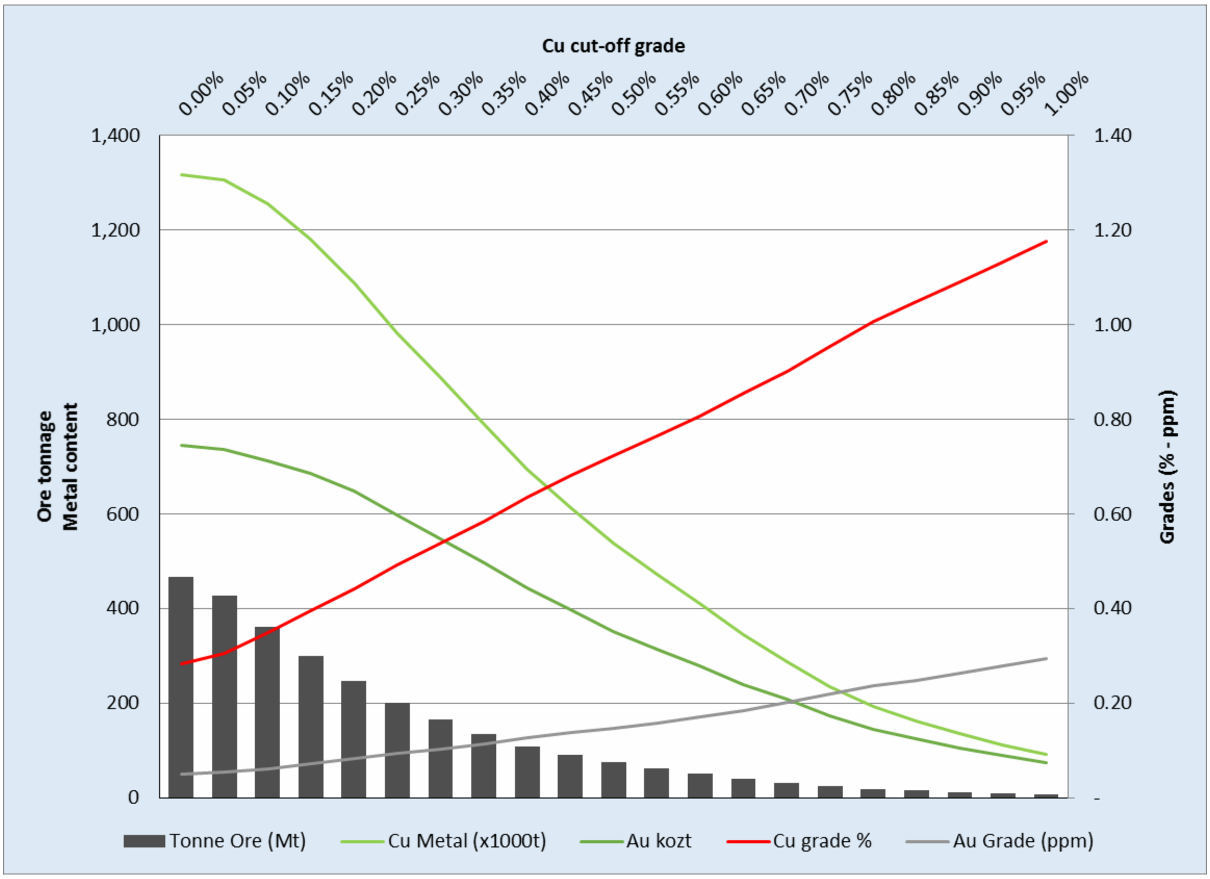
Category	Orebody	Oxide/ sulphide	Ore (Mt)	Cu (%)	Cu content (t)	Au (g/t)	Au content (oz)
Inferred	JO East	Oxide	55.6	0.40	221,900	0.13	234,700
Inferred	JO West	Oxide	16.2	0.31	50,000	0.05	22,500
Total oxide Inferred:			**71.8**	**0.38**	**271,900**	**0.11**	**257,200**
Inferred	JO East	Sulphide	138.3	0.49	673,500	0.08	347,200
Inferred	JO West	Sulphide	36.2	0.39	141,800	0.04	41,800
Total sulphide Inferred:			**174.5**	**0.47**	**815,300**	**0.07**	**389,000**
Total Inferred:			**246.3**	**0.44**	**1,087,200**	**0.08**	**646,200**

Jebel Ohier Exploration Potential estimate, cut-off 0.2% Cu (NI 43-101):

Exploration Potential	Oxide/ sulphide	Ore (Mt)	Cu (%)	Cu content (t)	Au (g/t)	Au content (oz)
JO East	Oxide	19.1	0.46	87,200	0.14	83,600
JO West	Oxide	1.9	0.27	5,300	0.06	3,200
Total oxide:		**21.1**	**0.44**	**92,500**	**0.13**	**86,800**
JO East	Sulphide	11.6	0.34	39,100	0.04	16,100
JO West	Sulphide	2.2	0.46	10,200	0.04	3,200
Total sulphide:		**13.8**	**0.36**	**49,300**	**0.04**	**19,300**
Total Exploration Potential:		**34.9**	**0.41**	**141,800**	**0.10**	**106,100**

(i) The information in this report related to Mineral Resources has been reviewed and endorsed by Remi Bosc, who is a Member of the European Federation of Geologists and an independent consultant. Remi Bosc has sufficient relevant experience to qualify as Qualified Person set out in National Instrument 43-101 of the Canadian Securities Administrators ("NI 43-101").
(ii) Values have been rounded to two or three significant figures to reflect the relative estimation precision of each resource classification.
(iii) Dyke material in the sulphide zone has been excluded from the Resource estimate, with the proportion of dyke material in each block estimated using indicator kriging.
(iv) Exploration Potential should not be mistaken as a Mineral Resource.

The following grade-tonnage curve has been calculated using a block filtering method applied to inferred resources:



Cu Cut off ppm	Ore Mt	Cu grade %	Cu '000t	Au ppm	Au kg	Au kozt
0,00%	466,9	0,28	1 320	0,05	23 200	745
0,05%	427,0	0,31	1 300	0,05	22 900	736
0,10%	360,1	0,35	1 250	0,06	22 100	711
0,15%	299,4	0,39	1 180	0,07	21 300	685
0,20%	246,3	0,44	1 087	0,08	20 100	646
0,25%	199,5	0,49	980	0,09	18 600	597
0,30%	164,8	0,54	890	0,10	17 000	548
0,35%	134,7	0,59	790	0,11	15 400	496
0,40%	109,2	0,64	690	0,13	13 800	443
0,45%	90,0	0,68	610	0,14	12 300	397
0,50%	74,5	0,72	540	0,15	11 000	352
0,55%	61,7	0,77	470	0,16	9 700	313
0,60%	50,9	0,81	410	0,17	8 700	278
0,65%	40,2	0,85	340	0,18	7 400	238
0,70%	32,0	0,90	290	0,20	6 500	208
0,75%	24,5	0,95	230	0,22	5 400	172
0,80%	19,1	1,01	190	0,24	4 500	145
0,85%	15,6	1,05	160	0,25	3 900	124
0,90%	12,5	1,09	130	0,26	3 300	106
0,95%	9,9	1,13	110	0,28	2 800	89
1,00%	7,8	1,18	90	0,29	2 300	73

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