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RESOURCE ESTIMATION | FEASIBILITY STUDIES | DUE DILIGENCE RESOURCE SPECIALISTS TO THE MINERALS INDUSTRY

NI 43-101 Technical Report Mineral Resource Estimates of the Doropo Project Cote d'Ivoire

Prepared for Centamin PLC
by
H&S Consultants Pty Ltd

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1 Summary

This Independent Technical Report was prepared by H&S Consultants for Centamin Plc (Centamin) on a Mineral Resource estimate for the Doropo Project under National Instrument 43-101 (NI 43-101). The Doropo Project currently consists of eight deposits named Souwa, Nokpa, Chegue, Chegue South, Tchouahinin, Kekeda, Han and Enioda.

1.1 Property Description and Ownership

The Doropo Project is located in north eastern Cote d'Ivoire, in the Bounkani region, 480 km north of the capital Abidjan and 50 km north of the city of Bouna.

The Doropo Project is contained within six current exploration permits that were granted to Ampella Mining Cote d'Ivoire and Ampella Mining Exploration Cote d'Ivoire, which are both 100% owned Ivoirian subsidiaries of Centamin. The block of permits covers a total area of 1,901.3 km^2.

The mineral resources reported in this report are located in two exploration permits, named PR 334 (Permit de Recherche de Kalamon) and PR 559 (Permis de recherche de Danoa). The exploration work and results over the other permits is also described in this report.

The eight deposits that form the resource estimates detailed here occur within a 7 km radius centred on about UTM 482,450mE and 1,074,951mN (WGS84, zone 30N).

1.2 Geology and Mineralisation

The block of exploration permits lie entirely in the Tonalite-Trondhjemite-Granodiorite (TTG) orthogneiss suite of the Birrimian domain in the Leo-Man shield. The TTG is bounded on its eastern side by the Boromo-Batie greenstones belt, in Burkina Faso, and by the Tehini greenstones belt on the west.

At the Project scale, the geology consists of fairly homogeneous medium to coarse grained granodiorite. Several of the deposits are intersected by regional, post-mineralisation diorite dykes.

Gold mineralisation occurs associated with discrete structurally controlled zones of intense silica-sericite alteration, focused within and along the margins of narrow (5-10 m wide to locally 20-25 m) shear zones. Outside of the mineralised zones, the granodiorite is fairly undeformed. The mineralised zones generally form clearly identifiable tabular bodies although this is complicated where two structures intersect, such as at the Nokpa deposit.

Gold grades within the mineralised zones are generally very variable and exhibit positively skewed grade distributions with relatively high Coefficients of Variation (CVs).

1.3 Status of Exploration, Development and Operations

The first exploration permits of the area were granted to Ampella Mining Cote d'Ivoire, in June 2013. Prior to that time, no mineral exploration has ever been conducted. At the end of 2013, Ampella Mining Limited conducted a preliminary reconnaissance program, leading to the highlight of the various prospects, with initial high grade rock chips.

Centamin acquired Ampella Mining Cote d'Ivoire via the takeover of Ampella Mining Ltd. in March 2014. Centamin has continuously conducted exploration activities on the Doropo Project since mid-2014. Preliminary exploration activities have included geological mapping and rock chip sampling surveys, an airborne aeromagnetic and radiometric survey, extensive soil sampling and auger drilling programs and Gradient Array Induced Polarisation (GAIP) surveys.

Targets identified by the preliminary exploration activities have been continuously followed up by trenching and aircore drilling programs, and followed by Reverse Circulation (RC) and diamond drilling programs. To date, eight deposits have been drilled with RC and diamond drilling to a sufficient level of detail to support mineral resource estimates. The exploration strategy continues to be applied to the pipeline of targets on the Project.

Centamin started RC and diamond drilling in November 2015 and has totalled 202,477 m of RC and 10,223 m of diamond drilling at the time of the effective date of this report within the Project area. Some of this drilling is located outside the eight deposits included in the resource estimates.

Centamin has set up a relatively well developed permanent exploration camp in the village of Danoa, which is located about 4 km south of Enioda and 14 km east-south-east of Souwa. The majority of exploration activities are conducted from this site. Centamin also maintains an office and smaller exploration camp in the town of Doropo. The regional exploration work is based out of fly camps or other temporary camps depending on the location of the programs.

1.4 Mineral Processing and Metallurgical Testing

ALS Metallurgy Services (Perth) conducted all test work on the Doropo resource materials 2017-2018, under the direct supervision of Paul Elms (ELMSMET PTY Ltd), a consultant metallurgist working on behalf of Centamin since 2017.

A representative suite of Upper Oxide, Lower Oxide, Transition and Upper and Lower Fresh composite samples were selected for testing from each of the main Doropo resource deposits. A summary of the test work conducted in 2017-2018 on the Doropo resource materials is outlined in Table 1-1.

Table 1-1: Metallurgical test work conducted by ALS Met Services 2017-2018

Ore Body	Souwa		Nokpa	Chegue South	Han	Kekeda	Kona	Doropo Oxide	
Testwork description									
In-situ SG	✓								
SMC	✓						✓		
Ai	✓		✓	✓	✓	✓	✓		
Rwi	✓		✓	✓	✓	✓	✓		
Bwi	✓		✓	✓	✓	✓	✓		
Head Assay	✓		✓	✓	✓	✓	✓	✓	✓
Mineralogy	✓						✓		
Gravity/CN leach	✓				✓	✓	✓	✓	
Gravity/float/CN leach	✓								
Bulk float/CN leach			✓	✓	✓	✓	✓		
Gravity/float/oxidative leach/CN leach		✓							
CN leach									✓
CN leach (coarse-crush)									✓
CN leach (column)									✓

The first stage of metallurgical test work was conducted on the Doropo fresh resource materials to establish the primary ore characteristics and process recovery options. The central objective was to compare overall gold extraction via:

1. Gravity gold recovery and whole-ore cyanide leaching.
2. Gravity gold recovery and flotation, with cyanide leaching of the flotation tails and re-grinding of the flotation concentrate prior to cyanide leaching of the flotation concentrate (separate to the flotation tail leach).

Subsequently, oxide and transition ore type composites from the main resource sources were tested by grinding a 10 kg composite of each sample to P80 passing 150, 106 and 75 μm and evaluating the gravity gold recovery test work ahead of cyanide leach test work on the gravity tailings.

Lycopodium have been contracted by Centamin to provide process design services for the Doropo 2019 PEA. The optimum process recoveries are listed in Table 1-2.

Table 1-2: Metallurgical recoveries for Doropo weathering zones

Weathering Type	Gold recovery	Source
Saprolite	**92.5 %**	Lycopodium 28-Nov-2018
Transition	**89.8 %**	Lycopodium 28-Nov-2018
Fresh	**88.8 %**	Lycopodium 28-Nov-2018

1.5 Mineral Resource Estimates

The gold concentrations were estimated by recoverable Multiple Indicator Kriging (MIK) using the GS3 geostatistical software. The gold grades at the Doropo deposits exhibit a positively skewed distribution with reasonably high coefficients of variation within each mineralised domain. The gold estimates at Doropo therefore show reasonable sensitivity to a small number of high grades, especially for Chegue South, Han, Tchouahinin and Souwa.

The method of recoverable MIK was developed during the early 1980's with a particular view toward addressing some of the difficult problems associated with estimation of resources in mineral deposits such as Doropo. MIK is one of a number of non-linear methods developed at that time, which can be used to provide better estimates than the more traditional methods of OK and inverse distance weighting.

Recoverable MIK is considered an appropriate estimation method for the gold grade distribution at the Doropo deposits because it specifically accounts for the changing spatial continuity at different grades through a set of indicator variograms at a range of grade thresholds. MIK can also help avoid or reduce the need to use the practice of top cutting, which can be somewhat arbitrary in the resource estimation process.

Centamin provided H&SC with a series of wireframe solids representing the interpreted zones of elevated gold grades. H&SC used these wireframes as the basis to create a new series of wireframe solids that were suitable for MIK estimation. These changes were made to include peripheral mineralisation and produce zones of reasonably consistent thickness. These wireframe solids were created to encompass coherent zones of gold mineralisation elevated above background values. This nominally resulted in a gold grade boundary of about 0.07 g/t.

Two wireframe solids representing barren diorite dykes at Nokpa and Chegue South were also provided by Centamin, which were used to discount the dyke proportions.

H&SC also created a series of wireframe surfaces for each deposit representing the base of transported material, the base of saprolite and the top of fresh rock using drill hole logging information.

The orientation of the mineralisation at the Doropo deposits varies significantly between deposits. Each of the deposits shows relatively long continuity in the along strike and down-dip directions and short continuity in the direction perpendicular to these. Rotated azimuth block models were used where necessary to better reflect the local orientation of the mineralisation.

The drilling at all of the deposits assessed in this study includes areas that have been drilled on a nominal 50x50 m grid pattern. Nokpa includes an area that has been drilled on a nominal 25x25 m grid. The vast majority of intervals have been sampled on 1 m intervals. Samples were composited to 2 m intervals whilst honouring the mineralised domain wireframes and with a minimum composite length of 1.0 m. The block dimensions were 50 m along strike, 25 m across strike and 10 m vertically. The along strike dimension was chosen as it is the nominal drill hole spacing (preferable for MIK estimation). The across-strike dimension was shortened to reflect the anisotropy of the mineralisation and inclined drilling. The vertical dimension was chosen to reflect downhole data spacing.

The search criteria used to estimate gold concentrations can be seen in Table 1-3 and consist of three search passes with progressively increasing search radii and/or decreasing data requirements. Declustering was carried out by the use of search octants. The search ellipsoids for each domain are rotated according to the local orientation of the mineralised domains. Discretisation of blocks is based on 5 x 5 x 5 (east, north and vertical respectively) points.

Table 1-3: Search criteria

Axis	Pass 1	Pass 2	Pass 3
Axis 1 (Perpendicular to Strike and Dip)	15 m	30 m	30 m
Axis 2 (Along Strike)	60 m	120 m	120 m
Axis 3 (Down Dip)	60 m	120 m	120 m
Composite Data Requirements			
Minimum data points (total)	16	16	8
Max points (total)	48	48	48
Octants Required	4	4	2
Max points (per octant)	6	6	6

Recoverable MIK allows for block support correction by means of a variance adjustment to account for the change from sample size support to the size of the minimum Selective Mining Unit (SMU) in order to produce estimates of recoverable resources at pre-defined gold cut off grades. This process requires an assumed grade control drill spacing and the assumed size of the minimum SMU. The variance adjustment factors were estimated from the gold metal variogram models assuming a minimum SMU of 5 by 12.5 by 2.5 metres (across strike, along strike, vertical) with high quality grade control sampling on a 5 by 12.5 by 1.5 metre pattern (across strike, along strike, vertical). This is the same grade control sampling pattern as that applied to Centamin's Sukari Mine, located in Egypt.

Estimates of dry bulk density are based on a total of 2,622 density measurements from drill core at the Doropo deposits. The average density within each of the weathering domains (transported, saprolite, transitional and fresh) was applied to the block model.

Resource classification is based on the search pass used to estimate the block. In order to limit small isolated volumes of different classification (spotted dog) the search passes used to populate each block were locally averaged. Pass one nominally equates to Indicated Resources and passes two and three equate to Inferred Resources. The maximum extrapolation of reported resources is limited to 80 m from drill hole data and limited to a depth of 250 m below surface. The Mineral Resource estimates are reported at a gold cut-off grade of 0.5 g/t in Table 1-4.

Table 1-4: Mineral Resource Estimates at 0.5 g/t gold cut-off

Deposit	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	18.1	1.41	0.82	6.3	1.5	0.30
Nokpa	6.9	1.30	0.29	1.8	1.2	0.07
Chegue	5.7	1.05	0.19	1.4	0.9	0.04
Chegue South	6.8	1.31	0.29	3.4	1.2	0.13
Tchouahinin	1.3	1.44	0.06	1.0	1.0	0.03
Kekeda	4.1	1.17	0.15	1.2	1.2	0.05
Han	3.8	1.48	0.18	1.6	1.4	0.07
Enioda	3.9	1.20	0.15	2.2	1.0	0.07
Totals	**50.5**	**1.31**	**2.13**	**19.0**	**1.3**	**0.76**

Illegal artisanal mining at the Doropo deposits is currently occurring despite efforts to limit the practice. Artisanal mining has occurred on all of the deposits assessed in this report except Chegue South and is most advanced at Tchouahinin and Souwa. It is difficult to quantify the amount of material that has been extracted and the effects that the artisanal mining has had on the resource estimates. The resource estimates have not been reduced to account for this mined material as exactly where mining has occurred is poorly understood. In addition to this, the majority of the artisanal mining occurred before the majority of drilling has been conducted. This is likely to produce estimates that underestimate the resources as the artisanal miners have targeted the high grade quartz veins so only the lower grade peripheral mineralisation has been intersected by drilling. It is likely that the amount extracted is unlikely to be significant in terms of the global resource estimates.

1.6 Conclusions

H&SC is of the opinion that the Mineral Resource estimates are suitable for public reporting and are a fair representation of the in-situ gold concentration and contained metal for the Doropo Project.

The current estimates are considered to compare well with the previous Mineral Resource estimates of the Doropo Project, with differences in tonnages and classification dominantly due to the significant increase in drill hole data coverage.

1.7 Recommendations

H&SC has been informed that Centamin plans to deliver a Preliminary Economic Assessment (PEA) report in the second half of 2019. H&SC agrees that this is the recommended next step in order to better understand the economics effecting the mining of the Doropo deposits. Following the PEA,

Centamin will be in a position to plan work programs directed towards improving the confidence in the assumptions on which the PEA is based.

In addition to this work, H&SC recommends that a portion of the assay results from Bureau Veritas Minerals Laboratory are checked by sending sample pulps to a second, independent, internationally recognised laboratory.

2 Introduction

H&S Consultants Pty Ltd (H&SC) was commissioned by Centamin to conduct a mineral resource estimate of the eight deposits that form the Doropo gold project. The Doropo project is located in the Bounkani Region of the Zanzan District, in the far northeast of Cote D'Ivoire. The eight deposits assessed in this report are named Souwa, Nokpa, Chegue, Chegue South, Tchouahinin, Kekeda, Han and Enioda. The gold concentrations were estimated by recoverable Multiple Indicator Kriging (MIK) using the GS3 geostatistical software.

H&SC previously estimated the resources of all the deposits except Tchouahinin in December 2017 and have updated the estimates based on a significant amount of new drill hole data.

The drill hole and QAQC data that underpin the resource estimates were collected by Centamin between 2015 and 2018 and all relevant data were provided to H&SC. H&SC has conducted sufficient checks to feel confident in the quality and veracity of the data provided. The analyses of the data and the information relating to the resource estimates were generated by H&SC. Information contained in Chapters 4, 5, 6, 7, 8, 9, 13, 23 and 26 of this report was provided by Centamin.

Rupert Osborn of H&SC visited the Doropo project site for three days in November 2017 and again for a day in December 2018. These visits were led by Pierrick Couderc of Centamin. During these visits H&SC observed diamond and RC drilling and sample handling procedures, which were found to be industry standard. H&SC also selected several diamond and RC drill holes in order to cross-check the geological logs against the drill core and chip trays and to better understand the geology and reliability of the logs. The method of measuring the density of the drill core was demonstrated to H&SC. H&SC spoke to many of the key personnel including senior and junior geologists and the database administrator. The location of around 30 drill hole collars was checked against the database records using a handheld GPS.

In December 2018 Rupert Osborn visited the Bureau Veritas Mineral Laboratory in Abidjan in order to observe sample preparation and fire assaying procedures.

3 Reliance on Other Experts

The Qualified Person's opinion contained herein is based on information collected by Centamin. H&SC is reliant upon the information and data provided by Centamin. Information included in Sections 4, 5, 6, 7, 8, 9, 10, 11.1, 13 and 23 is largely based on information provided to H&SC by Centamin. H&SC has, where possible, independently verified the data provided and completed site visits to review physical evidence for the deposit.

H&SC has not performed an independent verification of land title and tenure as summarized in Section 4 of this report. H&SC did not verify the legality of any underlying agreement(s) that may

exist concerning the permits or other agreement(s) between third parties, but have relied on information provided by Centamin for land title issues.

The costs associated with the PEA in Section 26 of this report were provided to H&SC by Centamin. H&SC has not independently verified these predicted expenses.

The information relating to land title, tenure and the predicted costs of the PEA were provided in the form of a draft report via a shared cloud storage website transfer on 22 March 2019 from Norman Bailie, who is Centamin's Group Exploration Manager.

H&SC has based Section 13, covering metallurgical test work on information received via Centamin from two independent service providers. H&SC received this information from Centamin by a shared cloud storage website transfer on 24 March 2019. Both named consultants have read Section 13 in its entirety and agree to the inclusion within this report. H&SC has relied on the metallurgical test work to justify prospects for eventual economic extraction.

- Section 13.1 is based on information received from Hamid Sheriff, BSc, FAusIMM, CP (Metallurgy), RPEQ. Mr Hamid is Group General Manager of ALS Metallurgy Services, Balcatta, Western Australia.
- Section 13.2 is based on information received from Geoffrey Duckworth, PhD, FAusIMM, RPEQ. Mr Duckworth is Manager of Process with Lycopodium Minerals Pty Ltd, Queensland, Australia.

H&SC was informed by the Centamin that there are no known litigations potentially affecting the Doropo Project.

4 Property Description and Location

The Doropo Project is located in north eastern Cote d'Ivoire, in the Bounkani region, 480 km north of the capital Abidjan and 50 km north of the city of Bouna. The block of permits lies between the border with Burkina Faso and the Comoe National Park (Figure 4-1).

The coordinate system utilised for the Project is the Universal Transverse Mercator (UTM) projection, WGS84, zone 30 north. It is centred on about UTM 475,000mE and 1,068,000mN, otherwise Latitude 9°39'42'' N and Longitude 3°13'40'' W.

The resource area, which fits in a 7 km radius, is centred on about UTM 482,450mE and 1,074,951mN, otherwise Latitude 9°43'28'' N and Longitude 3°9'36'' W.

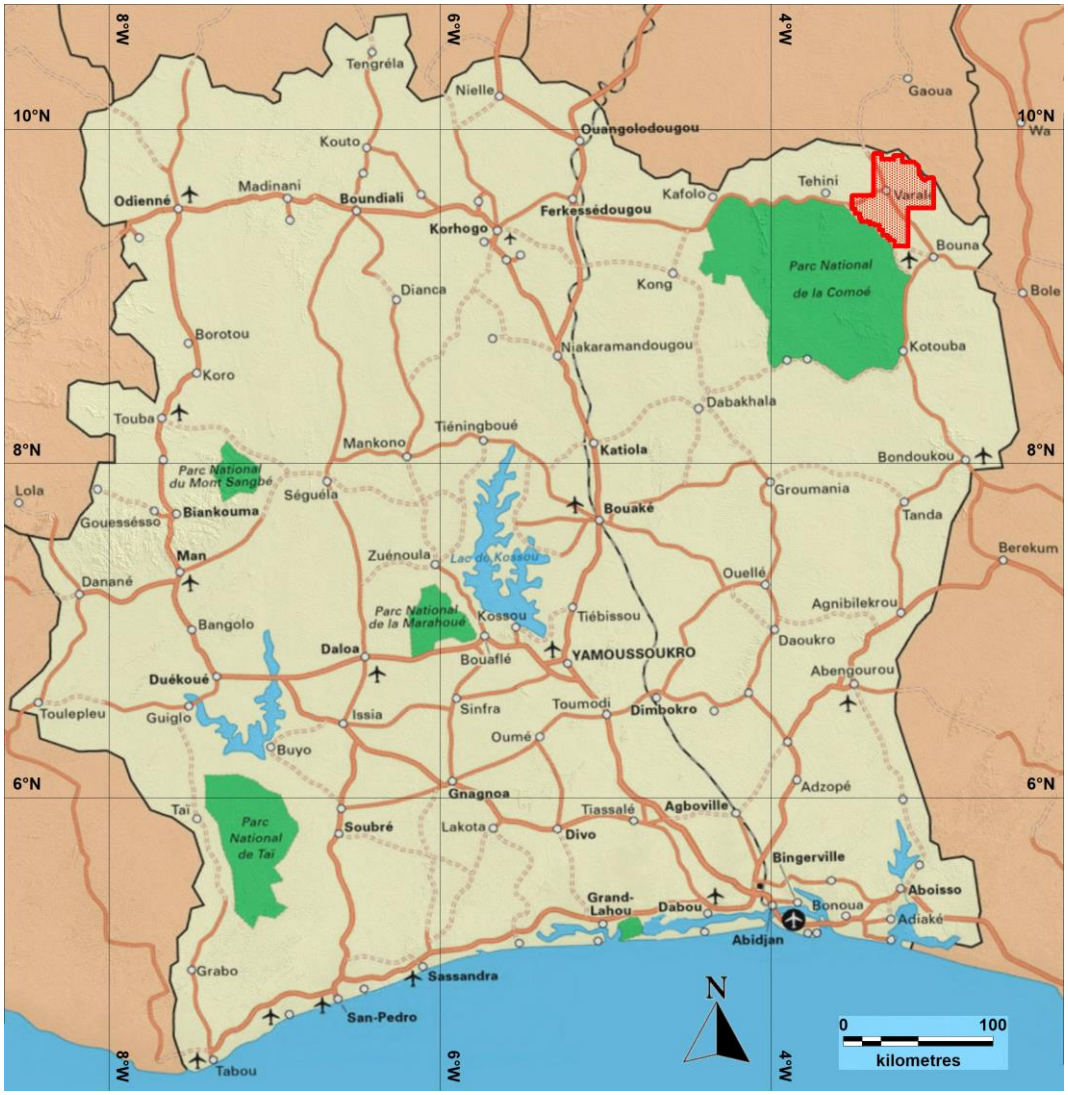

Figure 4-1: Location of the Doropo Project – map of Cote d'Ivoire
(From Centamin, March 2019)

The block of permits includes six granted exploration permits, all covering granitic rocks. Ampella Mining Cote d'Ivoire and Ampella Mining Exploration Cote d'Ivoire, both 100% owned Ivoirian subsidiaries of Centamin own these permits, as detailed in Table 4-1. The block of permits covers a total area of 1,901.3 km^2.

The mineral resources reported in this report are located in two exploration permits, named PR 334 (Permit de Recherche de Kalamon) and PR 559 (Permis de recherche de Danoa). The exploration work and results over the other permits is also described in the report.

The permits PR 335 (Permis de Recherche de Varale), PR 334 and PR 336 (Permis de Recherche de Doropo Ouest) were granted by presidential decrees in June 2013 for three years. The permit PR 336 has since been relinquished due to negative results on its surface. Both the PR 334 and the PR 336 permits were renewed once and are currently valid until June 2019. They can be renewed once more for three years before going to exceptional requests.

The permit PR 559 was granted by presidential decree in June 2015 for 4 years. It can be renewed twice for three years each time before going to exceptional request.

The permits PR 535 (Permis de Recherche de Tehini1) and PR 536 (Permis de Recherche de Tehini2) were granted by presidential decree in March 2017 for four years. They can be renewed twice for three years each time before going to exceptional request.

The permit PR 778 (Permis de Recherche de Tehini3) was granted by presidential decree in April 2018 for four years. Again, it can be renewed twice for three years each time before going to exceptional request.

Each presidential decree sets minimum expenditure requirements and type of work by year in order to maintain the rights on the permits. The total expenditures, the work achieved and the results are summarized in bi-annual and annual reporting to the Direction of Mines. Regular field visits are conducted by representatives of the Direction of Mines in order to reconcile the reports.

The exploration activities, including the drilling, need no other specific permitting in the field other than the normal compensation for crop destruction to the local communities. These compensations are paid according to the guidelines set by the Ministry of Agriculture directly to the landowners.

Table 4-1: Summary of the Exploration Permits – as of January 2019

Permit name	Permit ID	Surface (km^2)	Status	Company	Date granted	Expiry date
Kalamon*	PR 334	398.9	Granted	Ampella Mining Cote d'Ivoire S.A.	13/06/2013	12/06/2019
Varale	PR 335	400.0	Granted	Ampella Mining Cote d'Ivoire S.A.	13/06/2013	12/06/2019
Danoa*	PR 559	380.4	Granted	Ampella Mining Cote d'Ivoire S.A.	10/06/2015	09/06/2019
Tehini 1	PR 535	253.0	Granted	Ampella Mining Exploration C.I. S.A.	08/03/2017	07/03/2021
Tehini 2	PR 536	228.0	Granted	Ampella Mining Exploration C.I. S.A.	01/03/2017	28/02/2021
Tehini 3	PR 778	241.0	Granted	Ampella Mining Exploration C.I. S.A.	16/04/2018	15/04/2022

*These permits host the estimated mineral resources reported in this document

5 Accessibility, Climate, Local Resources, Infrastructure and Physiography

The area of Doropo shows relatively low relief, due to the nature of the underlying rocks – the granites. The surface soils are mostly sandy and outcrops are rare. The ridges form small plateaus and covered by laterites and occasionally duricrust of limited thickness. Large peneplains bound the area on the north and on the south while hill chains bound the eastern and the western sides where greenstone belts crop out (the Tehini-Hounde belt on the West and the Bonomo/Batie belt on the East).

Elevations range from about 250 m to 407 m at the highest point, which is more or less in the middle of the Doropo Project, and forms a drainage divide between the Volta Noire basin on the East and the Comoe basin on the West as shown in Figure 5-1. Streams and rivers on the Project are seasonal.

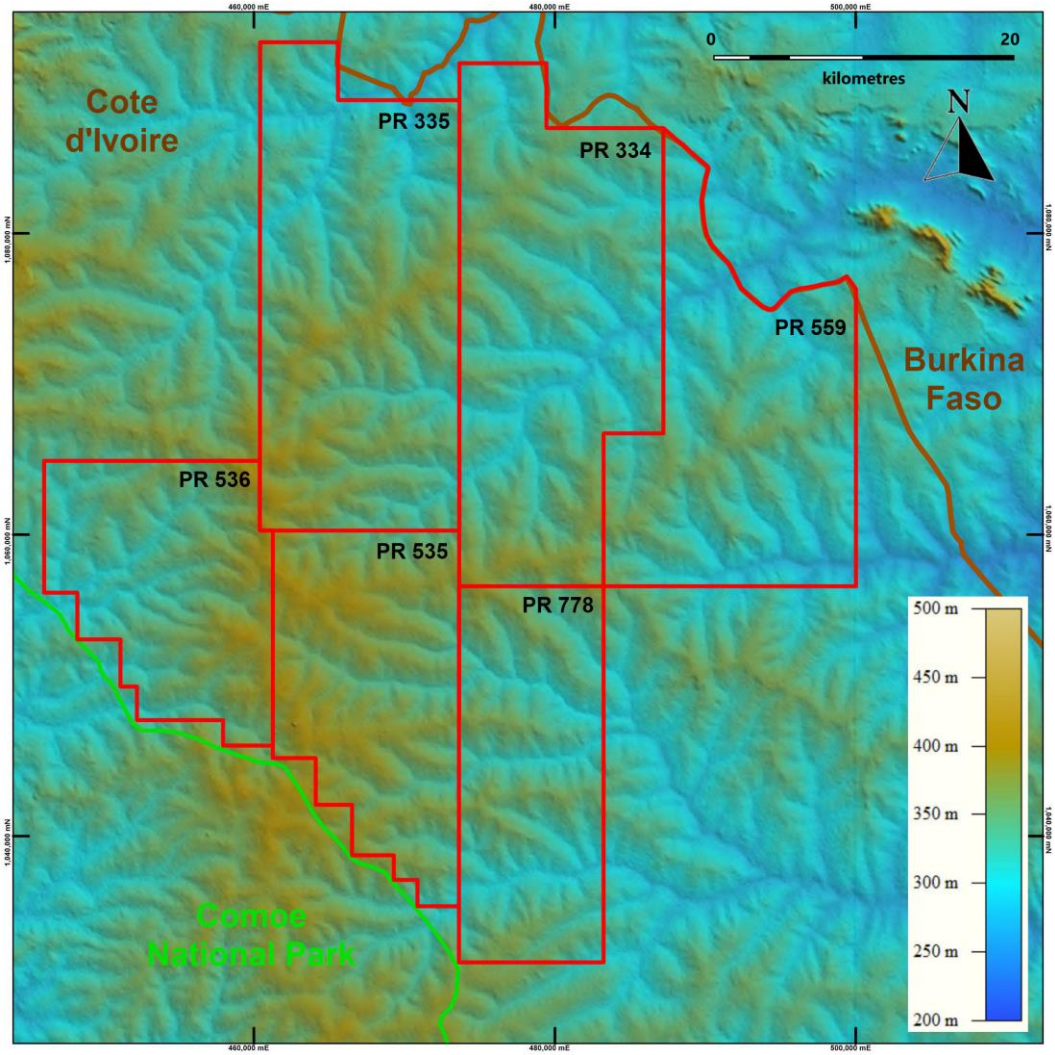

Figure 5-1: Elevations over the project – SRTM data
(From Centamin, March 2019)

The climate is of Sudanese type, with two distinct seasons, a rainy season and a dry season. The rainy season extends from May/June to September/October when rainfalls total between 1,100 mm and 1,200 mm. The dry season extends from September/October to May/June. The Harmattan, a hot dry wind coming from the Sahara regions, blows generally in December and January, sometimes extending to March, and brings dust clouds, which reduce visibility.

The average temperature is of 28°C, ranging between 21°C and 33°C. The hottest times of the year occur at the change of seasons.

The vegetation is characterised by the sparse forests and savannah where natural environment exists, as shown in Figure 5-2. However a large extent of ground is covered by seasonal crops, mostly yams, peanuts, rice, millet and sorghum and plantations of cashew trees – the Cote D'Ivoire is one of the main producers of cashew nuts in the world.

The National Comoe Park limits the Project all along its South-West side. The park covers 11,500 km^2, which is the largest protected area in West Africa. It is a biosphere reserve and a UNESCO world heritage site since 1983.

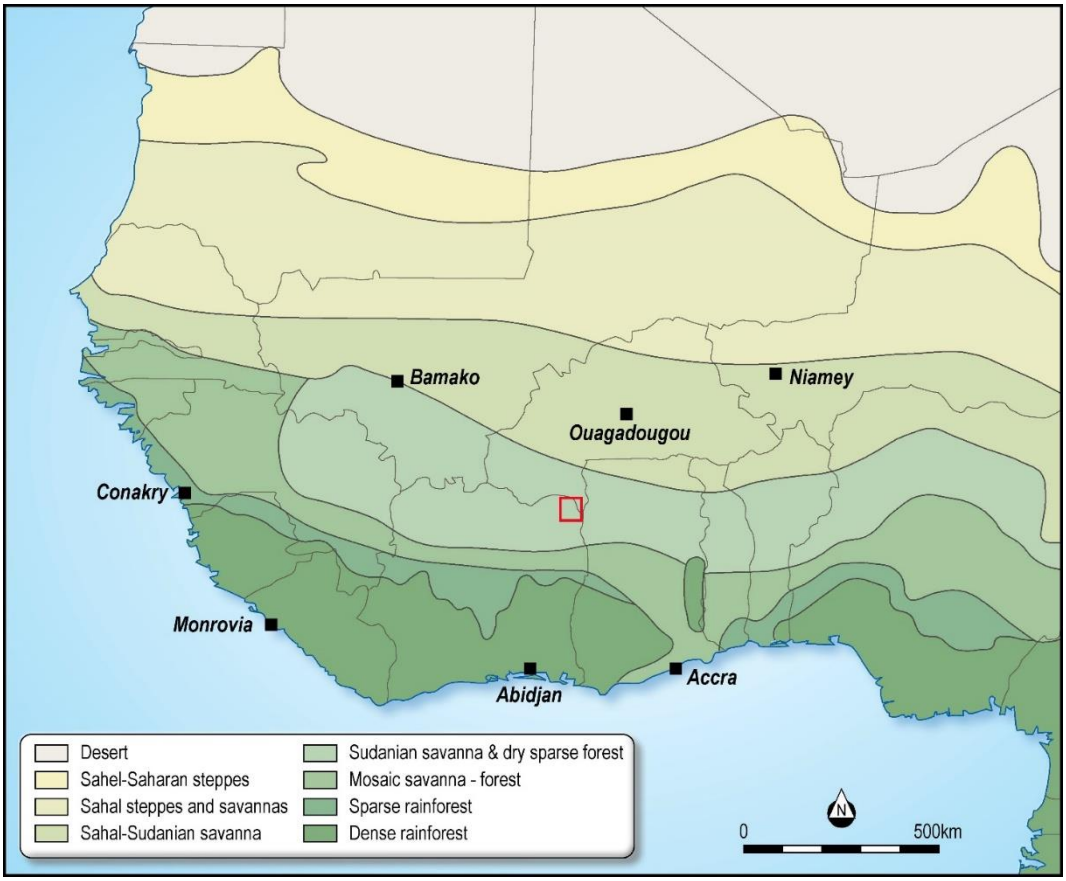

Figure 5-2: Main vegetation zones in West Africa
(From Centamin, March 2019)

The Doropo Project is accessible by a national sealed road called the A1 which crosses through the centre of the Project. The A1 is a major road that joins Abidjan and Ouagadougou, the Capital of Burkina Faso. Doropo, Prefecture or Department, is 76 km (about 1.5 hours' drive) from Bouna, the Capital of the Bounkani Region. It is also at 240 km (about 3.5 hours' drive) from Bondoukou, the capital of District and 645 km (about 10 to 11 hours' drive) from Abidjan, the economic capital. A dense network of small dirt/ sandy roads allows easy access to all parts of the Project, even during the wet season. The sandy nature of the soil allows a rapid drainage of the water on the access.

There is a dense network of rural villages in the area of the Project, mostly populated by the ethnic group of Lobi. Bigger villages, such as (but not only) Danoa, Kalamon, Kodo, Varale, Niamoin, are mostly populated by the Koulango ethnic group. The third ethnic group present in the area is the Fula, who are often nomads, living from cattle farming.

The main economic activity is represented by rural agriculture and farming. However for several years, mostly since the civil war times, some villagers also live from artisanal gold mining (mostly superficial rocks digging and laterite panning). To some certain extents, the illegal mining increased more recently with the arrival of nomadic Burkinabes (Mossi and Dioula ethnic groups mainly).

Local infrastructure remains limited so a Project development will have to include a self-sufficient aspect or backup options.

The power grid, coming from a Ghanaean source of power, currently supplies the main villages and cities along the A1 road, and is being extended to the secondary villages (Kalamon, Danoa, etc). However it remains an unstable supply during some periods of the year.

The mobile phone network is well deployed, from at least two main national providers. Internet access has overall proven reliable, via the general 3G mobile connections, or dedicated microwave connections for the sites.

Water is abundant underground, even if not flowing at surface during the wet season. No studies have yet been conducted but there are expectations to find a sufficient source of water for a mining project.

Due to the rural aspect of the area, the specialized professional skills and trade skills are very limited in the near vicinity but adequate workforces are available from elsewhere in the country.

6 History

The first exploration permits of the area were granted to Ampella Mining Cote d'Ivoire, Ivoirian subsidiary, in June 2013. Prior to that time, no mineral exploration had ever been conducted.

The region (the North-East part of the country) was first mapped by French Geologists from 1950 to 1958, in order to produce the first Geological map at the scale 1:500,000, prepared by the Bureau de Recherche Geologique et Minière (BRGM), printed in 1963.

Some evidence of historical gold mining during the Colonial time (under the French management) are seen at Varale, where a small open pit type operation occurred. However this operation seems to not have been documented.

The granitic domain that characterises the Doropo Project has always been considered as non-prospective for gold deposits.

At the end of 2013, Ampella Mining Limited conducted a preliminary reconnaissance program, leading to the highlight of the various prospects, with initial high grade rock chips.

Centamin acquired Ampella Mining Cote d'Ivoire via the takeover of Ampella Mining Ltd. in March 2014. Exploration activities then started on the Doropo Project from mid-2014.

7 Geological Setting and Mineralisation

7.1 Regional Scale Geology

The West African craton covers a surface area of 4.5M km^2, extending from the northern parts of Mauritania in the north, to the southernmost West African countries of Liberia, Cote d'Ivoire, Ghana in the south. It crops out in two major areas, the Reguibat shield in the north and the Leo-Man shield in the south, as shown in Figure 7-1. The Leo-Man shield includes the major gold producing provinces in Ghana, Burkina Faso, Southern Mali, Guinea and Cote d'Ivoire.

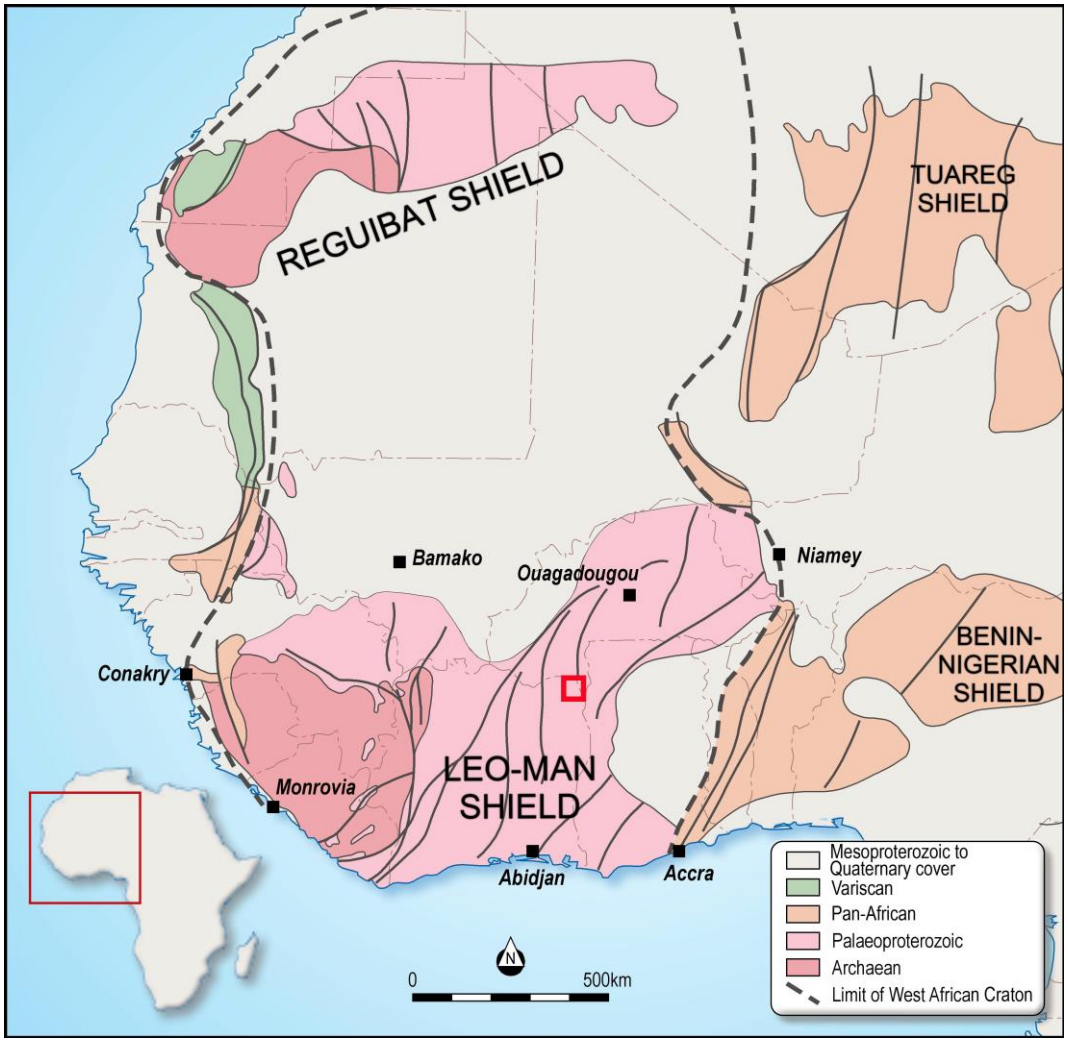

Figure 7-1: Map of West African Craton
(From Centamin, March 2019)

In the Leo-Man shield, shown in Figure 7-2, Paleoproterozoic rocks, known as the "Birrimian domain" are tectonically juxtaposed to the Archaean basement, separated by the Sassandra fault. The gold deposits largely lie within the Birrimian domain, which covers about 85% of the Cote d'Ivoire ground.

The structure within the Birrimian domain was formed during the Eburnean megacycle between 2.5 to 1.6 billion years ago and the main tectono-metamorphism events occurred between 2.2 to 2.0 billion years ago. This Paleoproterozoic domain includes greenstones belts (volcano-sediments) bounded by large areas of tonalitic granite-gneiss, trondhjémite and granodiorite (TTG orthogneiss suite, Tonalite-Trondhjemite-Granodiorite). Later stages of alkaline and calc-alkaline granitic plutons intrude this rock package.

The post Eburnean deformation events ended with large regional brittle deformation, often of a NW-SE orientation marked by the doleritic dykes.

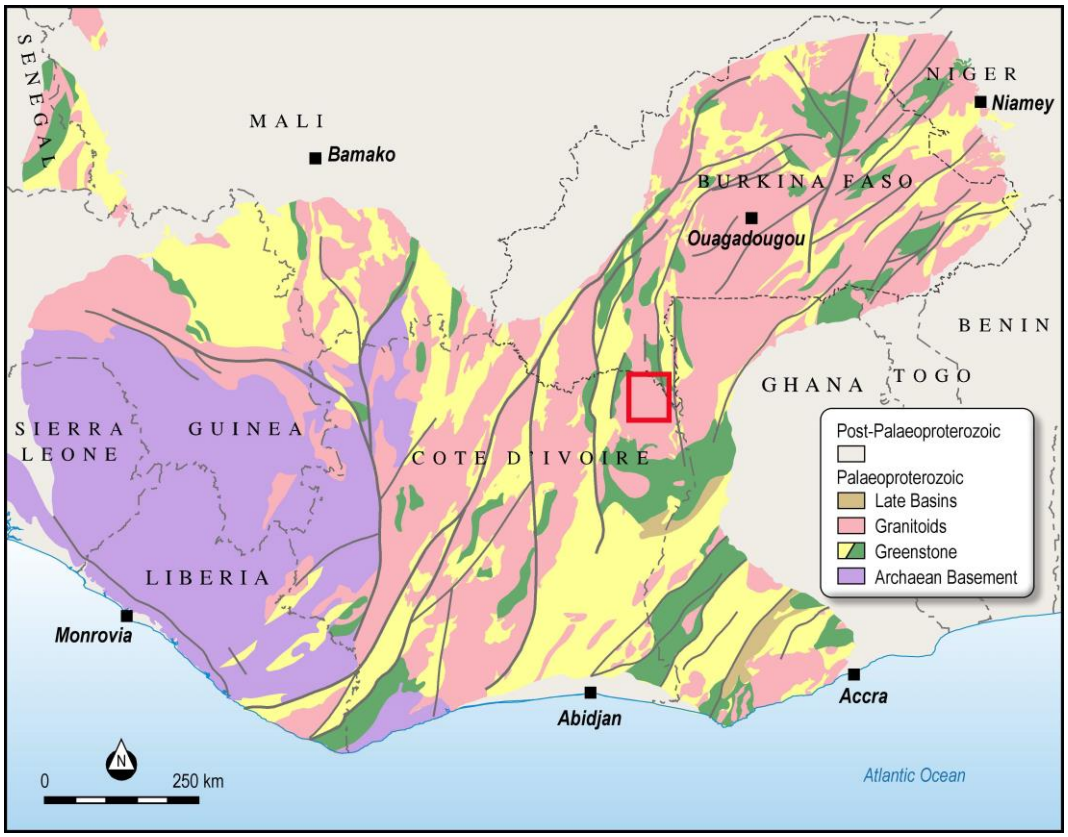

Figure 7-2: Geology of the Leo-Man Shield – from the BRGM interpretations
(From Centamin, March 2019, simplified from BRGM SIGAfrique (Milési, C. 2004))

7.2 Project Scale Geology

The block of exploration permits, shown in Figure 7-3, lies entirely in the TTG domain, bounded on its eastern side by the Boromo-Batie greenstones belt, in Burkina Faso, and by the Tehini greenstones belt on the west.

At the Project scale, the geology consists of granite-gneiss terrain, the granite being mostly of granodioritic composition. Outcrop is sparse, and generally confined to some slope sides with the flat ridge tops and low lying areas being covered by lateritic soils and transported sediments (alluvium, colluvium).

The transitions with the greenstones belts, on both the sides of the granitic domain, span progressive changes in the lithologies, encompassing layers of volcanic rocks (greenstones), as pyroxenites, amphibolites or more generally migmatites (mostly on the western side).

The various rock types are distinguished on the basis of aeromagnetic, radiometric and soil geochemical attributes. There is an ongoing research study, conducted by PhD students from the Felix Houphouët-Boigny University of Abidjan, focusing on identifying the regional scale litho-structural context of the Project, which aims to accurately map, interpret and date these various granitic facies. However, first results will not be available before 2020.

The granites are intruded by an abundant series of pegmatitic veins and quartz veins, ranging from the decimeter scale to several hundreds of meters scale. Some of this veining hosts gold mineralisation, often as primary native gold, across the entire area. This generates regular dispersed

gold anomalism in the surface geochemistry; it is also the main source of the gold extracted by the artisanal miners but is mostly uneconomic at the industrial scale.

Large late doleritic dykes criss-cross the whole domain at the regional scale.

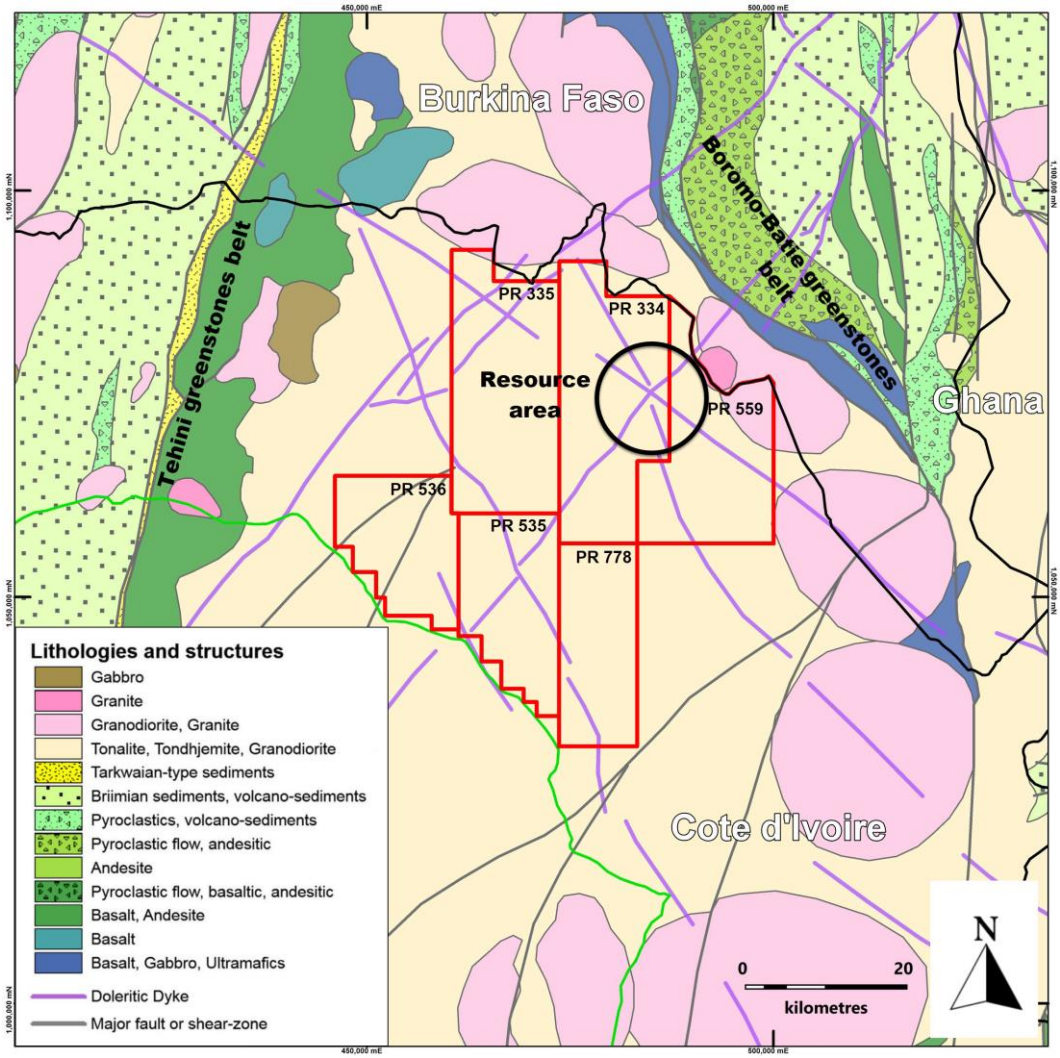

Figure 7-3: Geology map at the Project scale
(From Centamin, March 2019)

The resource estimates presented in this document cover eight deposits named Souwa, Nokpa, the Chegue Main, Chegue South, Han, Kekeda, Tchouahinin and Enioda. All these deposits are shown in Figure 7-4 and are located close to each other, within a 7 km radius. This area also includes numerous mineral occurrences that have not been tested to date and prospects yet to be further tested and developed.

The host rock is a fairly homogeneous medium to coarse grained granodiorite, locally intruded by biotite rich or aplitic dykes, mostly on the Enioda deposit, which also shows some amphibolite layers.

Mineralisation occurs associated with discrete structurally controlled zones of intense silica-sericite alteration, focused within and along the margins of narrow (5-10 m wide to locally 20-25 m) shear zones. Outside of the mineralised zones, the granodiorite is fairly undeformed.

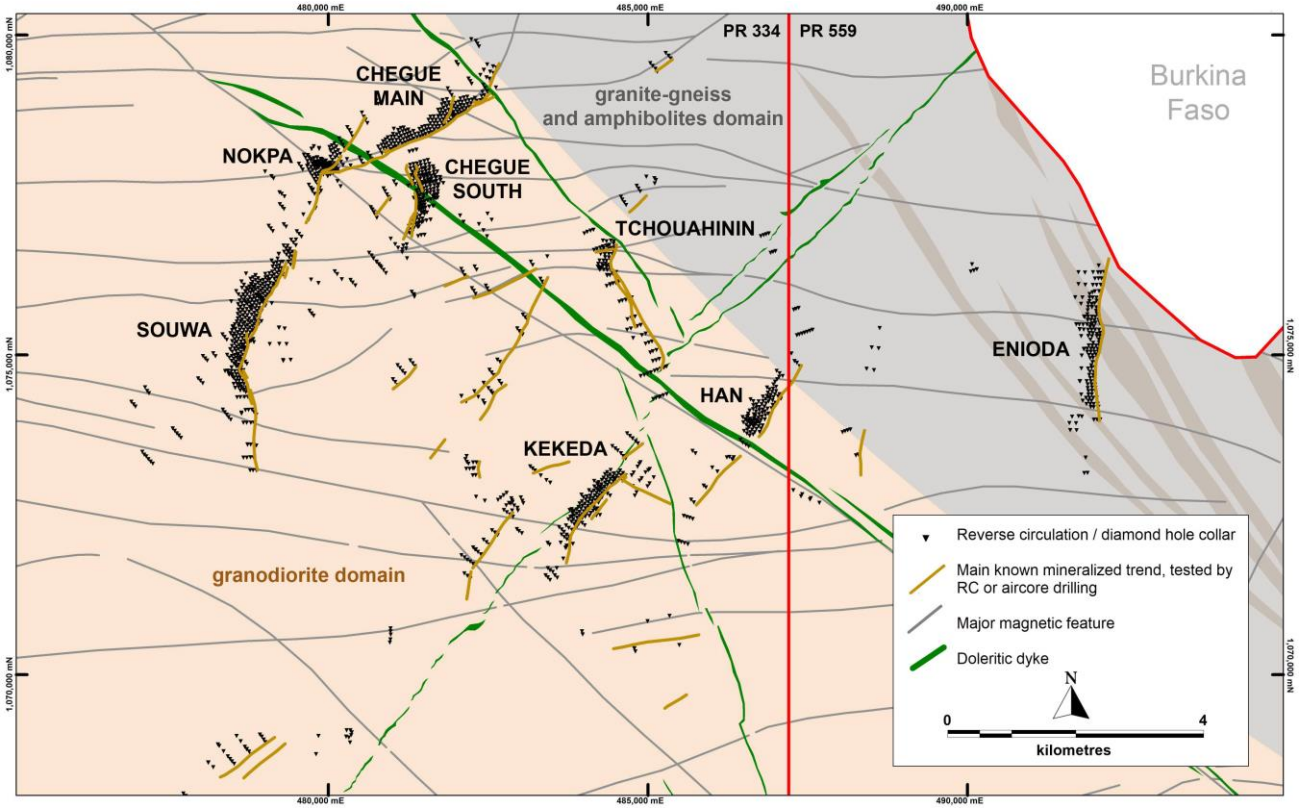

Figure 7-4: Resource area: location of deposits
(From Centamin, March 2019)

From August 2017 Centamin commissioned Orefind, an Australian based structural geology and geological modelling consulting company, to investigate the geological history of the Doropo Project area. The following text is an extract of their detailed report (Orefind, 2017)

"overprinting relationships indicate a massive deformation-controlled fluid flow system acting in tandem with a deformation regime that progressed from ductile through to brittle/brittle-ductile in the waning stages of fluid ingress.

Broadly similar sequences of quartz-carbonate veining were introduced at all prospects and indicate the following history:

- *Ductile shear zone initiation,*
- *Ingress of the first silica-dominated fluid phase during ductile deformation,*
- *Hiatus in fluid flow,*
- *Ingress of the second major silica dominated fluid phase with deposition of base metals and gold in the waning stages of this fluid deformation cycle. Deformation caused pervasive brecciation of the first stage of quartz dominant veins, with cementation and silicification of the breccias being facilitated by massive second-stage silica inflow,*
- *Hiatus in fluid flow,*
- *Deformation progresses to a dominantly brittle system. Deformation of the earlier silica stages, with breccia being cemented/ silicified by the final major silica-dominant fluid phase.*

The progressive/repeated reactivation of the host structures has channelled numerous fluid cycles. Each of the three major silica-dominated fluid flow episode described above will have comprised many individual fluid

pulses, resulting in progressive increases in vein volume. Silicification of the host structures will have modified the rheology of the host rock, resulting in strain accumulation and ongoing localisation of deformation."

"the first major stage of quartz rich fluid is inferred as being controlled by permeability associated with the accommodation of strain on structures that initiated as ductile shears in the granite. These structures likely also accommodated the greatest volume of silica bearing fluids, resulting in incremental formation of the largest white quartz veins seen in the deposits.

The second largest stage of quartz rich fluid was coeval with cycles of brittle deformation that overprinted the large, first generation quartz veins. Angular breccia fragments were produced and then "cemented" by a matrix of translucent to grey to black quartz infill and veining. The distinctive dark coloured veins are commonly the host to sulphides and are inferred as coeval with, and host to, gold mineralisation. Accumulation of shearing strain at the margins of the first generation veins commonly produced shear-induced lamination. Brecciation was sponsored in zones where the strain rate was great to accommodate ductile deformation. Overall, the special distribution of highest grades coincides with the deformed margins of the early formed veins.

The third major stage of quartz rich fluid was the volumetrically smallest, and manifests as cross-cutting white to translucent veins that inferred as forming under dominantly brittle conditions."

7.2.1 Weathering Profiles

The most common weathering profile includes transported sediments and granitic derived soils at surface that directly cover indurated mottle zones or gravelly profiles. The saprolite splits into an upper profile and a lower profile and the transition zone to fresh rock is very sharp.

The indurated mottled zone, shown in Figure 7-5, is very sandy, usually of a few tens of centimetres to a metre scale. It represents a reliable level to host in situ gold anomalies at the Project scale. Most of the soil sampling programs reach this level for sampling.

Figure 7-5: sandy indurated mottled zone (left) and gravelly level showing fragments of mineralised quartz veins (right)

The upper saprolite, shown in Figure 7-6, has very little to no fabric preserved. The granitic origin can be interpreted by the remaining coarse quartz grains that are supported by clay matrix. Thicknesses vary from a couple of meters to a maximum of about 40 meters, being very irregular across the drill sections and the deposits. Overall the thickest profiles have been found at the Souwa and Enioda deposits and the thinnest profile at the Han deposit.

Figure 7-6: Upper saprolite (where the original fabric is partially preserved)

The lower saprolite, shown in Figure 7-7, has most of its original fabric preserved; the rock is usually consolidated but can still be broken by hand. Thicknesses are more regular than the upper level across the deposits, varying from about 10 to 30 meters.

Figure 7-7: Lower saprolite

The transition zone from saprolite to fresh rock, shown in Figure 7-8, is generally very sharp and normally of no more than one to three meters thick. A maximum thickness of about ten meters can be found in a few places where weathering is controlled by the fractures in the rock. Figure 7-9 shows a photograph of fresh granodiorite drill core for comparison.

Figure 7-8: Transition zone between lower saprolite and fresh rock

Figure 7-9: Fresh granodiorite

7.2.2 Alteration and Mineralisation

Mineral assemblages distal to the mineralised zones include epidote-chlorite and hematite. Examples of these can be seen in in Figure 7-10 and Figure 7-11,. Hematite alteration is then pervasive at weak to medium intensity. This hematite alteration can be very strong in the vicinity of the doleritic dykes, making the vectoring towards mineralisation difficult in such areas; this is particularly demonstrative at the Nokpa deposit.

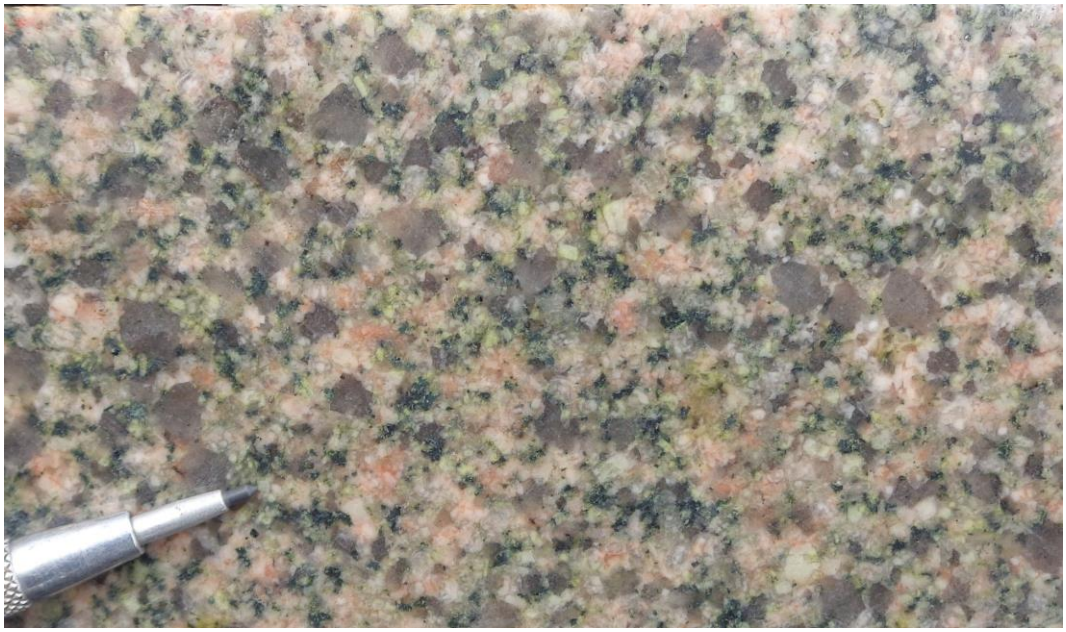

Figure 7-10: Distal epidote-chlorite-weak hematite alteration on granodiotite
(From foowall zone at Souwa - DPDD1382 at 103.4m depth)

Figure 7-11: Distal alteration: hematite-chlorite pervasive alteration
(From direct footwall of mineralisation at Souwa - DPRC0504 at 157m depth; 0.12 g/t Au)

Proximal mineral assemblages, as shown in Figure 7-12 and Figure 7-13, include strong silica-sericite alteration that often overprints earlier hematite and silica alteration. The sulphides, mostly pyrite, are abundant throughout the core of the shear zone; they host part of the gold mineralisation. The other part of the gold mineralisation occurs as native gold in the quartz veins and selvages.

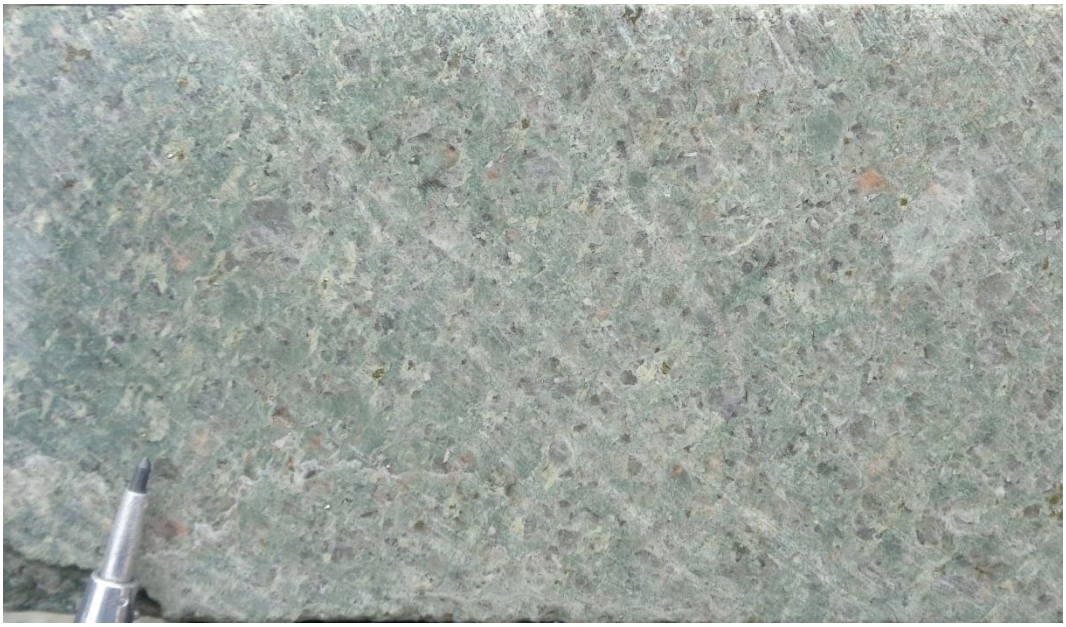

Figure 7-12: Proximal intense sericite and fine grained disseminated pyrite alteration
(from the Han deposit– DPRD0470 at 94m depth; 0.34 g/t Au)

Figure 7-13 shows a photograph of a sheared granite with strong silica-sericite overprinting earlier weak hematite alteration. This interval contains disseminated coarse pyrite and returned a gold assay of 3.9 g/t.

Figure 7-13: Strong silica-sericite alteration - high grade mineralisation
(From the Han deposit – DPRD0470 at 98.7m depth; 3.9 g/t Au)

8 Deposit Types

The Doropo Project currently includes eight distinct mineralised bodies that host the actual resource plus numerous prospects and geochemical surface anomalies yet to be tested, fitting an area of about 170 km^2, or within a circular area of 7 km radius.

The mineral occurrences tested to date include two model types, a "classic" shear hosted gold deposit model and a quartz vein hosted gold deposit model. Both these models are coherent in nature with the majority of the other West African deposits, except on the issue of the host environment (the granitic domain).

The granitic complex displays lozenge-shaped arrays of anastomosing shear zones. The shears have a broad South-South-West to North-North-East orientation, dipping shallowly towards the NW. This interpreted model has been developed by several authors but was formalised in 3D by the OreFind geologists. The mineralisation occurs all along the shears, which were all channel ways for the fluid flows, however at a generally low grade gold deposition. Significant higher grade mineralisation occurs on specific localised trend orientations, or when shears intersect, and often spatially associated with doleritic dyke swarms (Davis, 2017).

The quartz veins mainly occur along the NW-SE orientation, as sub-vertical or steeply dipping towards the SW. These veins show significant gold grades and often visible gold but have a limited width.

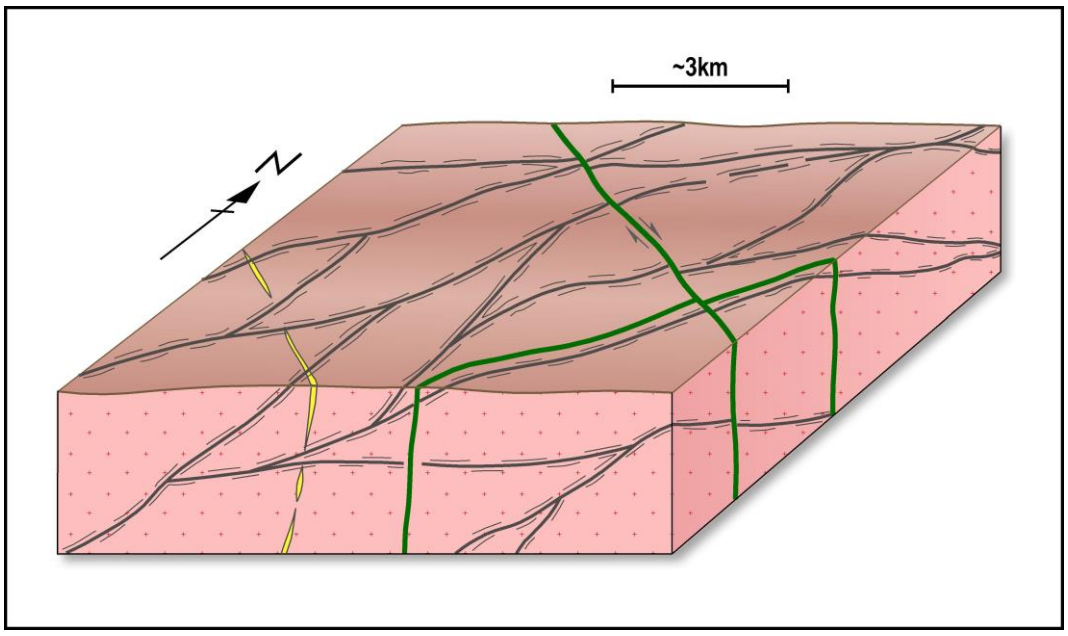

Figure 8-1: Schematic geological model interpretation of the resource area
(shear zones in black, quartz veins in yellow and doleritic dykes in green)
(From Centamin, March 2019)

9 Exploration

Only minor exploration work was conducted before Centamin took over the Doropo Project in 2014. This work was limited to field reconnaissance and rock chip sampling and was carried out by Ampella Mining Ltd.

Centamin started exploration work in 2014, progressing from the regional field mapping, to the surface geochemistry sampling, via soils and auger, to the geophysical surveys, ground surveys and airborne surveys, to trenching, aircore drilling and then reverse circulation and diamond drilling.

The above strategy currently remains unchanged, and continues to be applied to the pipeline of targets on all the Projects in the country.

All exploration work has started from a fixed base setup in the Doropo town. Following up the momentum in drilling activities on the prospects host of the actual resource, a second camp was set up in the Danoa village, located closer to the drill sites, about 45 km by tracks from Doropo. The regional exploration work (mapping, soil sampling, auger sampling, aircore drilling) is based out of fly camps or other temporary camps depending on the location of the programs.

9.1 Coordinates, Survey Controls and Topographic Surveys

The default coordinates system used on the Project is based on the UTM coordinates, Zone 30 North in the World Geodetic System (WGS) 84. The Shuttle Radar Topography Mission (SRTM) digital data is used as the topographic reference for all the exploration work carried out to date.

GEDES International SARL Surveyors (Geo-Engineering Design and Surveying) is an accredited surveyoring company that is contracted to carry all ground surveys on the Project, including recording the location of all drill hole collars.

Ground fixed control points are regularly established, to follow the exploration progress. At the end of 2018, height control points were setup by GEDES. They are cemented in the ground, generally located on duricrust plateaus in the vicinity of the major prospects.

All drill hole collars (including RC and diamond collars) are surveyed using differential GPS unless accuracy is deemed to be low due to issues such as poor satellite coverage or abundant vegetation cover. In these cases, a total station is used to record the location of the collars. All other programs including soil samples, rock samples, auger collars, trenches, aircore collars are located using hand-held GPS units.

The collar elevations are linked to the NGCI system (Nivellement General de Cote d'Ivoire), that is the standard system for recording elevation in Cote d'Ivoire.

9.2 Geological Reconnaissance, Mapping and Rock Chip Sampling

Outcrops on the Project area are uncommon due to the granitic nature of the underlying rock. In the resource area, the main access to outcrops are generated by the artisanal mining.

The initial reconnaissance focused on mapping all the artisanal mining spots, the outlines of the excavations and any data on the quartz veins that were mined. All quartz vein, and the veins selvages were sampled by rock chipping. The interpretation of the results of the regolith mapping can be seen in Figure 9-2.

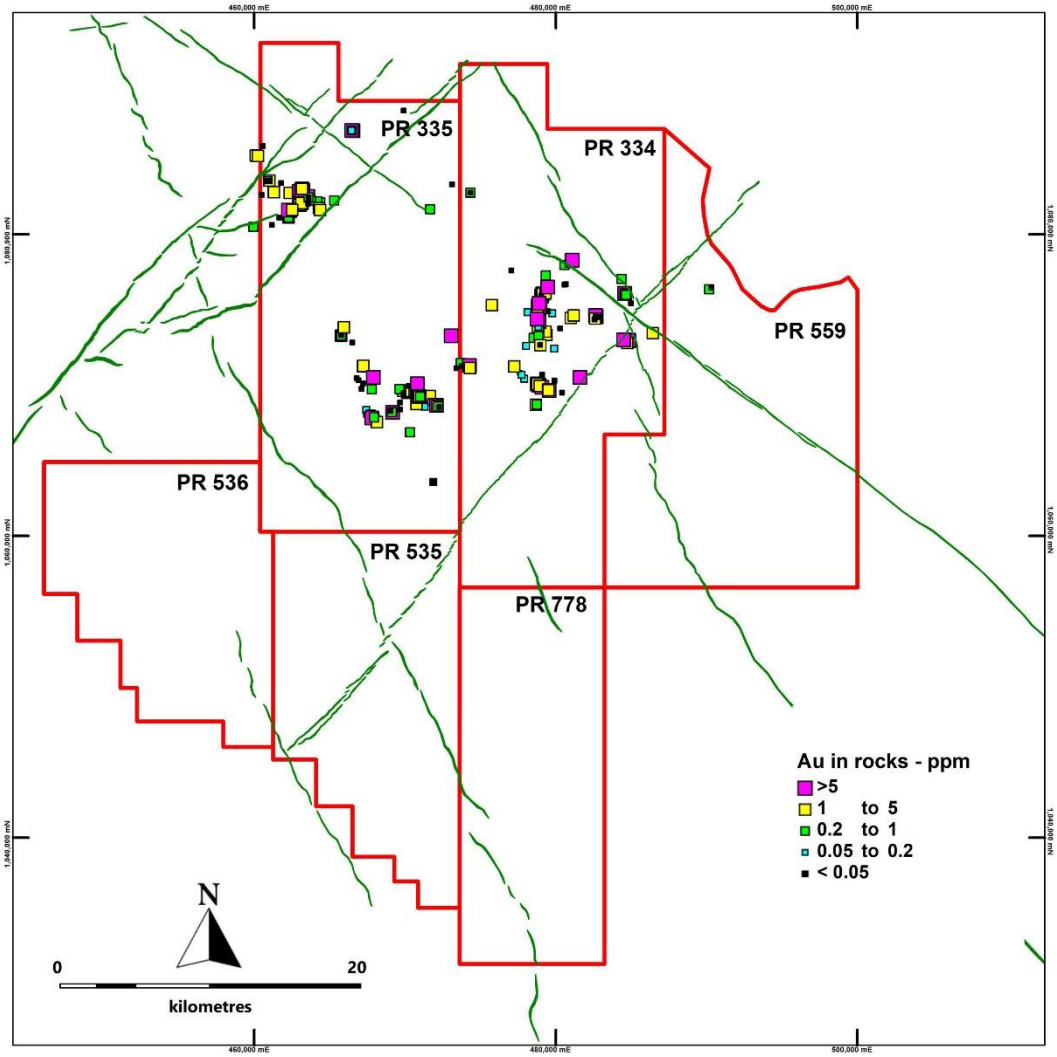

Figure 9-1: Location and results of rock chip sampling programs
(From Centamin, March 2019

9.3 Airborne Geophysical Survey

A regional aeromagnetic and radiometric survey, with additional detailed infill surveying over the Doropo Project, was flown by UTS Geophysics/Geotech Airborne Limited (UTS) between March 24 and May 27 in 2015 (Wood, 2015). The survey was flown using NNW-SSE oriented survey lines spaced either 200 m or 100 m apart, and covered a total of 21,827 line km.

The resulting imagery supported the initial regional interpretations and then the first regional exploration programs. The results of the magnetic imagery can be seen in Figure 9-2.

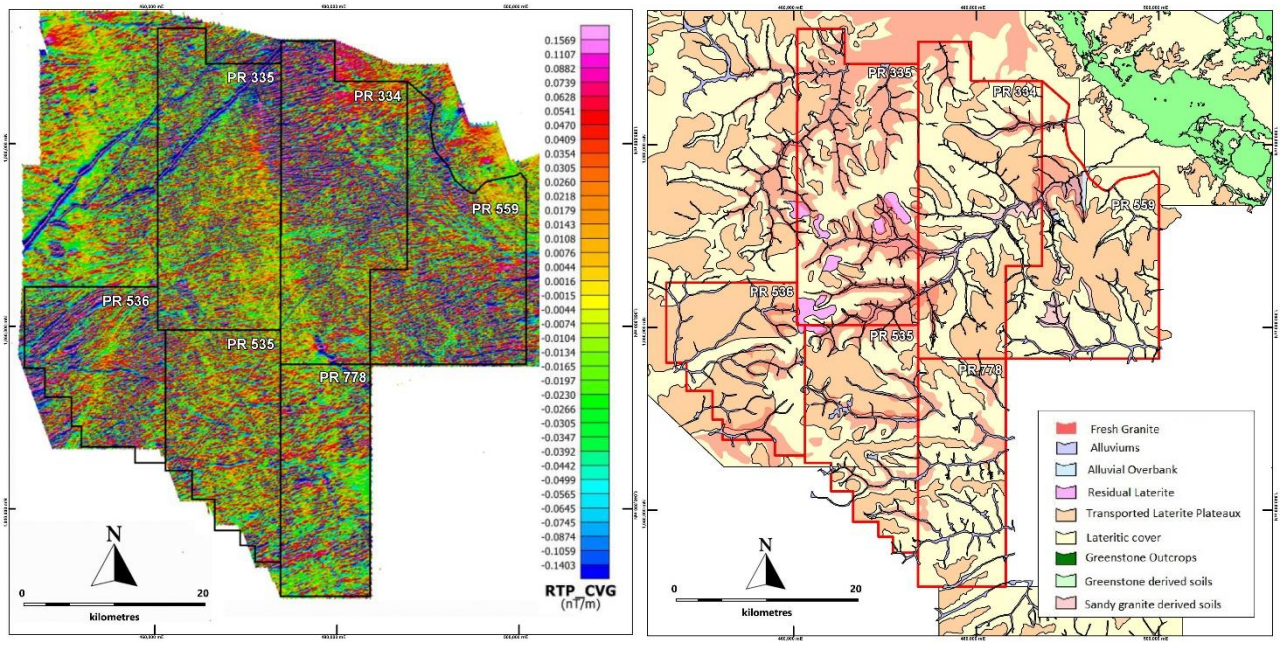

Figure 9-2: Exploration data: magnetic imagery and regolith mapping
(From Centamin, March 2019)

9.4 Soil Sampling

Soil sampling remains an efficient reconnaissance tool on the granitic domain, and has proven to return representative results.

Several orientation surveys were originally conducted within the permit areas, across zones of artisanal mining activity as well as areas with no specific activity. The results showed that the upper most surface material, of sandy composition and often transported, is not representative at the prospect scale and returned irregular widespread dispersions of the gold anomalism. However, the horizon of mottle zone, or sometimes stripped top of saprolite, returned more coherent and reliable gold anomalism in the vicinity of the mineralised structures.

All subsequent soil sampling surveys sampled these representative levels, which are accessible from about 0.5 m depth to about maximum 3 m depth by quick pitting. Beyond this depth, the auger drilling methods are more efficient.

The regional soil grid is set on a staggered 400 m x 400 m grid. Infill sampling is then carried out where necessary on 200 m or 100 m spaced grids.

All soil samples (and geochemistry samples in general) are analysed using a standard 50 g gold fire assay with an atomic absorption finish at Bureau Veritas Laboratories in Abidjan. Multi-elements are also analysed by four-acid digest with ICP-AES and ICP-MS finish at the ACME Laboratories in Vancouver.

In total, 26,630 soil samples were collected between 2014 and December 2018, including 12,254 samples on infill grids on the Project. Most of the deposits and current prospects are well highlighted by the soils results. A map showing the location and results of the soil sampling programs can be seen in Figure 9-3 and the combined results of the soil sampling and auger drilling surveys can be seen as a colour contour map Figure 9-5.

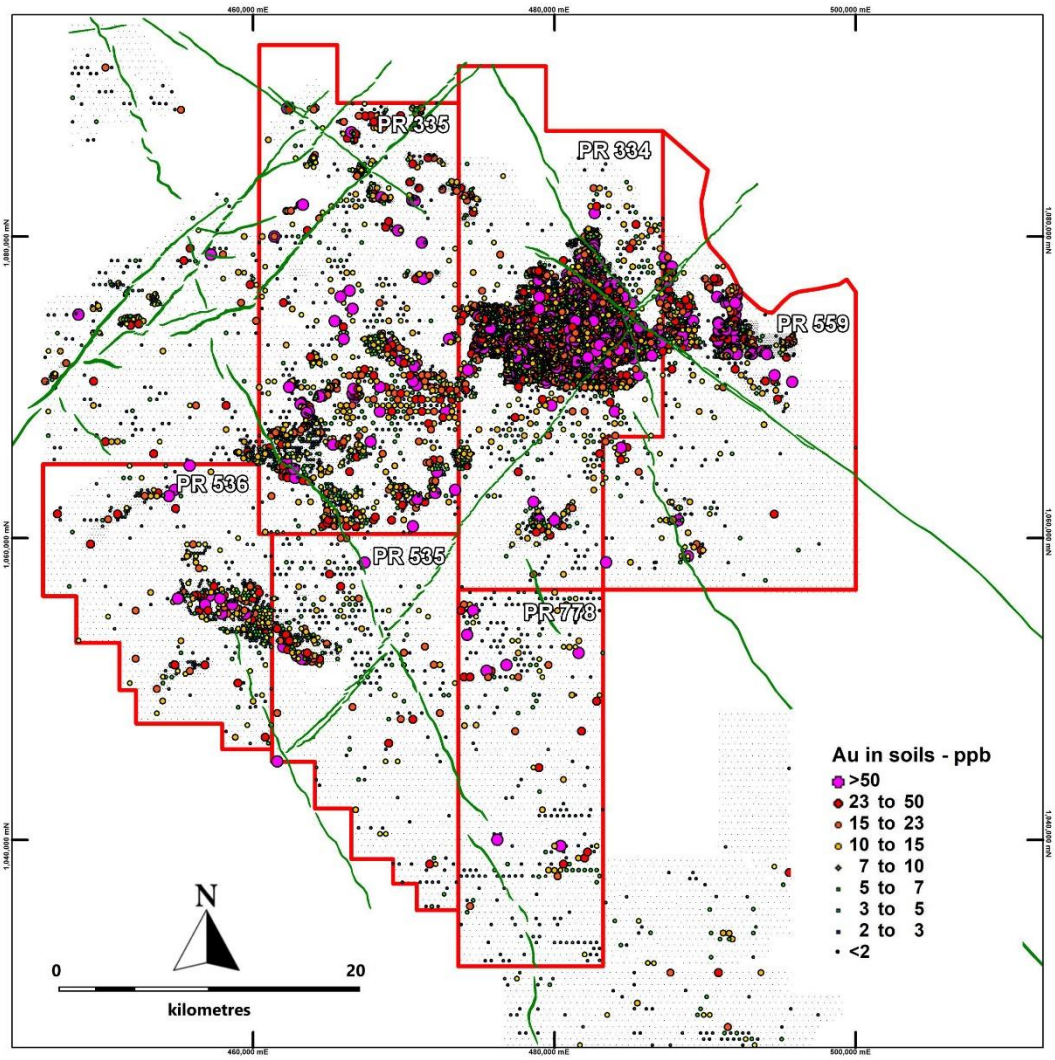

Figure 9-3: Location and results of soil sampling programs
(From Centamin, March 2019)

9.5 Auger Drilling

Auger drilling was largely used on the Project to complete the soil grid surveys were the thickest lateritic plateaus cover the in-situ material and where the transported horizons (alluvium, sand) average over 3 m thickness.

The powered augers, mounted on Land Cruisers, from Sahara Mining Services have been used on the Project to date.

Generally, one sample from the top of the saprolitic horizon is collected per auger hole and is analysed for gold only (same analysis methods as the soils). In some cases, a second sample is also collected at the base of the lateritic horizon, aiming to test for mineralised lateritic layers.

The samples collected from the auger drilling carried out in 2014 were analysed for gold by aqua regia digest with atomic absorption finish at SGS Laboratory in Ouagadougou.

A map showing the location and results of the auger drilling programs can be seen in Figure 9-4 and the combined results of the soil sampling and auger drilling surveys can be seen as a colour contour map Figure 9-5.

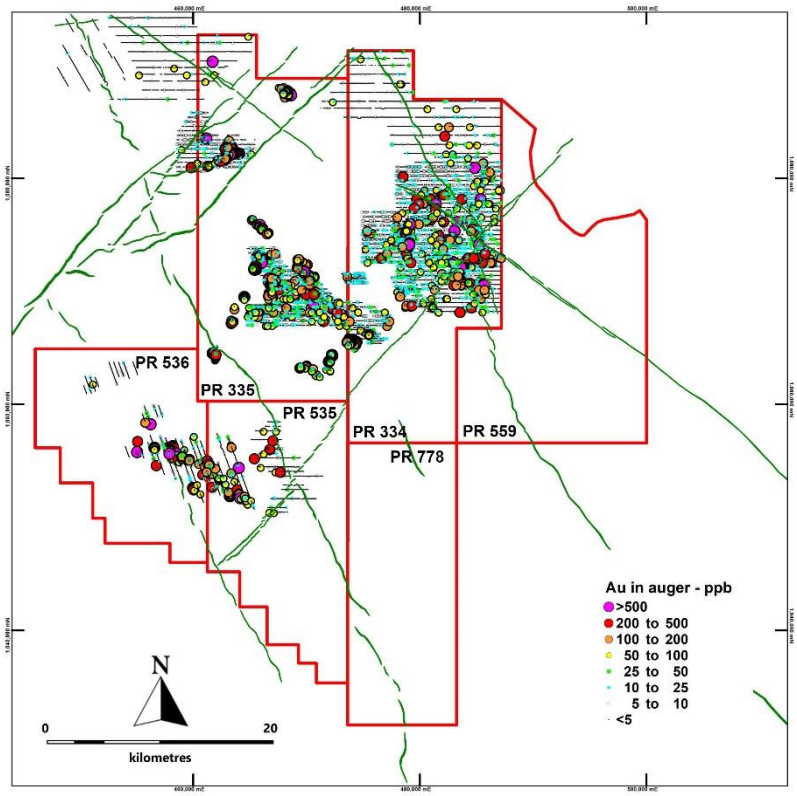

Figure 9-4: Location and results of auger sampling programs
(From Centamin, March 2019)

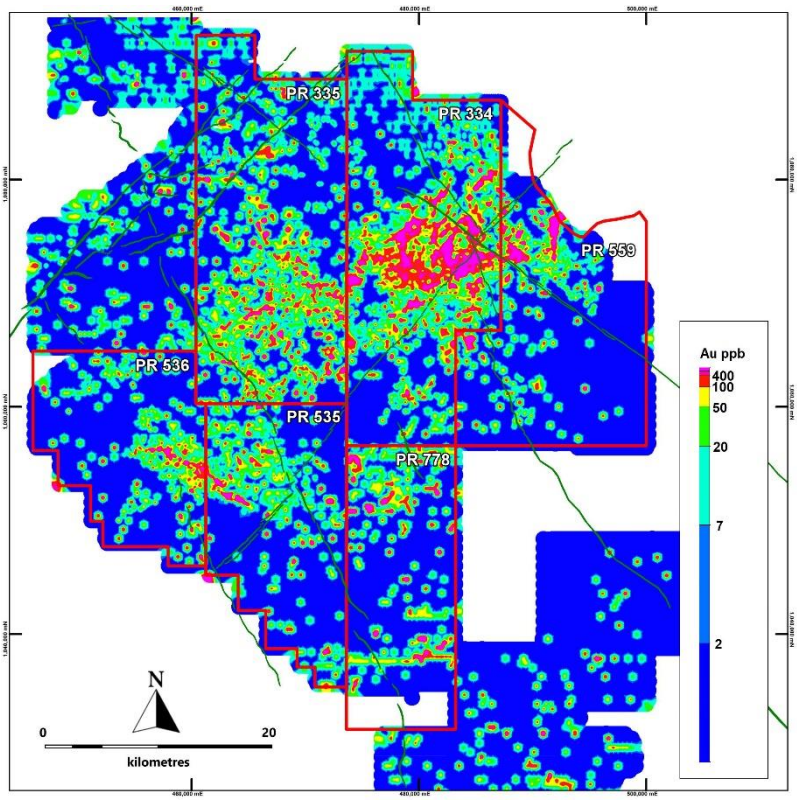

Figure 9-5: Exploration data: gridded gold values in surface geochemistry (merged soils and auger data)
(From Centamin, March 2019)

9.6 Trenching

Trenching was used on some remote areas to verify in-situ mineralised structures highlighted by geochemical sampling.

9.7 Regolith Mapping and Interpretation

The regolith map was generated to cover the entire Project area, using a combination of satellite imagery, radiometrics, soils database and field checking.

Weathering processes result in the depletion of potassium and relative enrichment of thorium and uranium, therefore radiometric maps including Th, K and U are extremely useful in identifying lateritic plateaus, as well as areas with little to no weathering profile. Large areas of lateritic plateaus, rivers and alluvial deposits can be easily identified using satellite imagery.

The soil sample descriptions, that include comments on the surface landscape, also provided good insight into the profile of the regolith.

9.8 Gradient Array Induced Polarisation Survey

Gradient Array Induced Polarisation (GAIP) surveys are regularly used to interpret the continuity of structures when already highlighted by other methods. Multiple blocks were surveyed in 2015 and 2016 in the resource area (Toni, 2017). The Nokpa deposit was targeted directly from the interpretation of the GAIP imagery.

SAGAX is used to run the ground survey while RESPOT works on the QAQC and data processing.

9.9 Aircore Drilling

Campaigns of aircore drilling are regularly conducted to quickly test coherent geochemical gold anomalism, conceptual targets or extensions to known mineralised structures. From June 2015 to December 2018, 121,811 meters were drilled on the Project. A map showing the combined aircore, RC and diamond drill hole locations can be seen in Figure 10-5. Aircore drilling is used as an exploration tool but is not included in the database used for resource estimates due to issues relating to sample representivity.

All the drilling completed to date was conducted by Geodrill Ltd.

The aircore holes are usually planned on lines across the targets to test; collars are planned heel to toe based on ground refusal along the lines.

The aircore programs identified several mineralised structures which have now been followed up by RC and diamond drilling, including Souwa, Kekeda, Enioda. Several other structures are yet to be followed up by further drilling programs.

The samples are composited on 2 m lengths and analysed for gold by fire assay at the Bureau Veritas Laboratories in Abidjan.

10 Drilling

The drilling programs (RC and Diamond) ran continuously on the Doropo Project since the end of November 2015, following the first significant hits from the aircore programs. This drilling is the first to have been completed for exploration purposes in the whole North-East region of Cote d'Ivoire. All the procedures applied have been specifically adapted to the Project from the experience previously gained by the team on previous projects – they respect the highest standards applied in the industry.

All the drilling was completed to date by the same drilling company, a reputable contractor who respects the best industry practices, Geodrill Limited. The drill rigs are well maintained and the maintenance crew is quickly responsive. All the staff, from the drillers to the offsiders, are well trained and operate smoothly. The drill rigs used on the Project are UDR200 (for diamond drilling only), UDR650 (small multipurpose rig, truck mounted) and UDR900 (big multipurpose rig, track mounted).

The drilling programs are planned using on-site interpretations, which are based on previous exploration programs, surface geochemistry, aircore drilling or other previous drilling completed, geophysical imageries and on conceptual interpretations.

The drill sites are marked by hand held GPS, prepared by hand clearing or dozer depending on the areas. By default, infill lines are cleared by dozer. The drill pad sizes are set by the needs from the drilling contractor.

Downhole surveys are taken every 30 m down hole, the first one being at 12 m depth (after two RC rods drilled), with single shot Relfex EZ SHOT system. Every survey is validated at the rig site by the geologist before being entered in the database. The geologist measures the hole orientation at surface using a compass, which is used as the collar downhole survey value.

The location of all drill collars are initially surveyed by the geologist using a hand held GPS, to rapidly enter the data into the database. Regular surveying campaigns are conducted by an independent surveyor company (GEDES International) to accurately pick up collar coordinates with either the Total Station or differential GPS. No dedicated ground topographic survey has yet been completed on the project. A topographic surface created from the drill hole is used for the resource work purpose.

After the completion of a drill hole, the drill site is cleaned of any rubbish and any contaminated soil (from oil spill, gasoil spill) is removed. A concrete block of approximatively 40 cm x 40 cm x 20 cm is set around the PVC casing for future reference.

The database is stored under the Acquire system, directly managed on site.

10.1 Reverse Circulation drilling

The Reverse Circulation (RC) drilling has been continuously used on the Project from the end of November 2015. One to three multipurpose rigs (to keep the opportunity to switch to diamond drilling) are rotating, depending on the program. In total, 202,477 meters have been drilled up to December 2018, including all the infill drilling achieved for the resource definition purpose.

The drilling is dominantly dry and the moisture content (dry, moist or wet) of the bulk sample has been recorded since the end of 2016. For resource definition drilling, the drilling stops when the water

table is reached and the air pressure cannot keep the samples dry. The hole may then be continued by diamond drilling if the targeted mineralisation was not intersected yet.

The RC drilling uses hammer bits of nominally 5 ¼, 5 ½ and 5 ¾ inch diameter; the bit size was poorly recorded by drill holes until November 2016. From this time onward, the bit sizes used by depth and by hole has been recorded.

10.2 Diamond drilling

The diamond drilling is used as drilling tails after RC pre-collar in case of the deepest drilling (over about 180 m depth) as well as holes drilled to get structural data. Some diamond drilling was also completed to composite for metallurgical test-work samples, in which case, either quarter core or half core (depending on the needs) were kept and analysed for gold assays to include for resource estimates.

A total of 10,223 meters of diamond drilling were completed on the Project until December 2018, including 4,102 meters for metallurgical sampling.

10.3 Sample Recovery and Grade

The relationship between drill hole recovery and assay grade was investigated with the use of a series of conditional expectation plots. In grade-recovery analysis, the main concern is higher grades associated with lower recoveries, which may indicate an upgrading of samples due to the preferential loss of gangue material. This would lead to biased sampling, resulting in an over-estimation of resources. A lesser concern is lower grades associated with lower recoveries, which may indicate a preferential loss of gold, resulting in an under-estimation of resources.

10.3.1 RC Drill Holes

From the total of 142,939 RC assays from the deposits estimated 139,310 intervals (97%) had records of the weight of the recovered interval. H&SC calculated the expected weight of the interval using the drill diameter data and the average density for each weathering domain in order to calculate the recovery. Figure 10-1 shows a conditional expectation plot of the gold grade of diamond drill core assays against recovery. It can be seen that there is a slight association between lower recoveries and lower grades.

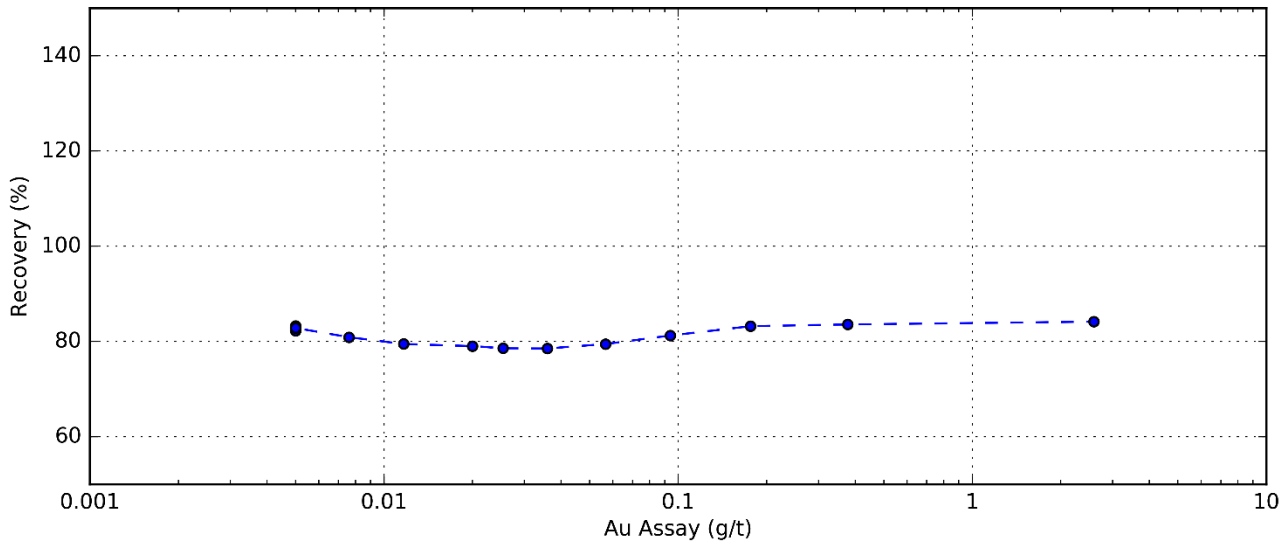

Figure 10-1: Conditional expectation plot of RC hole recovery and gold grade

The association between lower recoveries and lower grades shown in Figure 10-1 was investigated further. It was noticed that shallower RC intervals, below around 40 m are associated with lower recoveries. This relationship can be seen in Figure 10-2 and is considered to be common for RC drilling. Shallow RC drill samples are less likely to intersect mineralisation then deeper samples due to the dipping nature of the mineralised bodies. When the relationship between grade and recovery of RC intervals within the mineralised wireframes is compared, as shown in Figure 10-3, the association between lower recoveries and lower grades is not observed.

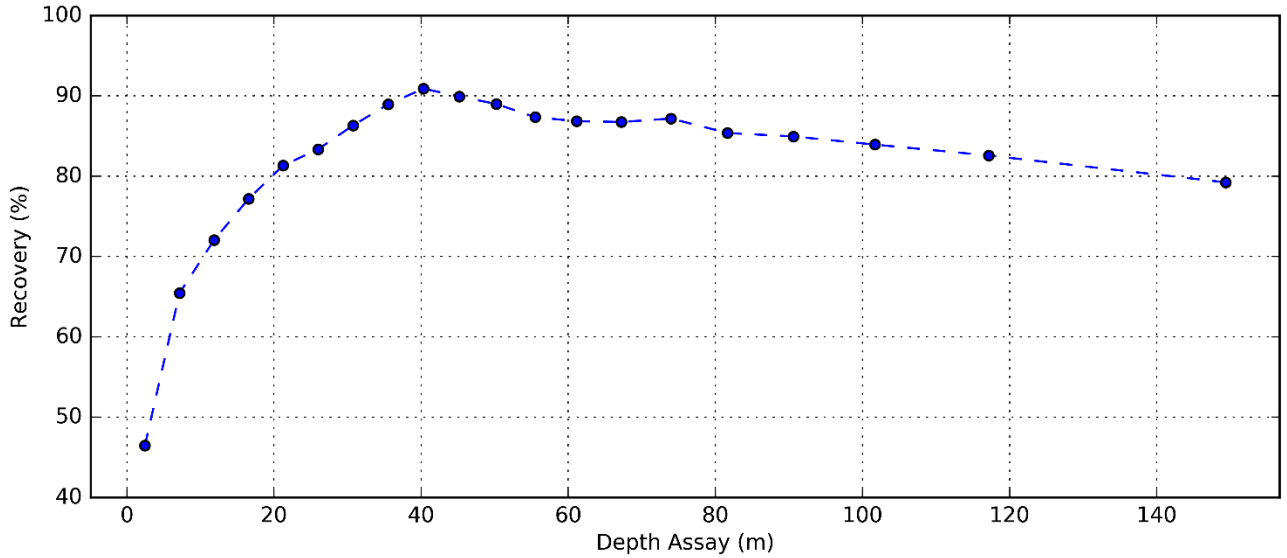

Figure 10-2: Conditional expectation plot of RC hole recovery and depth

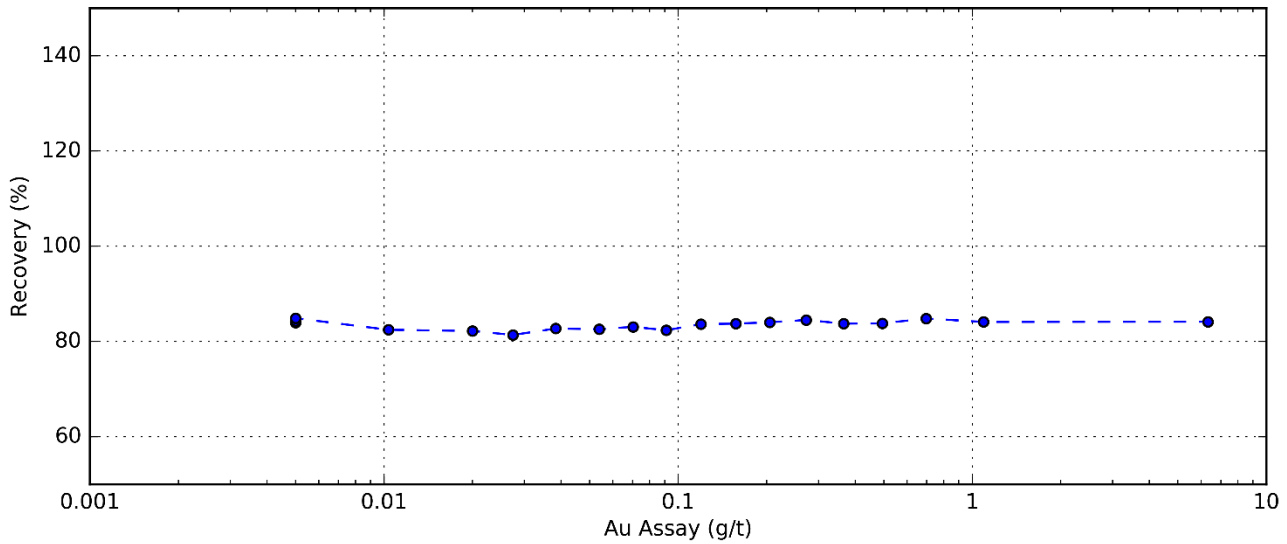

Figure 10-3: Conditional expectation plot of RC hole recovery and gold grade from mineralised zones

The relationship between recovery and grade was also assessed on an individual hole basis for 50 random drill holes through a series of downhole plots. No significant relationships were identified.

10.3.2 Diamond Drill Holes

From the total of 8,629 core assays from the deposits estimated 8,143 intervals (98%) had recovery data. Figure 10-4 shows a conditional expectation plot of the gold grade of diamond drill core assays against recovery. Overall the recovery of diamond drill core is high but there does appear to be a slight decrease of recovery associated with higher-grade gold mineralisation.

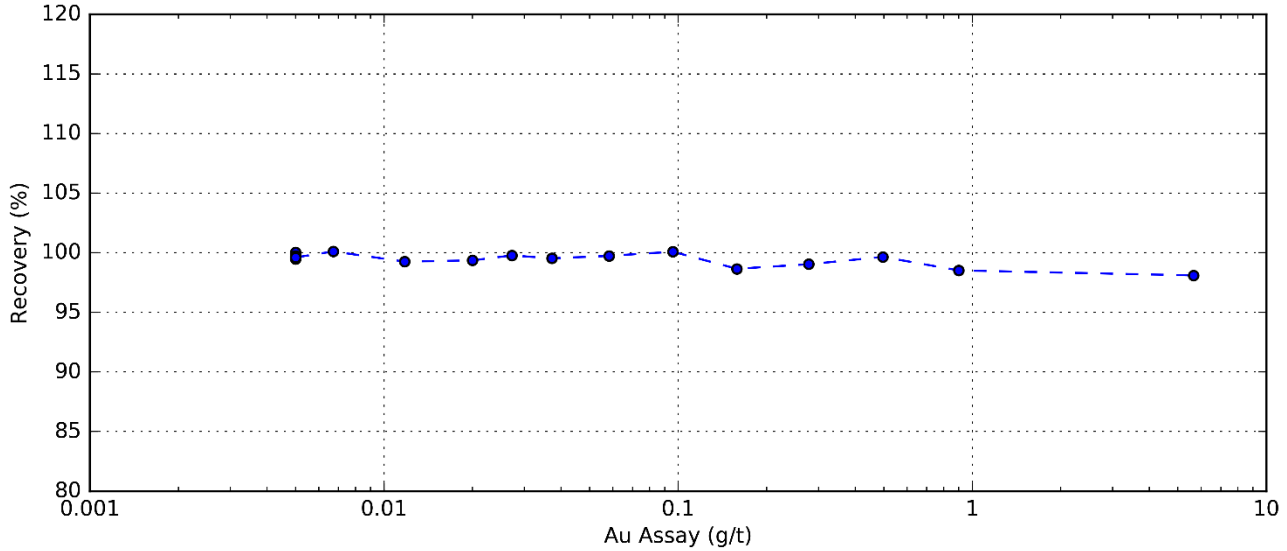

Figure 10-4: Conditional expectation plot of diamond drill hole recovery and gold grade

10.4 Twin Holes

Centamin has drilled a total of eight diamond drill holes that are within 15 m of an RC drill hole. In order to investigate whether the RC drill holes are fairly representing the mineralisation, H&SC

plotted the downhole gold assays for each pair and compared summary statistics. In general the RC assays was found to match the DD reasonably well and differences are believed to be due to the nuggety nature of the gold mineralisation. Within the mineralised zones the average RC grade was found to be slightly higher (0.08g/t) than the average DD grade. Three out of the eight DD holes had higher grades than the twinned RC holes.

10.5 Wet RC Samples

RC drilling in wet conditions can sometimes cause problems with sample recovery and can lead to downhole smearing. H&SC plotted the downhole gold assay and recovery data along with an indicator to identify moist or wet intervals for each of the 216 RC drill holes that had over 10 m of intervals logged as moist or wet. Each plot was assessed with an eye to identifying differences between the wet and dry sampling. No obvious pattern or downhole smearing was observed.

10.6 Drill Hole Coverage

This report presents Mineral Resource estimates of the Doropo deposits and it is considered by the Qualified Person that a drill plan and representative examples of drill sections through each of the deposits are more informative than a tabulation of mineralised intercepts. A map showing all the drilling covering the entire Doropo Project can be seen in Figure 10-5. A map showing the drill hole collar locations covering the deposits estimated can be seen in Figure 10-6. Maps and sections of each of the eight estimated deposits can be seen in Figure 10-7 through to Figure 10-22. The section line for each cross-section can be seen as a red line in the in the inserted plan maps.

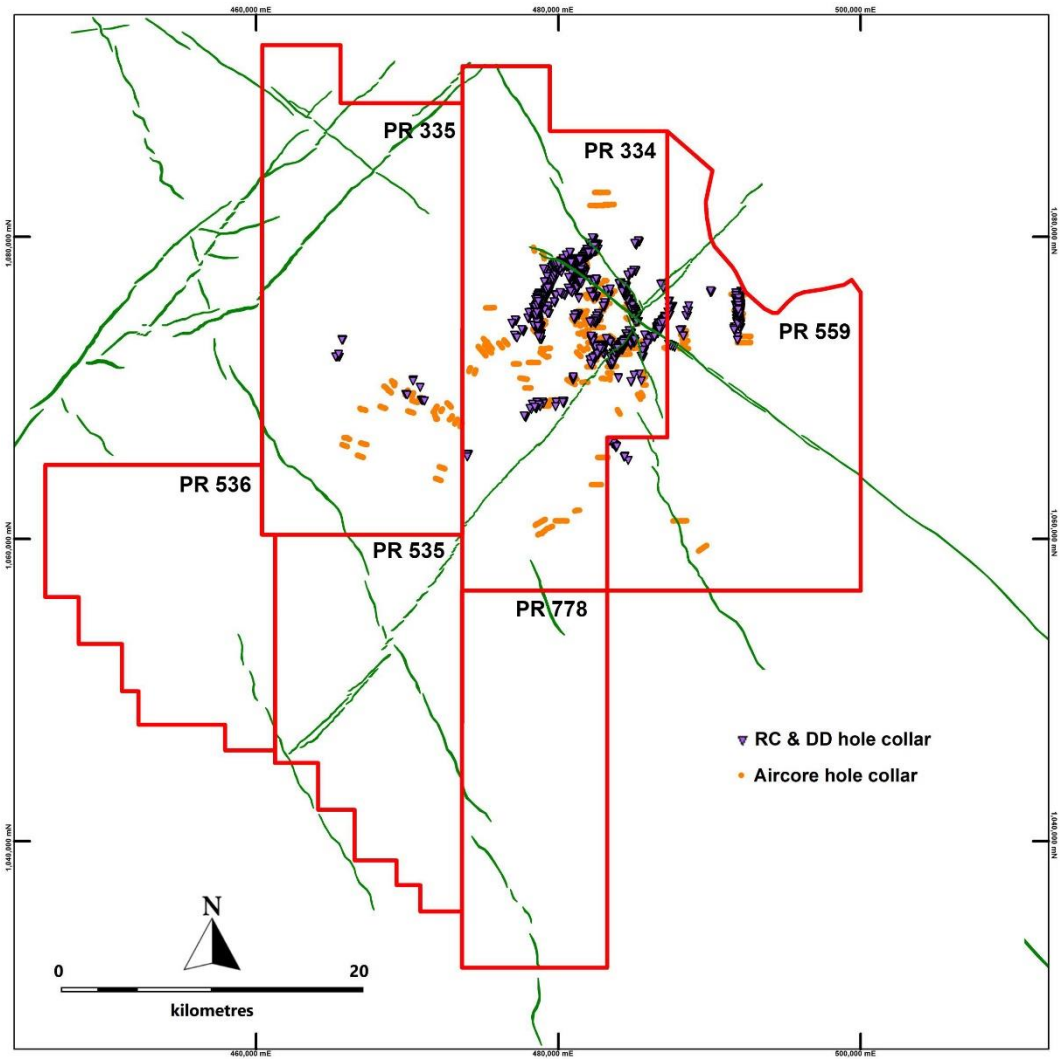

Figure 10-5: Map showing drill hole locations – Project scale
(From Centamin, March 2019)

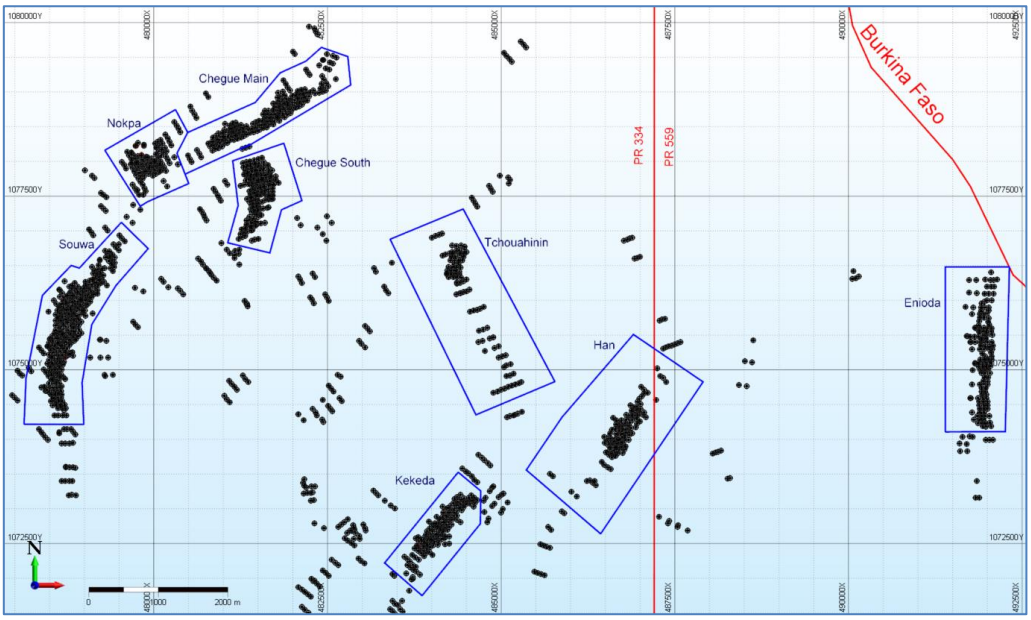

Figure 10-6: Map showing drill hole locations for estimated deposits
(Produced by H&SC, March 2019)

10.6.1 Souwa Map and Cross-Sections

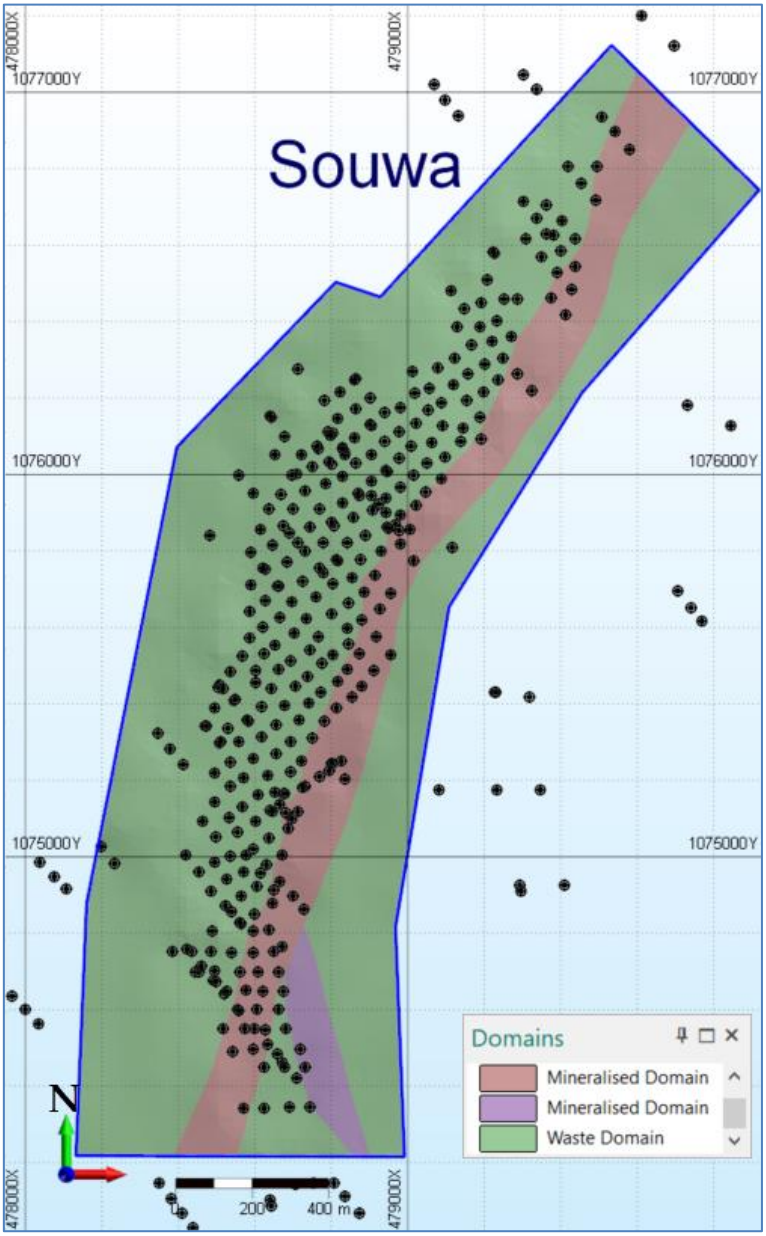

Figure 10-7: Map of the Souwa deposit
(showing drill hole locations and mineralisation wireframes)
(Produced by H&SC, March 2019)

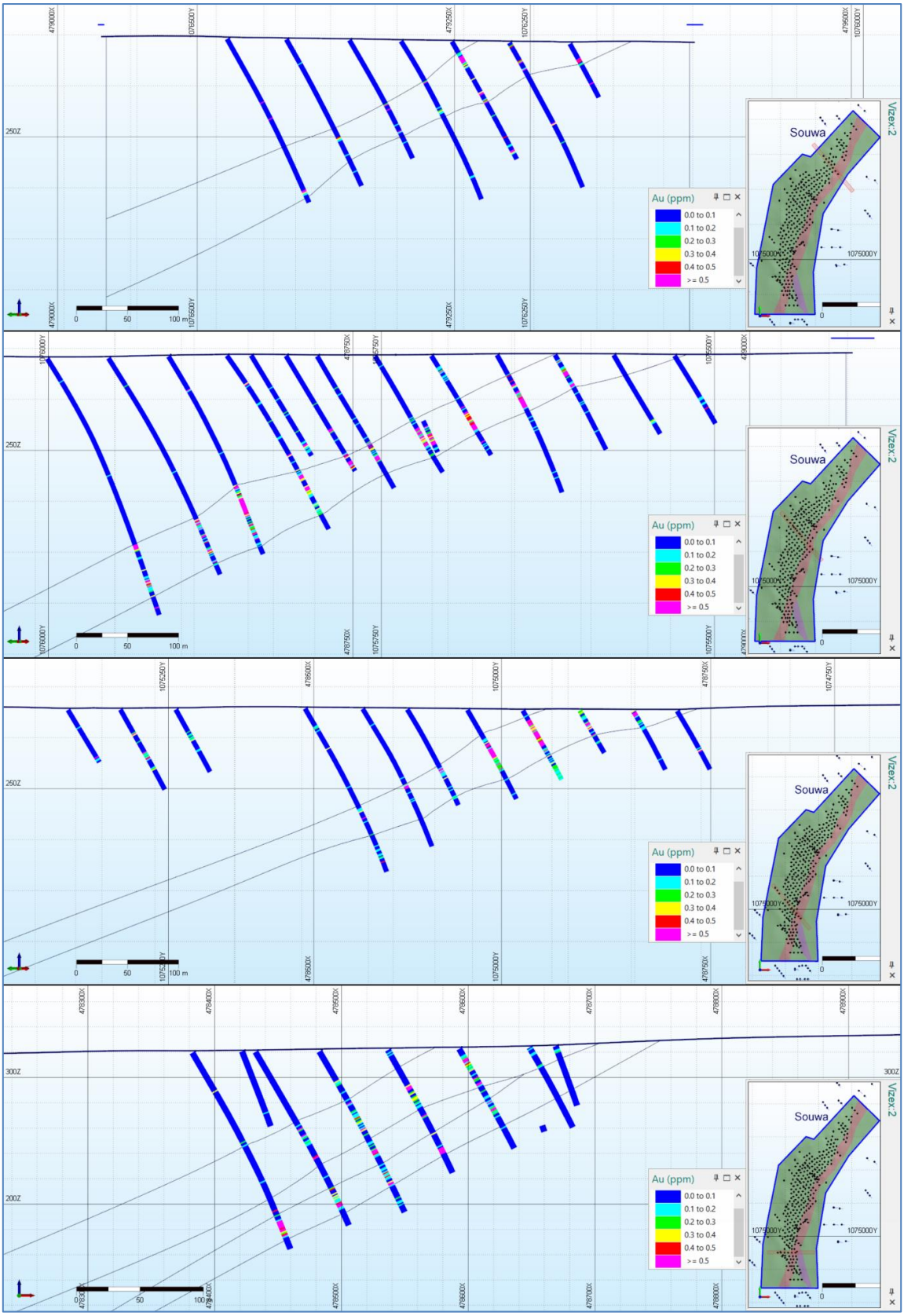

Figure 10-8: Cross-sections of the Souwa deposit
(Showing gold drill hole assays and mineralisation wireframes)
(Produced by H&SC, March 2019)

10.6.2 Nokpa Map and Cross-Sections

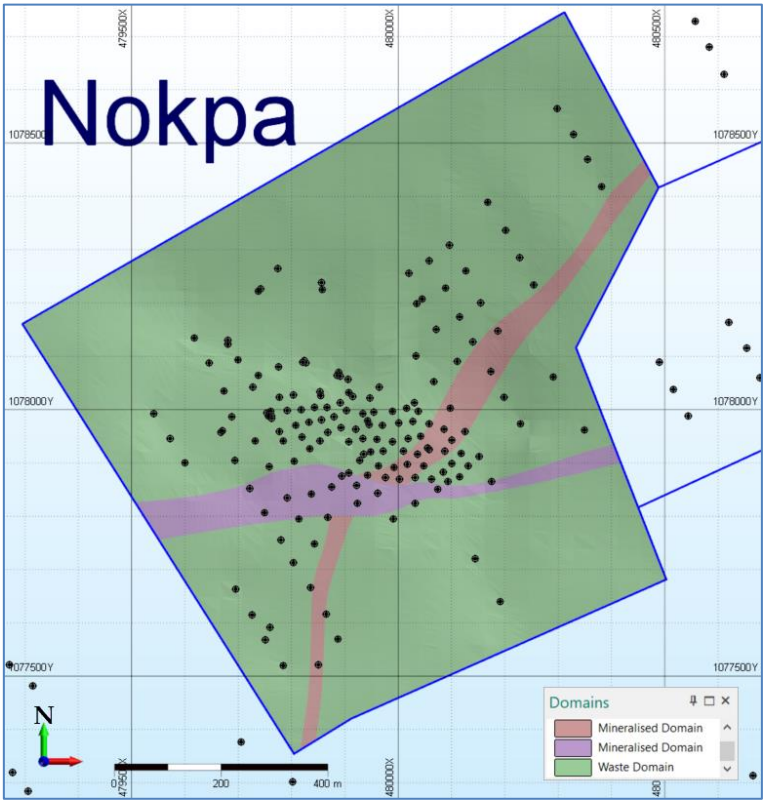

Figure 10-9: Map of the Nokpa deposit
(showing drill hole locations and mineralisation wireframes)
(Produced by H&SC, March 2019)

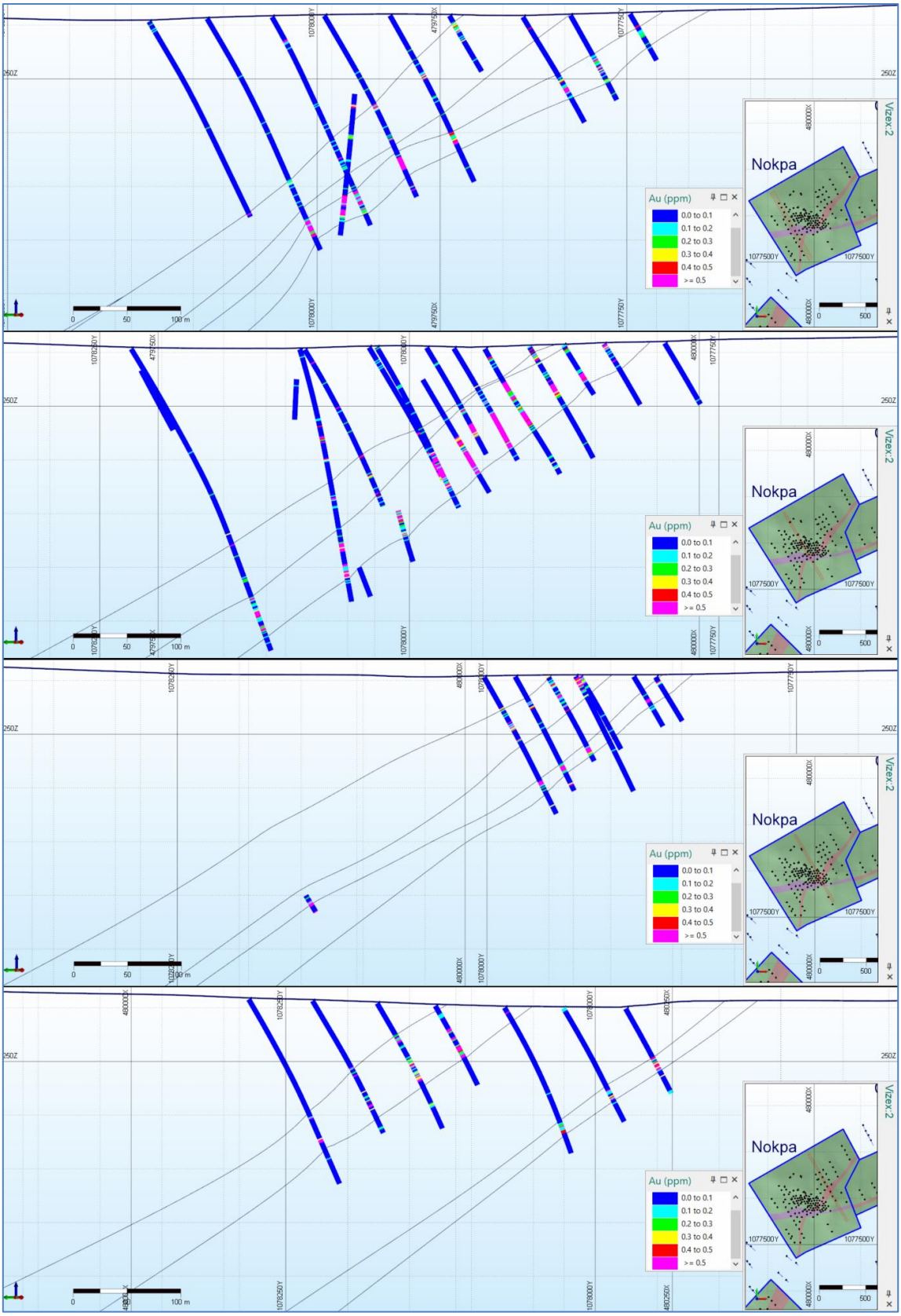

Figure 10-10: Cross-sections of the Nokpa deposit
(Showing gold drill hole assays and mineralisation wireframes
(Produced by H&SC, March 2019)

10.6.3 Chegue Main Map and Cross-Sections

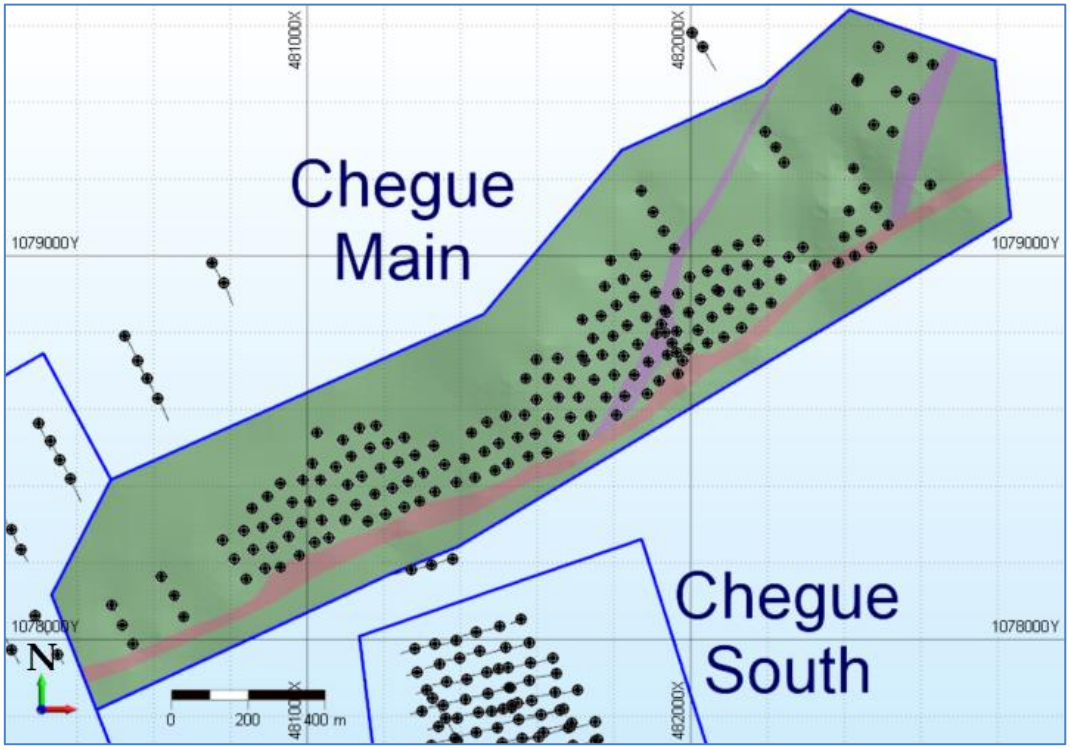

Figure 10-11: Map of the Chegue Main deposit
(showing drill hole locations and mineralisation wireframes)
(Produced by H&SC, March 2019)

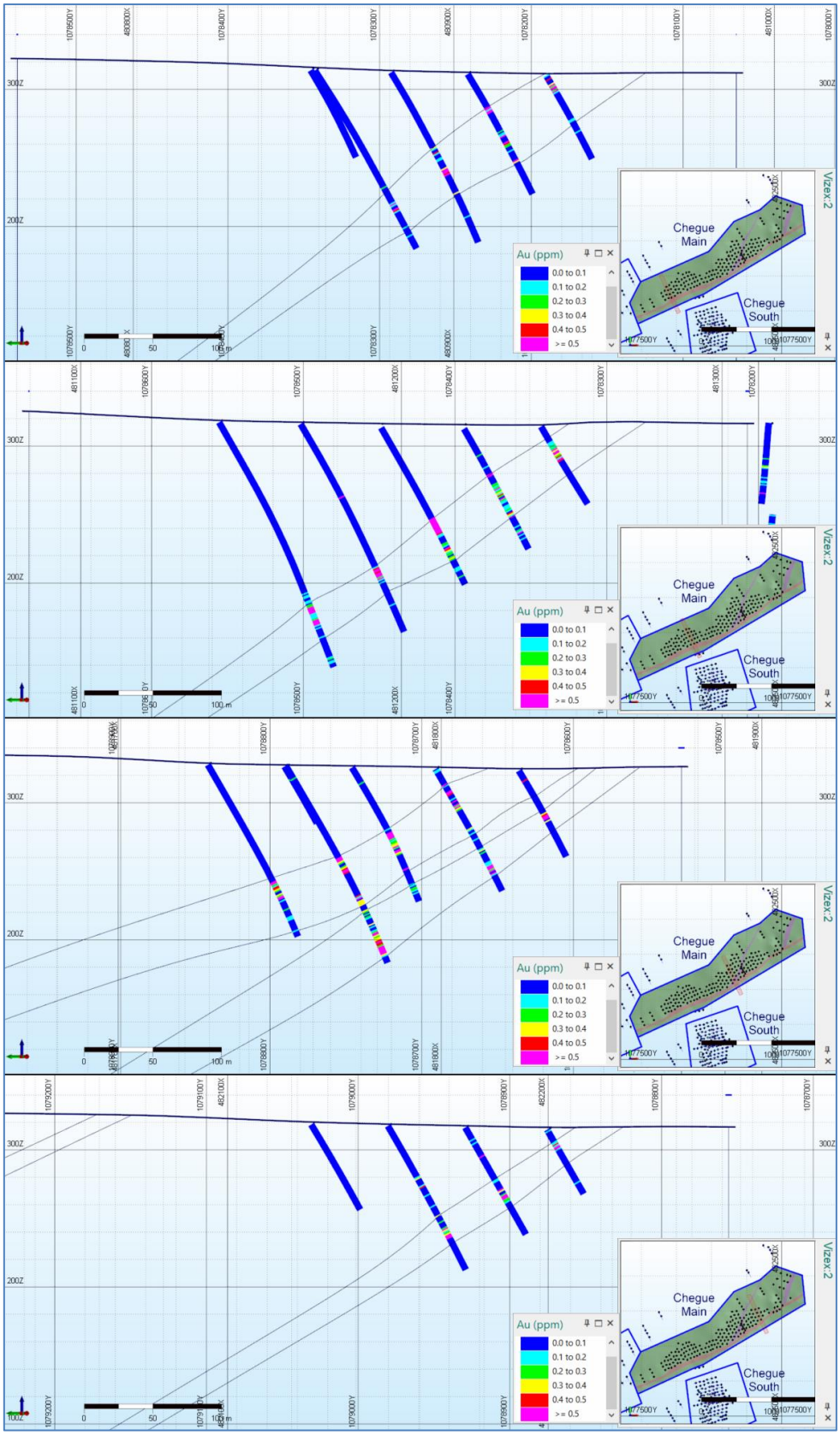

Figure 10-12: Cross-sections of the Chegue Main deposit
(Showing gold drill hole assays and mineralisation wireframes)
(Produced by H&SC, March 2019)

10.6.4 Chegue South Map and Cross-Sections

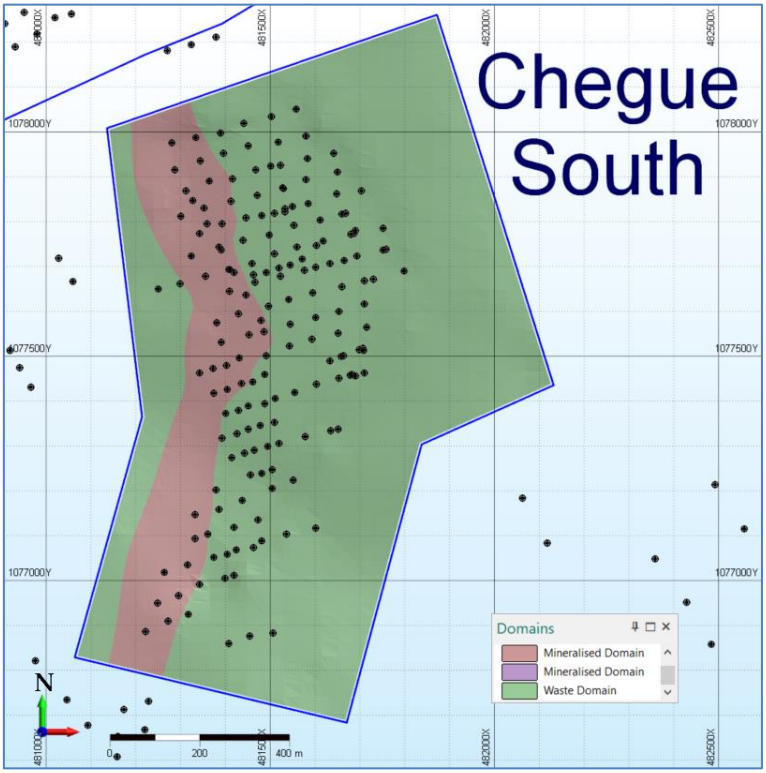

Figure 10-13: Map of the Chegue South deposit
(showing drill hole locations and mineralisation wireframes)
(Produced by H&SC, March 2019)

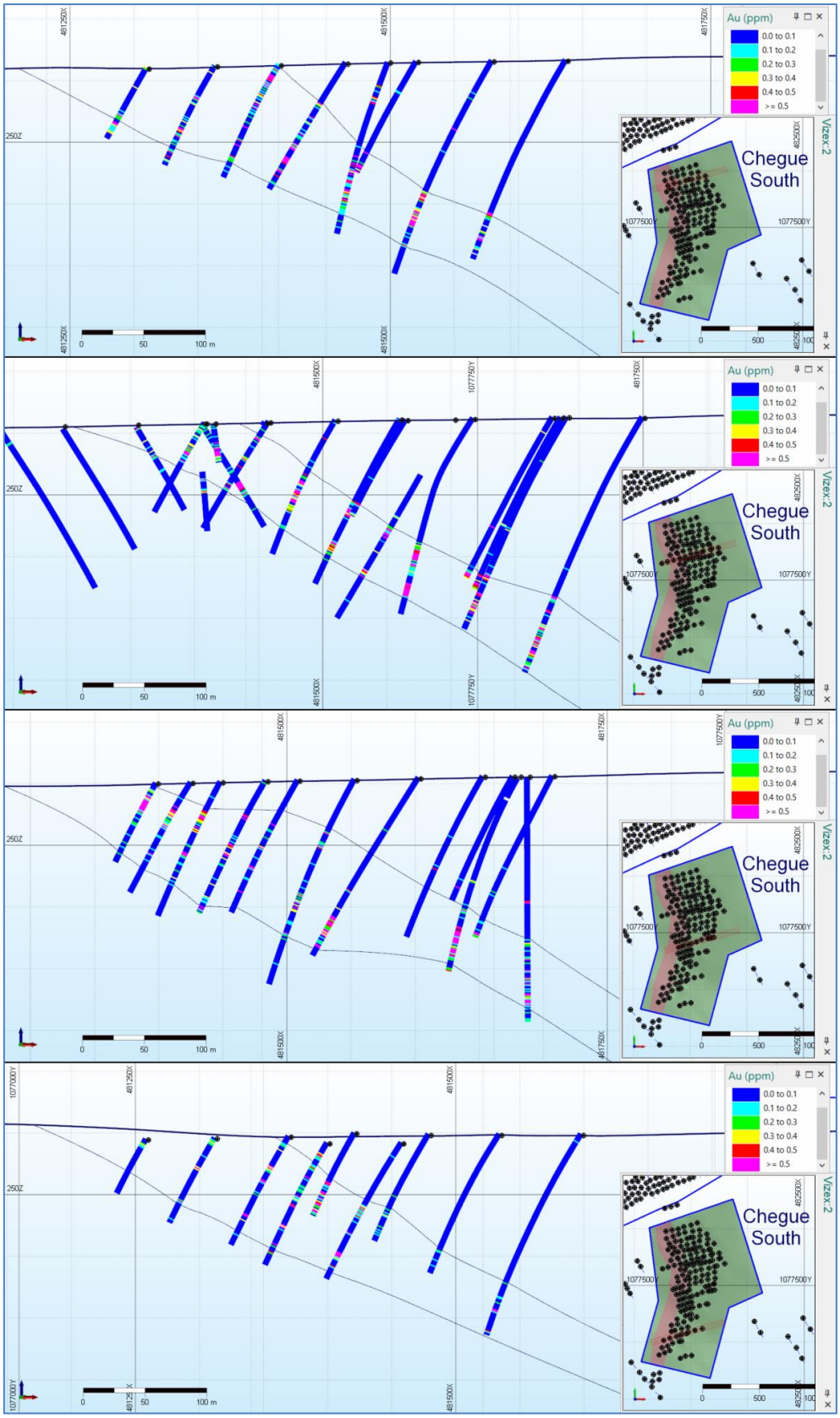

Figure 10-14: Cross-sections of the Chegue South deposit
(Showing gold drill hole assays and mineralisation wireframes)
(Produced by H&SC, March 2019)

10.6.5 Tchouahinin Map and Cross-Sections

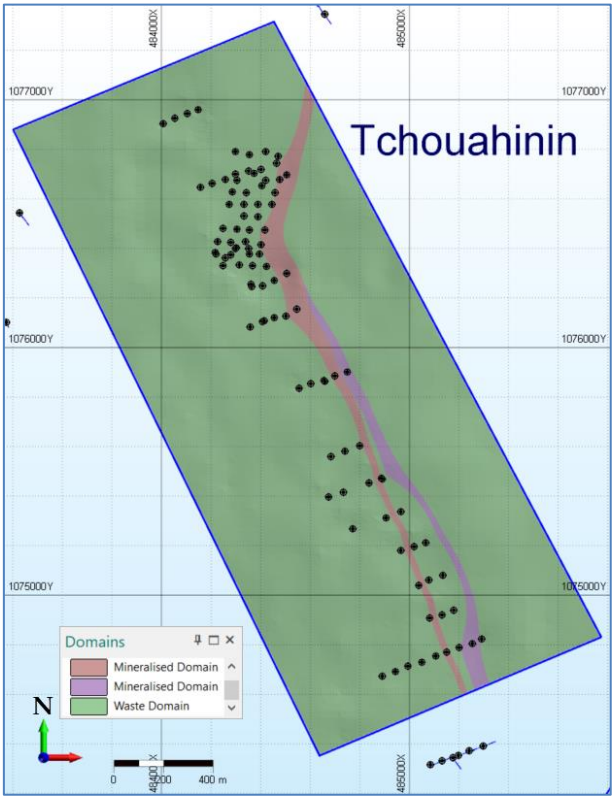

Figure 10-15: Map of the Tchouahinin deposit
(showing drill hole locations and mineralisation wireframes)
(Produced by H&SC, March 2019)

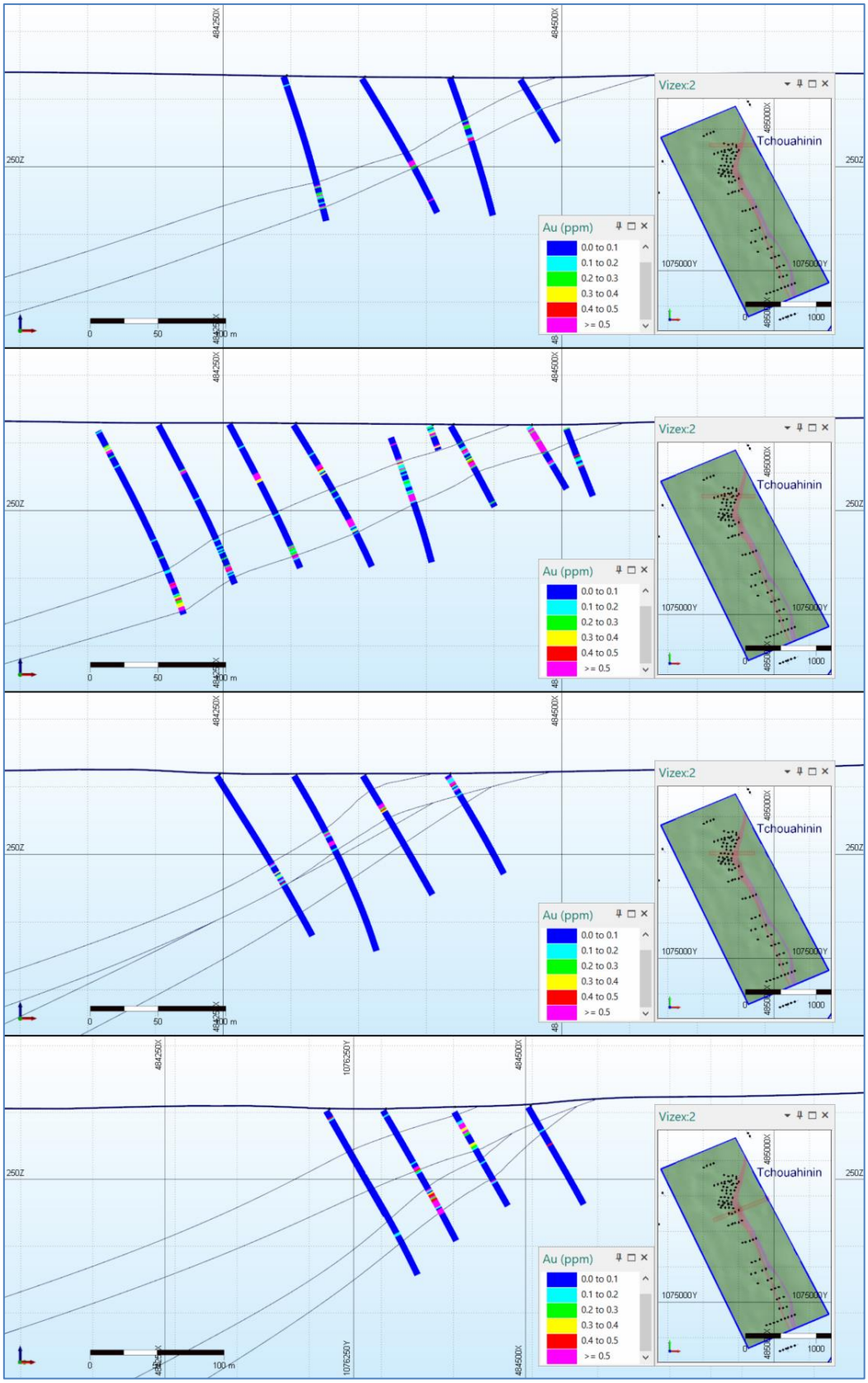

Figure 10-16: Cross-sections of the Tchouahinin deposit
(Showing gold drill hole assays and mineralisation wireframes)
(Produced by H&SC, March 2019)

10.6.6 Kekeda Map and Cross-Sections

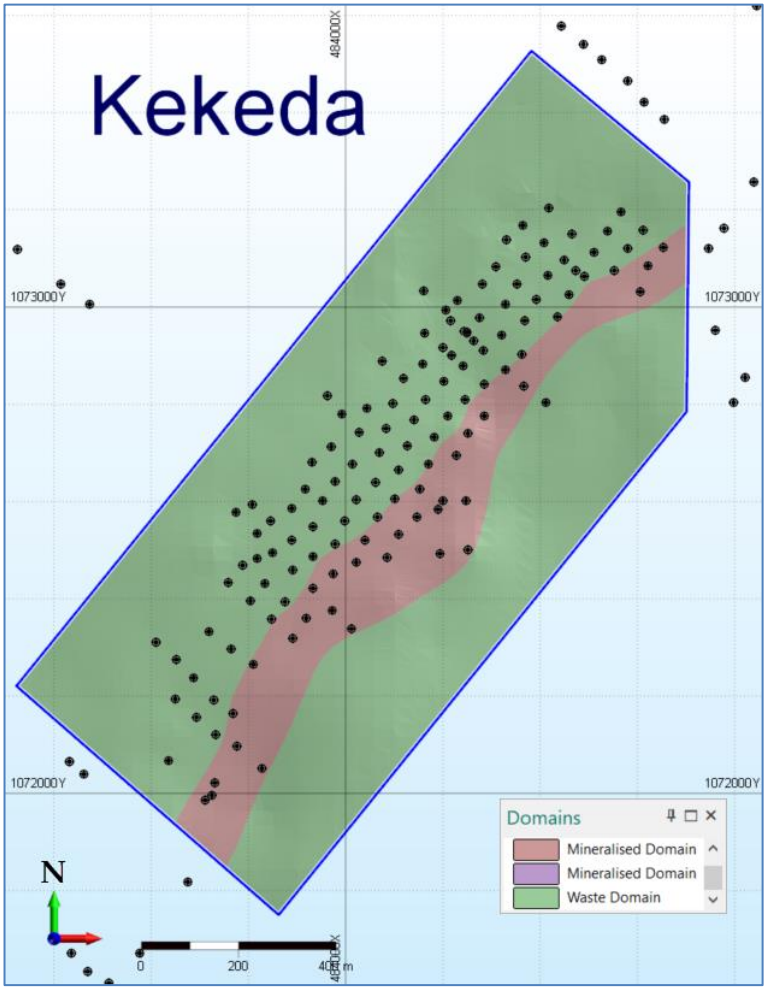

Figure 10-17: Map of the Kekeda deposit
(showing drill hole locations and mineralisation wireframes)
(Produced by H&SC, March 2019)

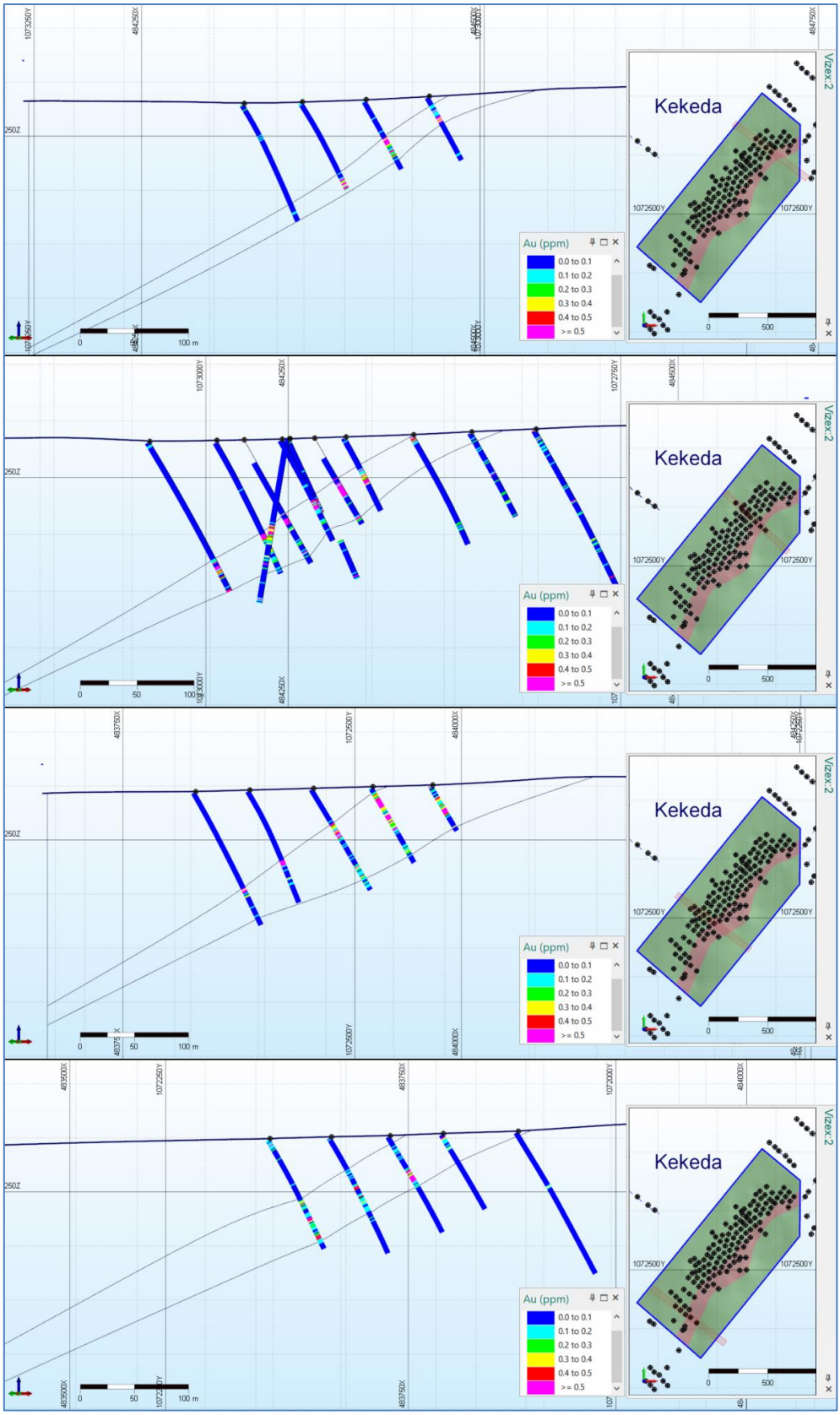

Figure 10-18: Cross-sections of the Kekeda deposit
(Showing gold drill hole assays and mineralisation wireframes)
(Produced by H&SC, March 2019)

10.6.7 Han Map and Cross-Sections

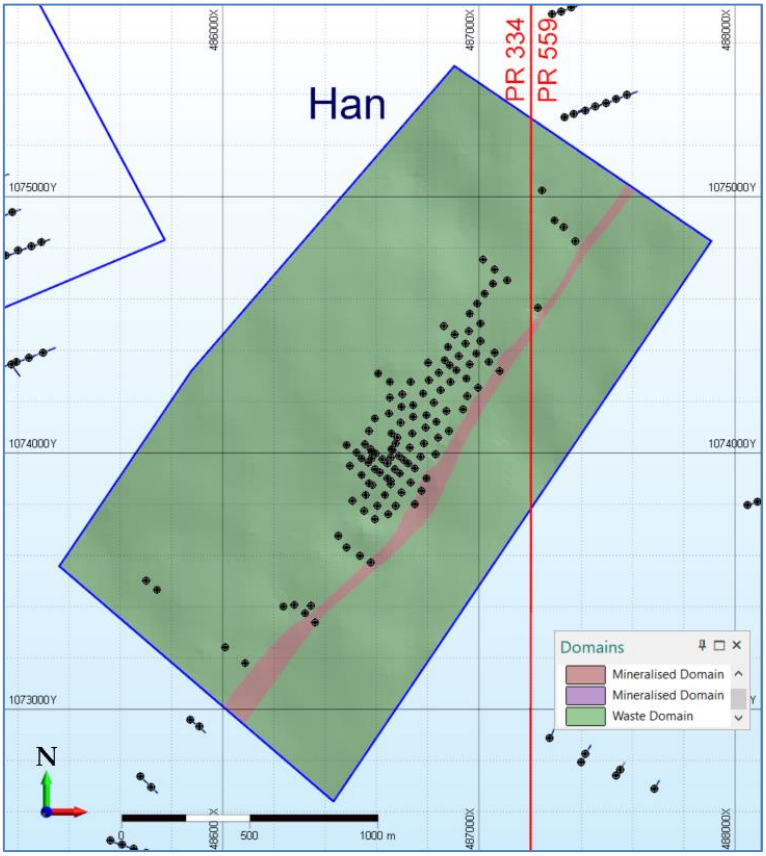

Figure 10-19: Map of the Han deposit
(showing drill hole locations and mineralisation wireframes)
(Produced by H&SC, March 2019)

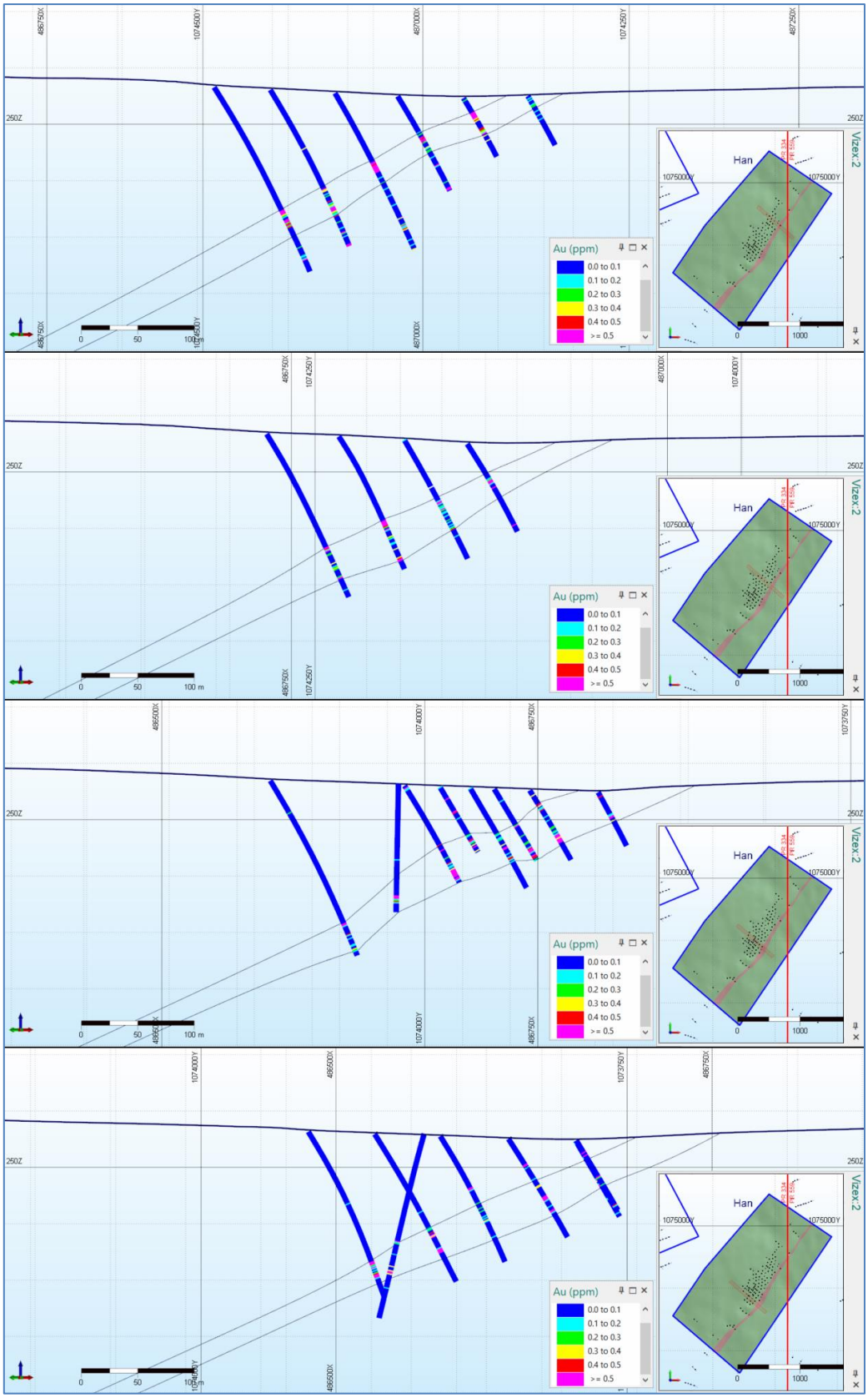

Figure 10-20: Cross-sections of the Han deposit
(Showing gold drill hole assays and mineralisation wireframes)
(Produced by H&SC, March 2019)

10.6.8 Enioda Map and Cross-Sections

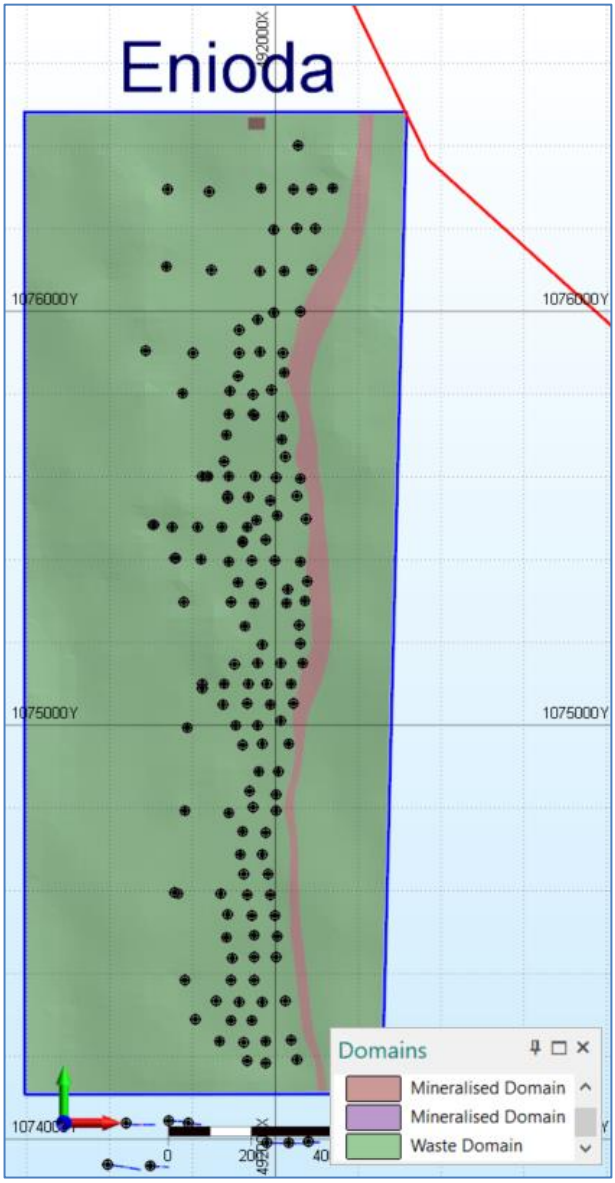

Figure 10-21: Map of the Enioda deposit
(showing drill hole locations and mineralisation wireframes)
(Produced by H&SC, March 2019)

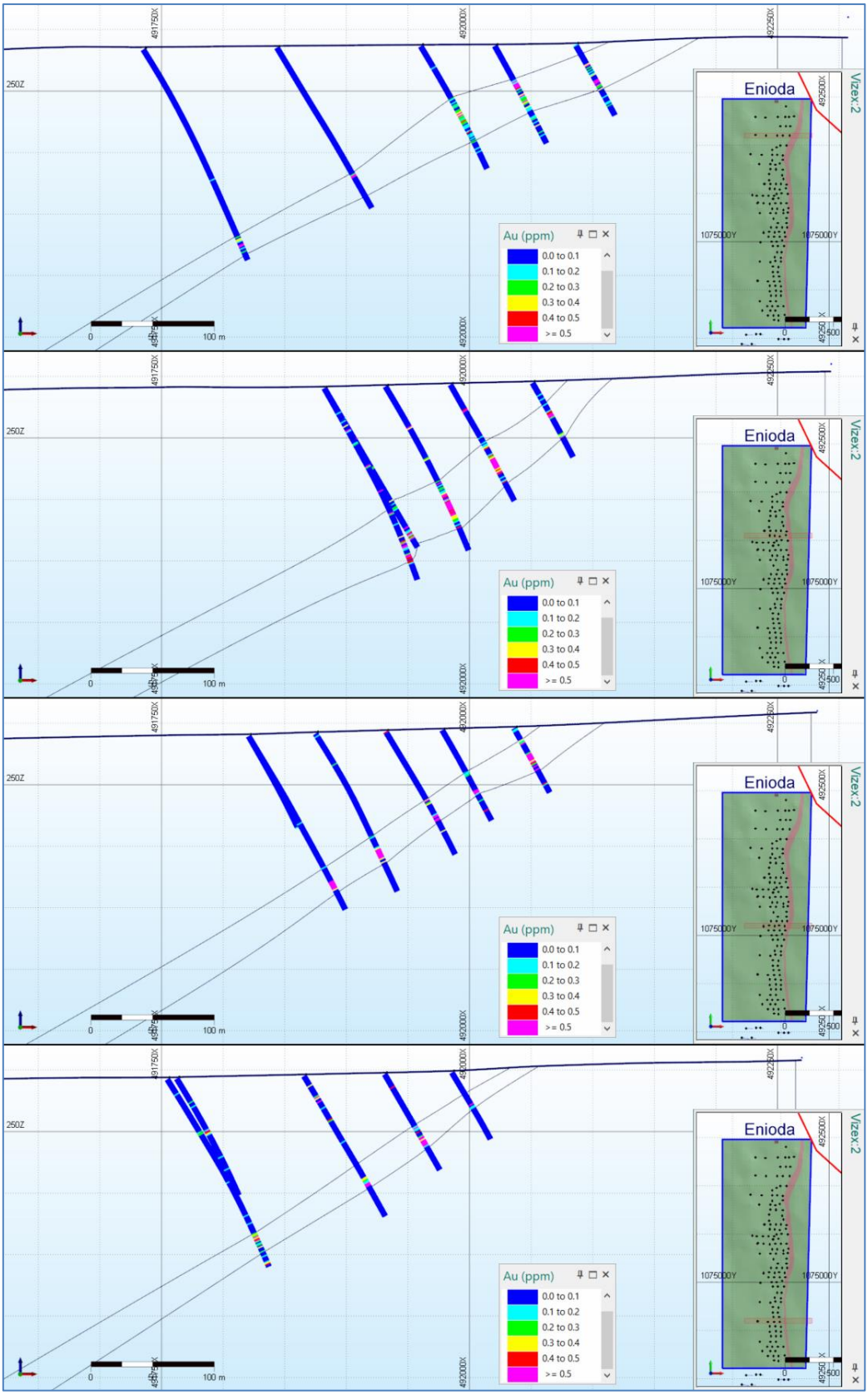

Figure 10-22: Cross-sections of the Enioda deposit
(Showing gold drill hole assays and mineralisation wireframes)
(Produced by H&SC, March 2019)

11 Sample Preparation, Analyses and Security

Bureau Veritas Minerals Laboratory (BVML) in Abidjan, Côte d'Ivoire, was the only analytical laboratory used for gold fire assaying on the Doropo project. The BVML head office is in Paris, France, and is independent of Centamin.

BVML Abidjan, Côte d'Ivoire, is in the process of ISO17025 accreditation (general requirements for the competence of testing and calibration laboratories). Currently the laboratory uses the same protocols and procedures as the accredited parent labs in Vancouver, Canada and Australia. BVML also falls under the Bureau Veritas group's certificates listed below:

- ISO9001 certificate
- ISO14001 certificate
- IFIA certificate
- OHSAS 18001 Certificate

11.1.1 Reverse Circulation Sampling Methods

During the RC drilling, samples are collected from the cyclone attached to the drill rig at 1 m intervals in large plastic bags. Each individual sample is weighed and then run through multi-stage riffle splitter until the sample is reduced to approximately 5 kg in weight. The sample is then passed through a single stage 50/50 splitter so that the final sample weighs between 2 and 3 kg which goes to the laboratory. Small plastic bags are used to bag the samples. A sample number is written on the outside of the bag with black marker and a stub from a sample ticket stapled to the top of the bag. Field duplicate samples are taken as another split of the original RC sample that followed the same sampling methodology as the primary sample. The final stubs of the sample tickets are stored at the site office. The sample bags that go to the laboratory are weighed and stored in polywoven bags containing 10 to 15 samples each. At the end of every day, Centamin personnel transport these samples back to the processing area. The batch of samples are collected by a Laboratory truck from the exploration camp once a week.

Quality Assurance and Quality Control (QAQC) samples are inserted on a regular pattern of one QAQC sample every 10th sample. As a general rule, QAQC samples follow the pattern: one blank sample, one Certified Reference Material (CRM) sample, and then one field duplicate sample. However, the geologist at site may decide to change or adapt this succession depending on the mineralisation intersected, for example by adding additional blank samples in close proximity to a possible high grade gold sample or adjusting the CRM used to the type of rocks intersected. In addition to this, a selected field duplicate from an interval assumed to be of a good gold grade from the hole is inserted at the end of the hole. Blanks and standards are inserted once the samples have been returned to the processing area to increase efficiency and reduce error.

The sample reject from the riffle splitter is returned to the original plastic bag and marked with the hole number and the downhole meter range of the sample. These samples are held in reserve for around four to six months at the drill site in case further resampling is required.

11.1.2 Diamond Core Sampling Methods

Core is oriented and placed in plastic core trays at the drill site. Rock Quality Designation (RQD) and core recovery are measured at the rig and core trays returned by Centamin personnel to the processing facility.

Once logged, the core is placed in a cradle and cut with a core saw. The cut is made to the left of the orientation line and both halves returned to the core tray. The right side of the core is then sampled and put in a calico bag. Sample intervals are at the discretion of the logging geologist but are regularly at 1 m intervals. The sample number is written on the outside of the bag and a sample ticket sub placed in the bag with the sample. The core trays with the remaining half-core are then moved to the core storage area.

QAQC procedures consisted of the insertion of either a CRM, a blank sample or a non-certified spike (previous RC samples with grade) every 10th sample. No sample duplicates of core have been taken.

11.1.3 Chain of Custody and Transport

All RC samples and core trays are transported by Centamin personnel between the drill sites and the sample processing facility. The processing area consists of an open logging area for core trays and a covered sample handing area for the staging of the RC and DD samples for transport. The sample processing area is adjacent to the main office and in the main compound. The compound is completely fenced and under 24 hour guard.

The core is laid out, logged and sampled by Centamin personnel. After RC and core samples are prepared, they are placed in sealed rice sacks in groups of 10 – 15 samples per sack.

Samples are transported to Abidjan by a BVML truck directly to the lab facility. A sample submission form accompanies each shipment of samples. An email copy of the submission form is also sent to the laboratory. No formal receipt of samples is received from BVML when they take custody of the samples.

All pulp rejects are returned by BVML transport to the site office and stored in locked shipping containers.

11.1.4 Sample Preparation and Analysis

After samples are received at BVML, they are sorted and weighed. RC and DD samples both followed the same preparation path.

11.1.4.1 Sample Preparation by laboratory:

Samples are dried for 12 hours at 105°C after which they are crushed in a jaw crusher until 70 percent passes 2 mm. The sample is then passed through a riffle splitter until approximately 1 kg in weight and pulverized using an LM2 until 85 percent passes 75 microns. A 250 g sample of the pulp is then placed in a pulp packet in preparation for final analyses.

11.1.4.2 Samples Analyses at Laboratory:

A standard fire assay for gold (FA450) was performed by BVML. A 50 g sub-sample is taken from the pulverised material, mixed with flux and then fired. The resultant lead button is then transformed to a prill using cupellation. The prill is then dissolved in Aqua Regia solution and the resultant liquor read by AAS with a detection limit of 0.01 g/t Au. This is considered to be a total assaying technique.

Internal laboratory QAQC analyses consists of:

- a size analysis 2mm after crushing for one in every 30 samples
- coarse duplicate was taken at 1 in 50 samples
- size analysis 75 microns after pulverising 1 in every 20 samples
- pulp repeat approximately one in 25 samples

H&SC considers the sample preparation, security, and analytical procedures to be at least industry standard and is adequate to for the style of mineralisation of the Doropo deposits.

11.2 Quality Assurance and Quality Control sampling

Centamin has adopted a reasonably stringent QAQC program with the use of Certified Reference Materials (CRMs), blanks, RC field duplicates and 'spike' samples. Centamin routinely monitors QAQC sample results when assay results are returned from the laboratory. Any concerns or questions are immediately raised with the laboratory.

Centamin has not conducted any inter-laboratory cross-checks to verify the results from BVML. H&SC recommends that at least 200 samples from within the mineralised zones are reassayed in a second independent, internationally accredited laboratory.

Quality control procedures employed by Centamin include industry standard drill core and RC sample processing techniques discussed in Section 10.

For RC drill holes either a CRM, a blank sample or a field duplicate are inserted every 10th drill hole sample. For diamond drill core either a CRM, a blank or a spike sample are inserted every 10th drill hole sample.

Drilling at the Doropo project includes prospects that are outside the areas assessed by the current resource estimates. The QAQC sampling discussed in the following sections is limited to the deposits that form the reported mineral resources.

11.2.1 Certified Reference Materials

Centamin routinely inserts a CRM nominally every 30 drill hole samples. A total of 20 different CRMs, ranging in grade from 0.047 to 9.25 g/t have been used to verify the BVML gold assays. Seventeen of the 20 CRMs are sourced from Ore Research & Exploration Pty Ltd and the remaining three CRMs were produced by Geostats Pty Ltd. Both of these providers are considered to produce high quality CRMs that are suitable for use on the Doropo project. The number of CRM samples submitted for each of the deposits estimated are shown in Table 11-1.

Table 11-1: Number of CRM samples from each estimated deposit

Deposit	Count
Souwa	1,625
Nokpa	849
All Chegue	1,435
Tchouahinin	364
Kekeda	569
Han	517
Enioda	593
Total	**5,952**

Centamin compares the expected and assayed CRM values at the time that the assays are imported into the database. Centamin has reported to H&SC that a batch will fail if any one of the following criteria are met.

- One CRM +/- 3 standard deviations from expected
- Two CRM assays in a row outside 2 standard deviations on the same side from expected
- Three CRM assays in a row +/- 2 standard deviations from expected

The batches identified by the above rules are investigated thoroughly by reviewing photos of the standards and reviewing sample tickets to identify CRM mix-ups, and transcription or sampling errors. If no obvious errors can be found, then 5 samples above and below the "failing" standard are requested for reassay by the laboratory. If the results of the reassay are not significantly different from the originals, the originals are kept and the reassay results rejected, along with the original failing standards.

H&SC is informed that only two batches were identified as problematic. In total fifteen drill core samples had their original assays rejected in favor of the reassay values. Thirteen of these were for gold grades less than 0.1 g/t and two were of higher grade 0.21 and 1.05 g/t

Figure 11-1 shows a Shewart control chart of all 5,952 CRM assays from the deposits that were estimated. The y axis shows the relative difference from the expected CRM value. Relative difference values over 100% indicate that the assay value is higher than the expected value. The x axis in this graph is ordered by the expected CRM value and then the assay date as this is believed to produce a more readable graph. The vast majority of CRM assays performed well within acceptable limits. The most notable exceptions are discussed below.

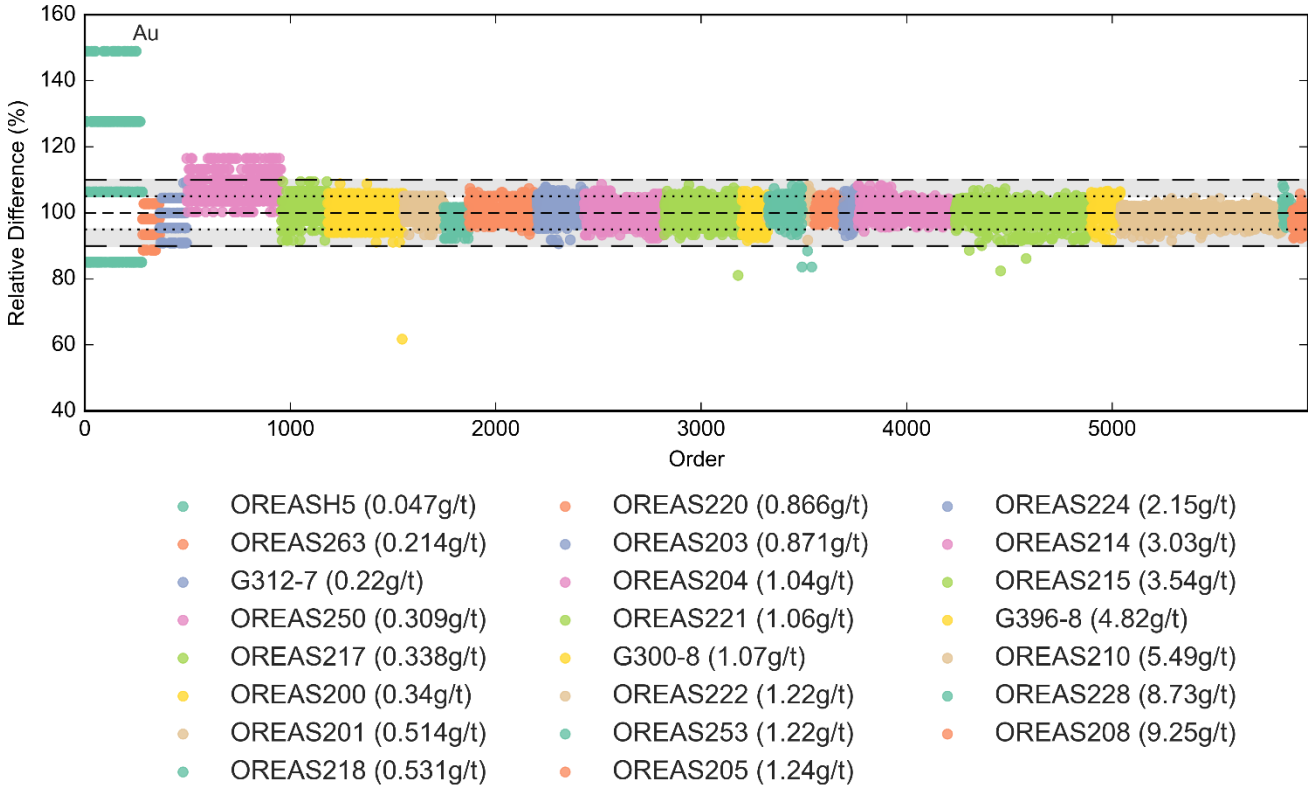

Figure 11-1: All CRM assays from estimated deposits

Table 11-2 shows a summary of the all of the CRM assays from the estimated deposits. It can be seen that the bias for all the CRMs except two (OREASH5 and OREAS250) is within tolerable limits.

Table 11-2: Summary of Certified Reference Material samples

CRM ID	Count	Au Expected (g/t)	Au Mean (g/t)	Bias (%)	Au Minimum (g/t)	Au Maximum (g/t)
OREASH5	279	0.047	0.052	8.3	0.04	0.07
OREAS263	84	0.21	0.21	-3.0	0.19	0.22
G312-7	131	0.22	0.21	-2.8	0.2	0.24
OREAS250	460	0.31	0.33	7.7	0.31	0.36
OREAS217	227	0.34	0.34	0.9	0.31	0.37
OREAS200	368	0.34	0.34	-0.1	0.21	0.37
OREAS201	197	0.51	0.52	1.2	0.48	0.54
OREAS218	121	0.53	0.52	-1.8	0.49	0.54
OREAS220	331	0.87	0.87	0.4	0.81	0.93
OREAS203	231	0.87	0.88	0.6	0.79	0.94
OREAS204	389	1.04	1.04	-0.1	0.96	1.13
OREAS221	377	1.06	1.07	0.6	0.86	1.15
G300-8	129	1.07	1.06	-1.5	0.98	1.14
OREAS222	58	1.22	1.24	1.7	1.12	1.32
OREAS253	168	1.22	1.23	1.0	1.02	1.32
OREAS205	138	1.24	1.25	0.8	1.2	1.32
OREAS224	73	2.15	2.14	-0.4	2	2.31
OREAS214	473	3.03	3.04	0.5	2.86	3.28
OREAS215	661	3.54	3.53	-0.4	2.92	3.8
G396-8	143	4.82	4.87	1.0	4.42	5.14
OREAS210	789	5.49	5.46	-0.7	5.03	5.74
OREAS228	47	8.73	8.80	0.8	8.35	9.46
OREAS208	78	9.25	9.09	-1.7	8.54	9.78

H&SC created a Shewart control chart for each of the CRMs in order to compare the assayed values to the expected values. Presentation of each of the 23 charts is beyond the scope of this report although a select few have been chosen to represent CRMs across a range of grades and to highlight issues.

The lowest grade CRM, named OREASH5 and shown in Figure 11-2, performed reasonably badly and indicates a significant bias. Although this artefact is worrying, H&SC considers the variation acceptable bearing in mind that the expected value is within an order of magnitude of the assay method detection limit.

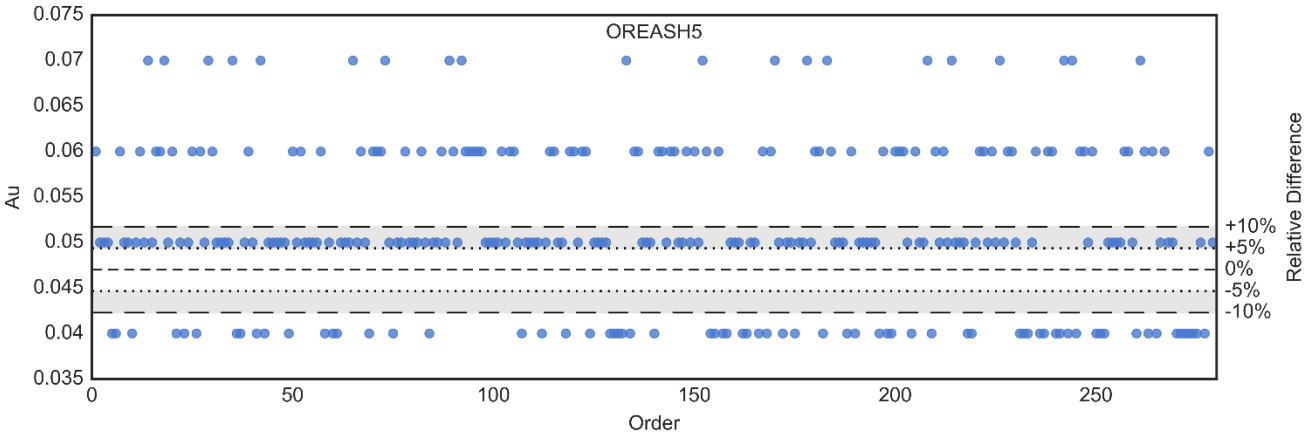

Figure 11-2: Shewart control chart of OREASH5 (0.047 g/t)

Figure 11-3 shows the Shewart control chart for OREAS250. This CRM has an expected value of 0.309 g/t but the assayed values show a significant positive bias. H&SC investigated this issue further and found that the CRM OREAS200, shown in Figure 11-4, was submitted over the same period. OREAS200 has an expected grade of 0.34 g/t. H&SC believe that the majority of the CRMs recorded in the database as being OREAS250 were actually OREAS200.

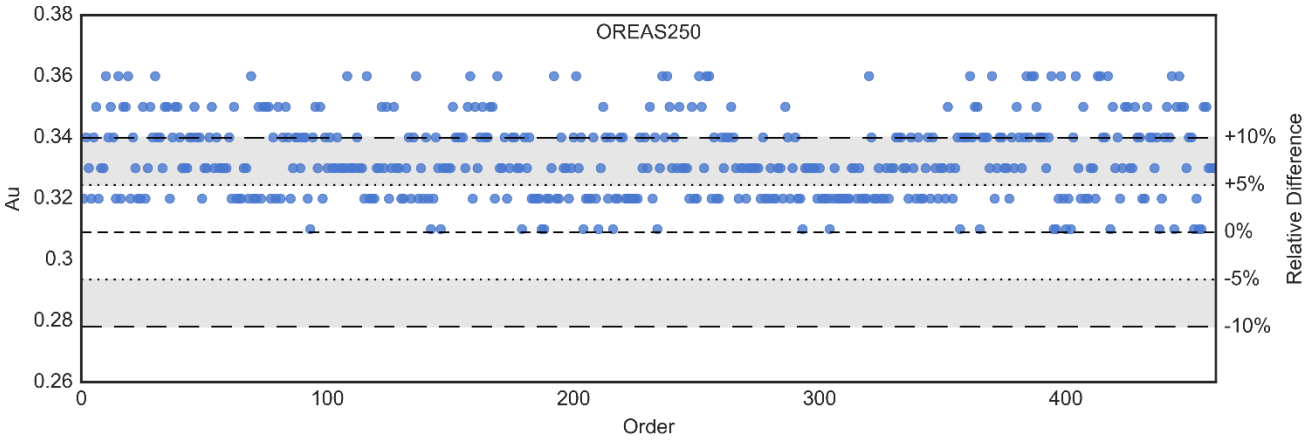

Figure 11-3: Shewart control chart of OREAS250 (0.309 g/t)

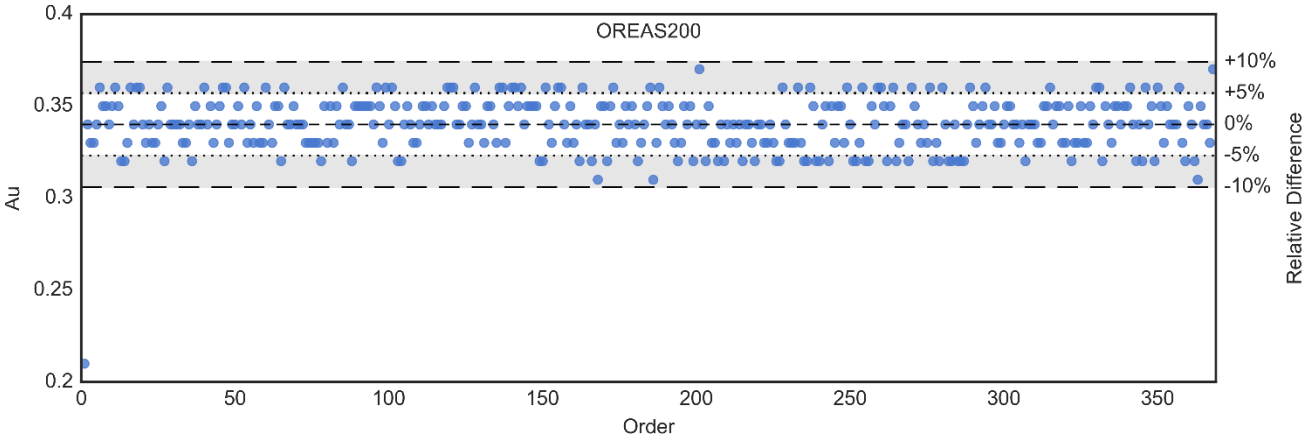

Figure 11-4: Shewart control chart of OREAS200 (0.340 g/t)

Figure 11-5 shows the assay results for OREAS204, which has an expected grade of 1.04 g/t. This plot is shown as it is moderately high grade and shows typically good performance.

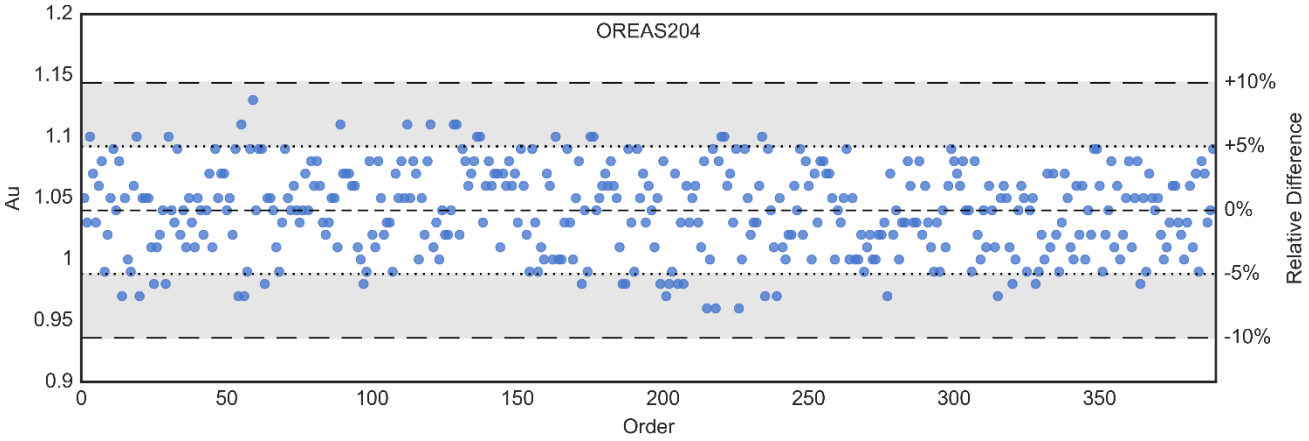

Figure 11-5: Shewart control chart of OREAS204 (1.04 g/t)

Figure 11-6 shows the control chart for OREAS215, which has an expected value of 3.54 g/t. In general the results from this CRM are within acceptable limits although there is clearly a period where this CRM was consistently underreporting. The results of these samples were received between 29 March and 22 September 2017. Centamin investigated this issue at the beginning of 2018 and found that the CRM OREAS214, with a grade of 3.03 g/t gold, had been submitted instead of the intended OREAS215. Following this investigation the sample procedure was modified to limit future mix-ups. Now, all QAQC standard samples are photographed with the sample ticket and respectively labelled sample bag. These photos are then archived on the file system so that they can be used in verifying any new anomalous standard results. A decision was also made that OREAS 214 would not be used at the same project that was currently using OREAS 215 (Keleman, 2019).

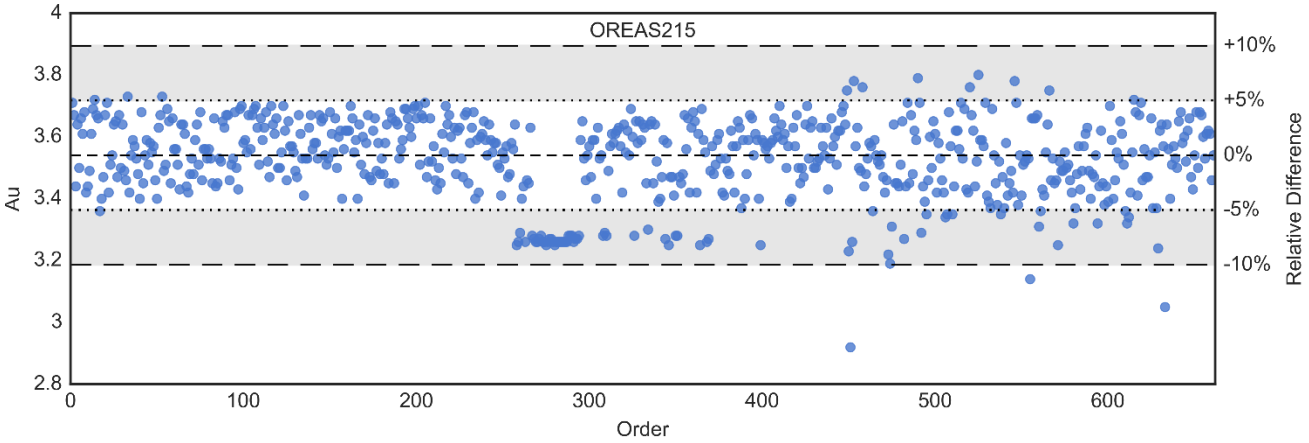

Figure 11-6: Shewart control chart of OREAS215 (3.54 g/t)

Figure 11-7 shows the assay results for OREAS210, which has an expected grade of 5.49 g/t. This plot is shown as it is high grade.

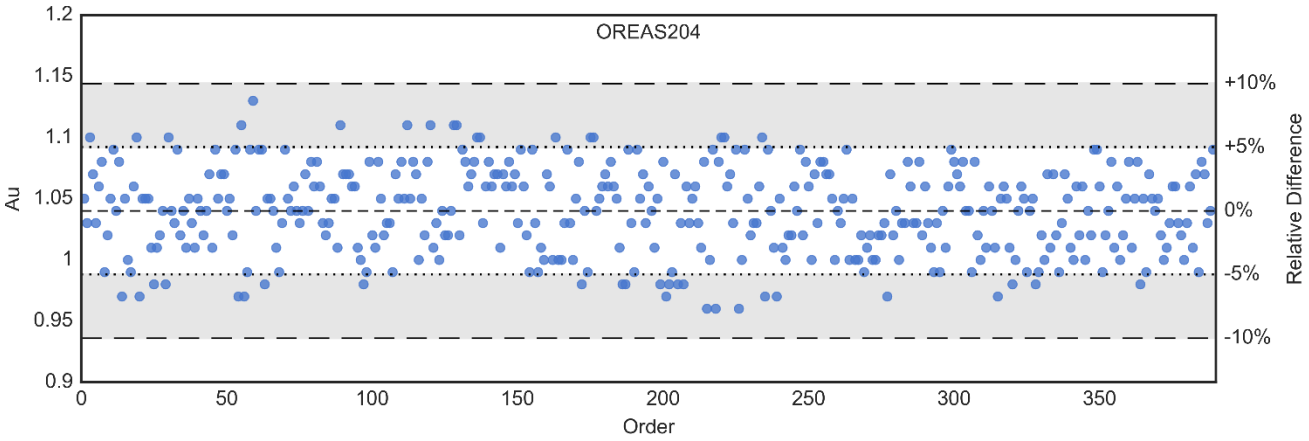

Figure 11-7: Shewart control chart of OREAS204 (5.49 g/t)

In conclusion the CRM assaying indicates that the BVML analysis is within acceptable levels of precision and accuracy. Furthermore, the constant monitoring of CRM results by Centamin and proactive response to unexpected results provide confidence in the way the QAQC sampling process is conducted.

11.2.2 RC Field Duplicates

Centamin routinely inserts an RC field duplicate every 30 RC samples. Field duplicates are used to check the sub-sampling technique is not biasing results and to give an indication of the representivity of the sub-sample.

Field duplicate samples are taken as another split of the original RC sample that followed the same sampling methodology as the primary sample.

H&SC produced Percentage Half Difference (PHD) plots and summary statistics of field duplicates from each of the deposits. PHD=(x+y)/(x-y), where x is the original value and y is the duplicate.

No noticeable difference was found between the different deposits so they are summarised together here. Figure 11-8 shows a PHD plot of all the RC field duplicates from the areas estimated. It can be seen that a large scatter is apparent, indicating that the repeatability of gold duplicate grades is reasonably poor. Table 11-3 shows a summary of the RC duplicate pair statistics. No significant bias is evident for any of the RC field duplicates.

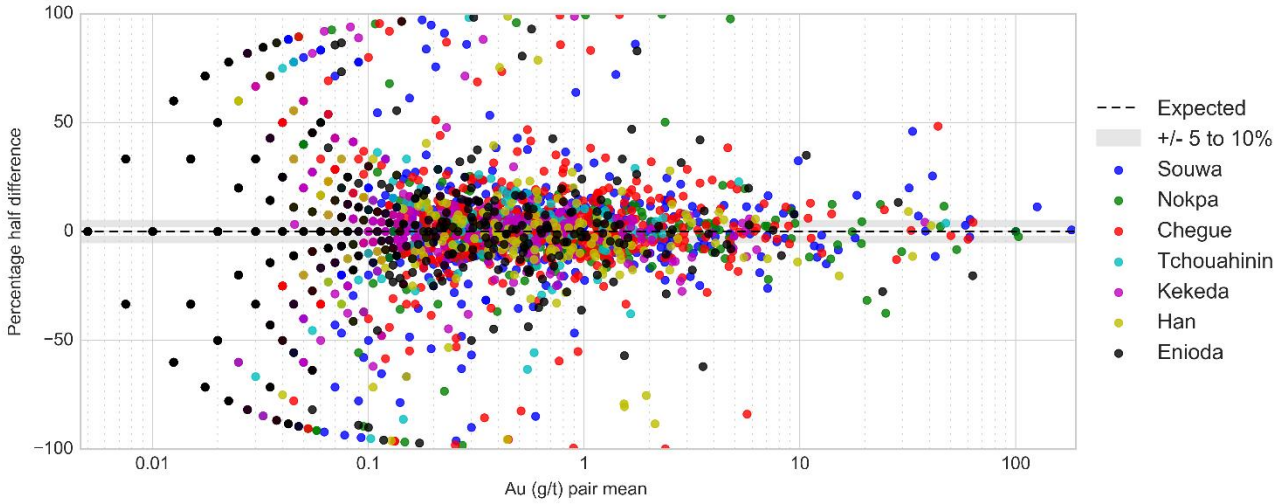

Figure 11-8: Percentage half difference plot of RC field duplicates

Table 11-3: RC field duplicate summary statistics

Statistics	Original	Duplicate	Differences
Minimum	0.005	0.005	0
Maximum	182.4	179.9	2.5
Mean	0.57	0.56	0.01
No. of Samples	7,224	7,224	0

11.2.3 Blanks

Centamin routinely inserts a blank sample for every 30 samples from drill holes. Blanks are used to check for contamination within the laboratory sample preparation procedure. Centamin uses blanks produced from RC intervals that have been assayed and shown to be barren and a long way from mineralised intervals. In total, Centamin has submitted 7,289 blank samples, which are shown in Figure 11-9. Two assays, with gold grades of 0.24 and 0.96 g/t are omitted from this graph. The vast majority of blank samples returned assays at, or just above, the assay detection limit of 0.01 g/t gold. All but three of the 7,289 blank assays returned values that are significantly below 0.1 g/t gold, which is ten times the detection limit. H&SC considers that the blank samples indicate that contamination between samples is not significant.

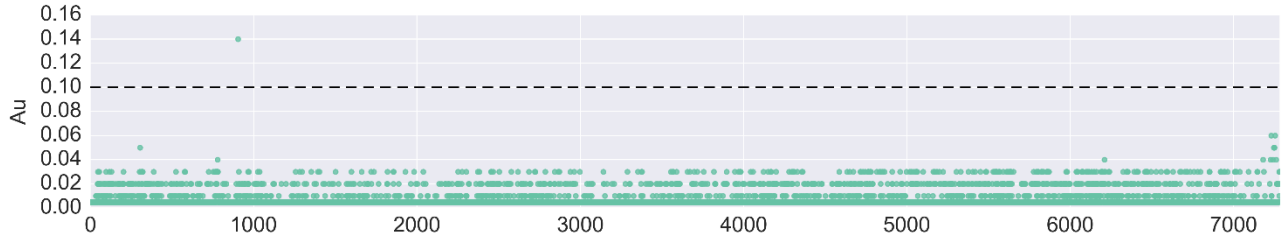

Figure 11-9: Blank samples

12 Data Verification

H&SC has conducted several checks in order to verify the data veracity and data quality. The steps taken are summarised below. H&SC considers that sufficient verification of the data that underpin the resource estimates has been carried out. H&SC has not independently checked the information presented in this report regarding project history, metallurgical test work or exploration licence details as these information has been provided by Qualified Persons as detailed in Chapter 3.

In conclusion, H&SC is of the opinion that the quality of the data at least meets industry standard and is suitable to form the basis of the resource estimates presented in this report.

12.1 Data Verification by Centamin

The exploration database has been maintained on site in acQuire since the beginning of the project. Field data is collected on paper and transcribed to excel spreadsheets by field geologists and a dedicated data entry person. Spreadsheets are then imported to acquire by a dedicated database manager.

Data is internally validated by acquire as it is entered and ensures:

- Collar, survey, assay and geology end of hole depths are compatible
- No overlapping intervals are allowed
- No repeat sample identification numbers can occur within the database
- Laboratory assays are loaded to the correct sample identification number
- All analytical results are stored in the database as reported by the laboratory. Assay values below detection are converted to half detection limit for reporting and modelling purposes
- All logged codes adhere to the accepted libraries.

12.2 Site visit

Rupert Osborn of H&SC visited the Doropo project site for three days in November 2017 and again for a day in December 2018. During these visits, H&SC observed diamond and RC drilling and sample handling procedures, which were found to be industry standard. H&SC also selected several diamond and RC drill holes in order to cross-check the geological logs against the drill core and chip trays and to better understand the geology and reliability of the logs. The method of measuring the density of the drill core was demonstrated to H&SC. H&SC spoke to many of the key personnel including senior and junior geologists and the database administrator.

12.3 Database Audit

H&SC checked that the drill hole database was internally consistent. Validation included checking that no assays, downhole surveys, density measurements or geological logs occur beyond the end of hole and that all drilled intervals have been geologically logged. The minimum and maximum values of assays, density measurements and downhole survey measurements were checked to ensure values are within expected ranges. Further checks included testing for duplicate samples and overlapping sampling or logging intervals. H&SC found the data to be of good quality and consistency, owing largely to the fact that Centamin continuously conducts its own validation internally.

In addition to the basic checks described above, H&SC conducted extra verification of data as described below.

12.3.1 Collar Location Check

In November 2017, the location of around 30 drill hole collar locations was checked by H&SC against the database records using a handheld GPS. The collar locations contained in the database are surveyed using either a Differential GPS or Total Station, both of which are significantly more accurate than a handheld GPS. All Easting and Northing coordinates were found to be within four metres of the database records and this difference is believed to be due to the accuracy of the handheld GPS unit. Variations in elevation were more significant but are not believed to be significant as handheld GPS measurements are known to be poor for measuring elevations.

12.3.2 Laboratory Certificate Check

H&SC checked that the assay values were identical to those provided by BVML by reimporting the entire assay database from the csv files provided by BVML. These values were then compared to the data provided in the assay database provided by Centamin. No differences were found. H&SC additionally visually checked a small selection of the csv files against the pdf versions of the laboratory certificates in order to ensure that the csv files had not been altered since their creation. Again, no differences were identified.

12.3.3 Laboratory visit

In December 2018, Rupert Osborn visited the BVML in Abidjan in order to observe sample preparation and fire assaying procedures. H&SC found the laboratory to be professional, clean and using processes that are considered to be standard industry practices.

13 Mineral Processing and Metallurgical Testing

13.1 Metallurgical test work – ALS Metallurgy Services

ALS Metallurgy Services (Perth) conducted all test work on the Doropo resource materials 2017-2018, under the direct supervision of Paul Elms (ELMSMET PTY Ltd), a consultant metallurgist working on behalf of Centamin on the Cote d'Ivoire Projects since 2017.

A representative suite of Upper Oxide, Lower Oxide, Transition and Upper and Lower Fresh composite samples were selected for testing from each of the main Doropo resource deposits. A summary of the test work conducted 2017-2018 on the Doropo resource materials is outlined in Table 13-1.

Table 13-1: Metallurgical test work conducted by ALS Met Services 2017-2018

Ore Body	Souwa		Nokpa	Chegue South	Han	Kekeda	Kona	Doropo Oxide	
Testwork description									
In-situ SG	✓								
SMC	✓						✓		
Ai	✓		✓	✓	✓	✓	✓		
Rwi	✓		✓	✓	✓	✓	✓		
Bwi	✓		✓	✓	✓	✓	✓		
Head Assay	✓		✓	✓	✓	✓	✓	✓	✓
Mineralogy	✓						✓		
Gravity/CN leach	✓				✓	✓	✓	✓	
Gravity/float/CN leach	✓								
Bulk float/CN leach			✓	✓	✓	✓	✓		
Gravity/float/oxidative leach/CN leach		✓							
CN leach									✓
CN leach (coarse-crush)									✓
CN leach (column)									✓

QEMSCAN quantitative mineralogical studies were conducted on each of the test work composite samples. Doropo ore mineralogy is dominated by pyrite hosting a range of gold particles down to fine gold below 20µm. The oxide and transition mineralogy is the weathered equivalent with more free liberated gold particles within the corroded sulphides and leached, fractured quartz.

Full SMC comminution test work was conducted and the fresh ores classified as moderately hard and abrasive, with Bond Ball and Rod Mill Work Index averaging 17.4 kWh/t with an abrasion index of 0.246.

Table 13-2: Metallurgical test work conducted by ALS Met Services

Option 1	Gravity + whole ore leach @ P_{80} 75 µm
Option 2	Gravity + whole ore leach @ P_{80} 75 µm +100 g/t $Pb(NO_3)_2$
Option 3	Gravity + whole ore leach @ P_{80} 53 µm +100 g/t $Pb(NO_3)_2$
Option 4	Gravity + flotation @ P_{80} 106 µm + leaching of float tail and con (CIL) @ as-received size
Option 5	Gravity + flotation @ P_{80} 106 µm + leaching of float tail and con (CIL) @ P_{80} 45 µm
Option 6	Gravity + flotation @ P_{80} 106 µm + leaching of float tail and con (CIL) @ P_{80} 30 µm
Option 7	Gravity + flotation @ P_{80} 106 µm + leaching of float tail and con (CIL) @ P_{80} 15 µm
Option 8	Gravity + flotation @ P_{80} 106 µm + leaching of float tail and con (CIL) @ P_{80} 10 µm
Option 9	Gravity + flotation @ P_{80} 106 µm + leaching of float tail and con (CIL) @ P_{80} 7 µm

ALS conducted nine process options in evaluating the Doropo fresh ore types, refer to Table 13-2. The objective of the test work program was to compare overall gold extraction via:

1. Gravity gold recovery and whole-ore cyanide leaching.
2. Gravity gold recovery and flotation, with cyanide leaching of the flotation tails and re-grinding of the flotation concentrate prior to cyanide leaching of the flotation concentrate (separate to the flotation tail leach).

A summary of the test work results is outlined in Table 13-3.

Table 13-3: A Summary of the Doropo Fresh recovery test work

FRESH Test Work	Souwa	Souwa	Nokpa	Nokpa	Chegue Main	Han	Kekeda
	UF	LF	UF	LF	UF	UF	UF
Bond Abrasion Index	0.2625	0.2175	0.2726	0.2296	0.2484	0.2241	0.2532
Bond Rod Mill Work Index (kwh/t)	18	17.2	16.7	16.9	18.4	14	15.5
Bond Ball Mill Work Index (kWh/t)	17	16.8	17.1	17	19.3	15.1	16.7
Au Head assays(g/t)	3.53/2.93	1.54/1.20	1.78/1.42	1.26/0.76	0.88/0.74	1.16/1.11	1.89/1.94
Gravity Recovery (%)	21.6	14.5	21.6	8.4	8.6	25.3	11.4
Overall Gold Extraction via Gravity and Cyanide Leaching at P80 75um	78.25	83.49	78.4	69.1	63.3	78.7	68.2
Overall Gold Extraction via Gravity, flotation and Cyanide Leaching and float con reground to P100 63um	87.87	81.15	86	78.7	69.2	86.4	84.3
Overall Gold Extraction via Gravity, flotation and Cyanide Leaching and float con reground to P80 10um	90.59	84.6	90.6	89	84	95.2	96.2
Overall Gold Extraction via Gravity, flotation and and float con reground to P80 10um and Cyanide Leaching of Oxidized float concentrate	94.54	91.69					

The oxide and transition ore type composites from the main resource sources were tested by grinding a 10 kg composite of each sample to P80 passing 150, 106 and 75 μm and evaluating the gravity gold recovery test work ahead of cyanide leach test work on the gravity tailings. The objective was to optimise gold extraction evaluating grind size, gravity gold recovery and cyanide leach kinetics. The results of the oxide recovery test work are summarised in Table 13-4.

Table 13-4: A Summary of the Doropo oxide recovery test work

GRAVITY/CYANIDE LEACH TESTWORK: SUMMARY OF RESULTS													
Composite ID	Grind Size P_{80} (µm)	Head Au Grade (g/t)		Leach Au Grade (g/t)		Au Extraction (%)					Tail Au Grade (g/t)	Reagents (kg/t)	
		Assay	Calc.	Assay	Calc.	Gravity	4-hr	8-hr	24-hr	48-hr		NaCN	Lime
CHEGUE MAIN UPOX 01	150	0.98/1.15	1.08	0.67	0.84	22.2	93.8	95.2	95.2	95.8	0.05	0.14	0.53
	106		1.09		0.85	22.0	94.4	94.4	95.0	96.3	0.04	0.10	0.46
	75		1.11		0.87	21.5	96.8	94.9	95.5	95.5	0.05	0.17	0.44
CHEGUE SOUTH LWOX 01	150	1.33/1.39	1.38	0.72	0.81	41.2	91.0	92.6	95.2	95.7	0.06	0.18	0.66
	106		1.39		0.82	40.9	93.0	95.6	95.6	97.1	0.04	0.10	0.48
	75		1.38		0.81	41.2	93.3	95.4	96.5	97.5	0.04	0.17	0.48
SOUWA SOUTH UPOX 01	150	1.88/1.58	1.78	1.04	1.24	30.5	87.6	90.5	92.8	94.4	0.10	0.03	0.89
	106		1.80		1.26	30.2	90.1	92.1	94.1	94.4	0.10	0.03	0.97
	75		1.80		1.26	30.1	90.3	92.7	93.5	95.0	0.09	0.11	0.93
SOUWA SOUTH LWOX 01	150	2.08/3.74	1.33	0.78	0.88	33.4	87.5	88.6	91.3	92.8	0.10	0.17	0.70
	106		1.32		0.88	33.6	88.6	91.3	92.9	93.9	0.08	0.14	0.57
	75		1.31		0.87	33.8	90.9	92.0	92.6	94.7	0.07	0.10	0.61
SOUWA NORTH LWOX 01	150	1.98/2.11	2.17	1.24	1.56	28.2	79.3	83.2	87.5	89.4	0.23	0.07	0.42
	106		2.18		1.57	28.0	81.4	85.3	88.3	90.1	0.22	0.14	0.35
	75		2.16		1.55	28.2	85.5	87.2	89.5	91.7	0.18	0.10	0.38
SOUWA NORTH UPOX 01	150	1.55/1.35	1.78	1.02	1.25	29.7	91.9	93.5	95.5	96.6	0.06	0.15	0.58
	106		1.78		1.25	29.7	92.7	97.6	95.6	96.4	0.07	0.15	0.57
	75		1.82		1.29	29.2	93.1	95.1	94.7	97.0	0.06	0.17	0.60
NOKPA LWOX 01	150	0.84/0.95	1.05	0.88	0.91	13.7	85.4	87.4	90.1	93.4	0.07	0.10	0.42
	106		1.04		0.89	13.9	87.4	90.2	92.9	94.2	0.06	0.15	0.39
	75		1.02		0.87	14.1	90.7	94.2	94.9	95.6	0.05	0.17	0.39

13.2 Process design test work - Lycopodium

Lycopodium have been contracted by Centamin to provide process design services for the Doropo PEA. The optimum process recoveries are listed in Table 13-5.

Table 13-5: Metallurgical recoveries for Doropo ore types

ORE Type	Gold recovery	Source
Saprolite	**92.5 %**	Lycopodium 28-Nov-2018
Transition	**89.8 %**	Lycopodium 28-Nov-2018
Fresh	**88.8 %**	Lycopodium 28-Nov-2018

Centamin intends to complete a Doropo PEA report by the second half of 2019. The report will involve the independent 3rd party contributions of Australia Mine Design and Development (AMDAD), H&SC, SRK UK, Lycopodium, ALS-AMMTEC, Elms Metallurgical Services (ELMSMET), GCS, Knight Piesold, Digby Wells, PAH Consulting, Australasian Mining Services (AMS), AUSDRILL, MAXAM and BCM International Ltd.

14 Mineral Resource Estimates

The gold concentrations were estimated by recoverable Multiple Indicator Kriging (MIK) using the GS3 geostatistical software. The gold grades at the Doropo deposits exhibit a positively skewed distribution with reasonably high coefficients of variation within each mineralised domain of between 1.6 and 6.6. The gold estimates at Doropo therefore show reasonable sensitivity to a small number of high grades, especially for Chegue South, Han, Tchouahinin and Souwa.

The method of recoverable MIK was developed during the early 1980's with a particular view toward addressing some of the difficult problems associated with estimation of resources in mineral deposits such as Doropo. MIK is one of a number of non-linear methods developed at that time, which can be used to provide better estimates than the more traditional methods of OK and inverse distance weighting.

Recoverable MIK is considered an appropriate estimation method for the gold grade distribution at the Doropo deposits because it specifically accounts for the changing spatial continuity at different grades through a set of indicator variograms at a range of grade thresholds. MIK can often help avoid or reduce the need to use the practice of top cutting, which can be somewhat arbitrary in the resource estimation process.

14.1 Wireframes and domaining

Centamin provided H&SC with a series of wireframe solids representing the interpreted zones of elevated gold grades. H&SC used these wireframes as the basis to create a new series of wireframe solids that were suitable for MIK estimation. These changes were made to include peripheral mineralisation and produce zones of reasonably consistent thickness. These wireframe solids were created to encompass coherent zones of gold mineralisation elevated above background values. This nominally resulted in a gold grade boundary of about 0.07 g/t.

Two wireframe solids representing diorite dykes at Nokpa and Chegue South were also provided by Centamin, which were used to discount the dyke proportions.

H&SC also created a series of wireframe surfaces for each deposit representing the base of transported material, the base of saprolite and the top of fresh rock using drill hole logging information. These wireframes were used to derive proportions used to calculate the density of the blocks and used to report the resources according to oxidation zones.

The orientation of some of the mineralised zones vary slightly along strike. The zones represented by mineralised wireframes were split using plan strings to encapsulate areas with similar orientation in order to ensure that the search ellipse and variogram models are aligned to the local orientation of mineralisation. In cases where the gold grade population distribution was significantly different between these sub-domains, indicator conditional statistics (used for MIK estimation) were generated for each sub-domain. An example of the string used to sub-domain Souwa is shown in Figure 14-1.

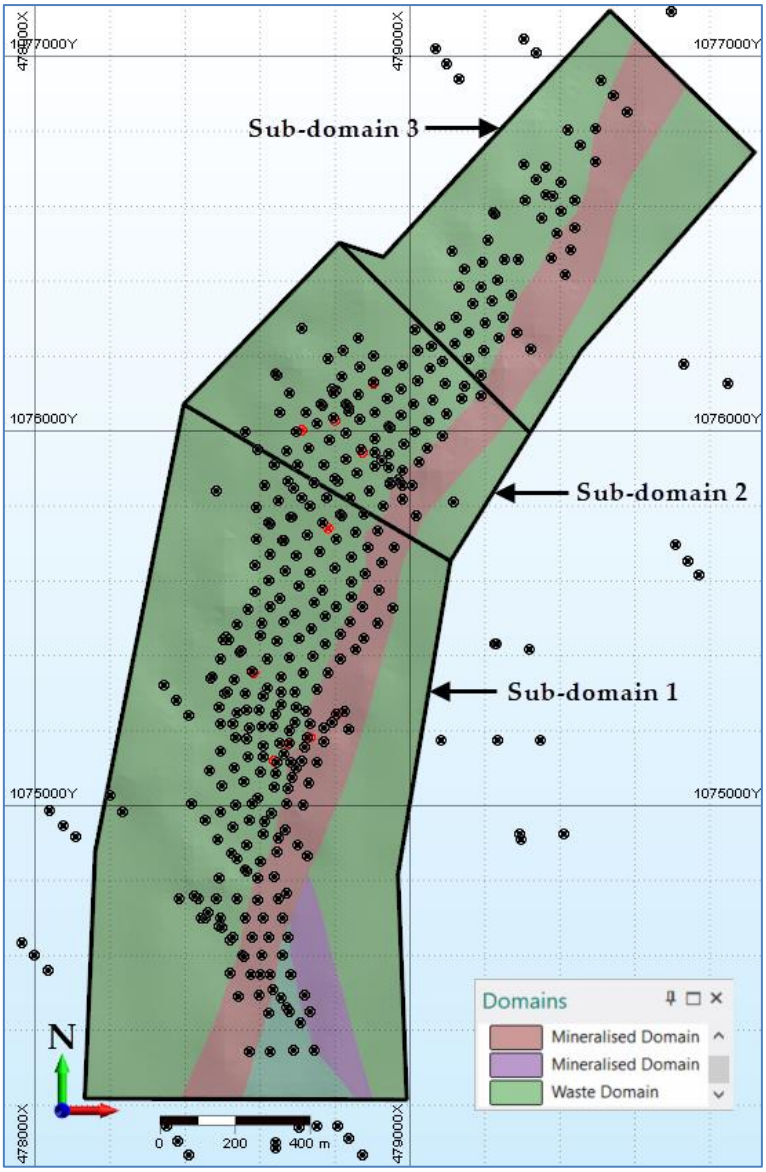

Figure 14-1: Map of the Souwa deposit showing wireframes and sub-domains
(Produced by H&SC, March 2019)

14.2 Density Data

Dry bulk density is measured on-site using an immersion method (Archimedes principle) on selected diamond drill core intervals ranging in size from 10 to 30 cm. Density samples are routinely collected from diamond drill core every 10 m. The samples chosen are believed to be representative of the surrounding rock type. Weathered samples are coated in wax to avoid water absorption. A total of 2,626 density measurements have been taken from drill core at the Doropo deposits. Four density values (6.96, 6.24, 5.45 and 3.31 t/m^3) were excluded from the analyses because as it was felt that these values are unrealistic.

Measured density values show that the density of the fresh rock at the Doropo deposits does not vary significantly. Weathering, near surface, decreases the density.

Table 14-1 shows the summary statistics of the measured density values for each of the weathering domains and Figure 14-2 shows a boxplot of the density measurements.

The proportion of the blocks in each of the weathering domains was assigned to the block model. These proportions and the mean density values shown in Table 14-1 were used to calculate the weighted average density for each block.

Table 14-1: Summary statistics for dry bulk densities

Weathering Zone	Count	Mean	Minimum	Maximum	Standard Dev	CV
Transported	16	2.01	1.65	2.20	0.13	0.06
Saprolite	172	2.05	1.57	2.70	0.29	0.14
Transitional	50	2.53	1.59	2.75	0.19	0.07
Fresh	2,384	2.70	1.78	3.03	0.05	0.02

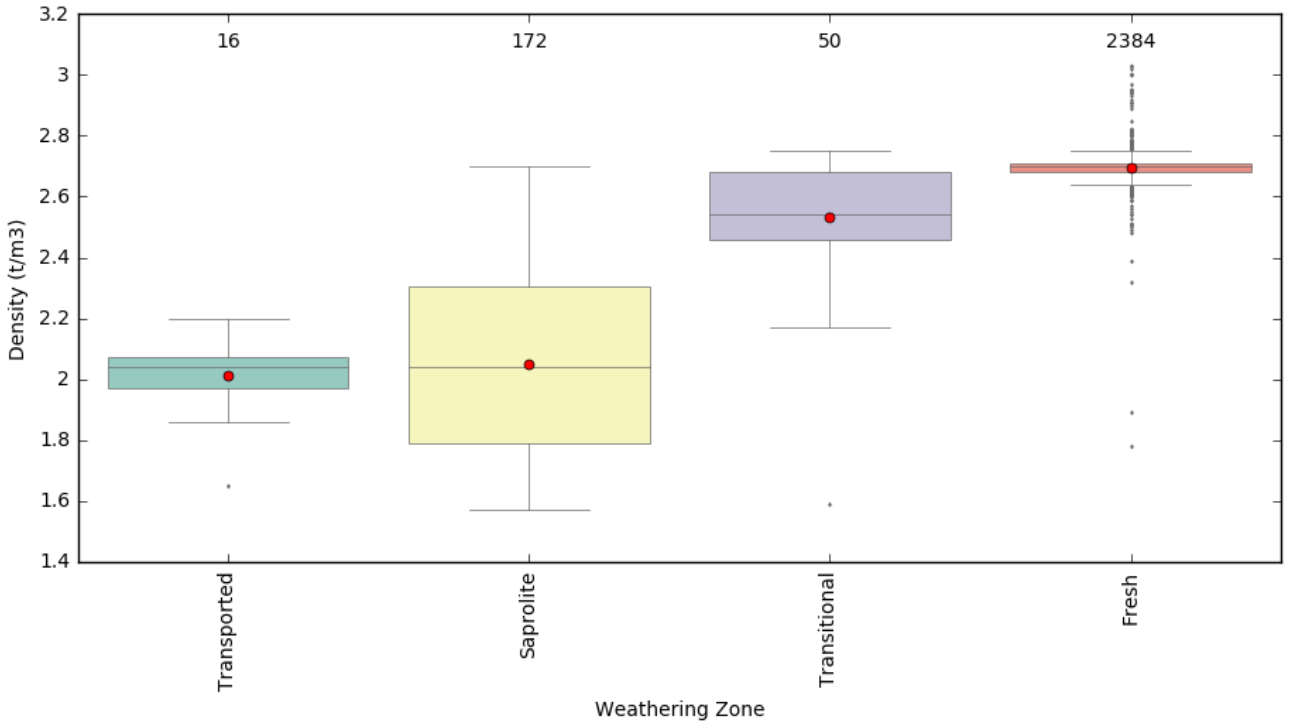

Figure 14-2: Boxplot of measured density values by weathering zone

14.3 Assayed intervals used for estimation

Centamin provided H&SC with a complete drill hole database. The drill hole database contained data from Reverse Circulation (RC) and Diamond drill holes (DD). Centamin routinely samples the entire drill hole and so the vast majority of intervals had valid grades. Unsampled intervals may occur where drilling recovery is too low, or in some rare cases where assays have not yet been received from the laboratory. Centamin also drilled seven diamond drill holes, twinned with existing RC drill holes for metallurgical studies. The seven diamond drill holes had been sampled over the mineralised zones. Unsampled intervals were left blank due to the fact that the nearby RC twin holes had been entirely assayed.

A summary of the number of drill holes and assayed intervals for each deposit is shown in Table 14-2.

Table 14-2: Drill hole summary

Area	Number of Drill Holes	Metres Drilled	Metres Assayed	Percentage Assayed
Souwa	343	40,870	40,056	98%
Nokpa	168	22,557	22,129	98%
Chegue	184	20,020	20,014	100%
Chegue South	178	21,460	21,217	99%
Tchouahinin	97	9,989	9,983	100%
Kekeda	133	12,854	12,755	99%
Han	123	13,779	13,628	99%
Enioda	149	15,865	15,864	100%

Table 14-3 shows the summary statistics of the gold assays weighted by interval length. In this table, samples within the mineralised domains are separated from those outside the mineralised domains.

Table 14-3: Gold assay sample statistics

AOI	Domain Type	Count	Metres (m)	Mean (ppm)	Min (ppm)	Max (ppm)	Standard Deviation	CV
Souwa	**Mineralised**	13,973	13,987	0.59	0.005	306.13	4.33	7.38
	Waste	26,078	26,883	0.03	0.005	23.64	0.25	7.40
Nokpa	**Mineralised**	7,628	7,627	0.66	0.005	100.50	3.39	5.14
	Waste	14,514	14,930	0.02	0.005	9.22	0.16	7.20
Chegue	**Mineralised**	5,364	5,366	0.41	0.005	27.02	1.18	2.86
	Waste	14,650	14,654	0.02	0.005	7.12	0.11	4.85
Chegue South	**Mineralised**	8,659	8,667	0.43	0.005	229.77	3.70	8.67
	Waste	12,555	12,793	0.02	0.005	9.94	0.13	5.99
Tchouahinin	**Mineralised**	2,531	2,531	0.36	0.005	117.90	3.19	8.85
	Waste	7,452	7,458	0.02	0.005	2.03	0.07	3.78
Kekeda	**Mineralised**	4,346	4,337	0.43	0.005	135.30	2.69	6.26
	Waste	8,422	8,517	0.03	0.005	9.05	0.12	4.29
Han	**Mineralised**	2,905	2,906	0.64	0.005	172.07	4.77	7.41
	Waste	10,728	10,873	0.02	0.005	3.65	0.09	4.67
Enioda	**Mineralised**	3,176	3,176	0.50	0.005	56.10	1.85	3.71
	Waste	12,688	12,689	0.02	0.005	7.69	0.11	4.44

14.4 Composites used for estimation

The drilling at all of the deposits assessed in this study include areas that have been drilled on a nominal 50x50 m grid pattern. Nokpa includes an area that has been drilled on a nominal 25x25 m grid. The vast majority of intervals have been sampled on 1 m intervals. Samples were composited to 2 m intervals whilst honouring the mineralised domain wireframes and with a minimum composite length of 1.0 m.

No assumptions were made regarding the correlation of gold with any other variable. Only gold concentrations were estimated.

Figure 14-3 shows the gold grade composites within the mineralised domains for each deposit. The red circles show the mean of the population. The summary statistics for each mineralised zone and the waste zones for each deposit are shown in Table 14-4.

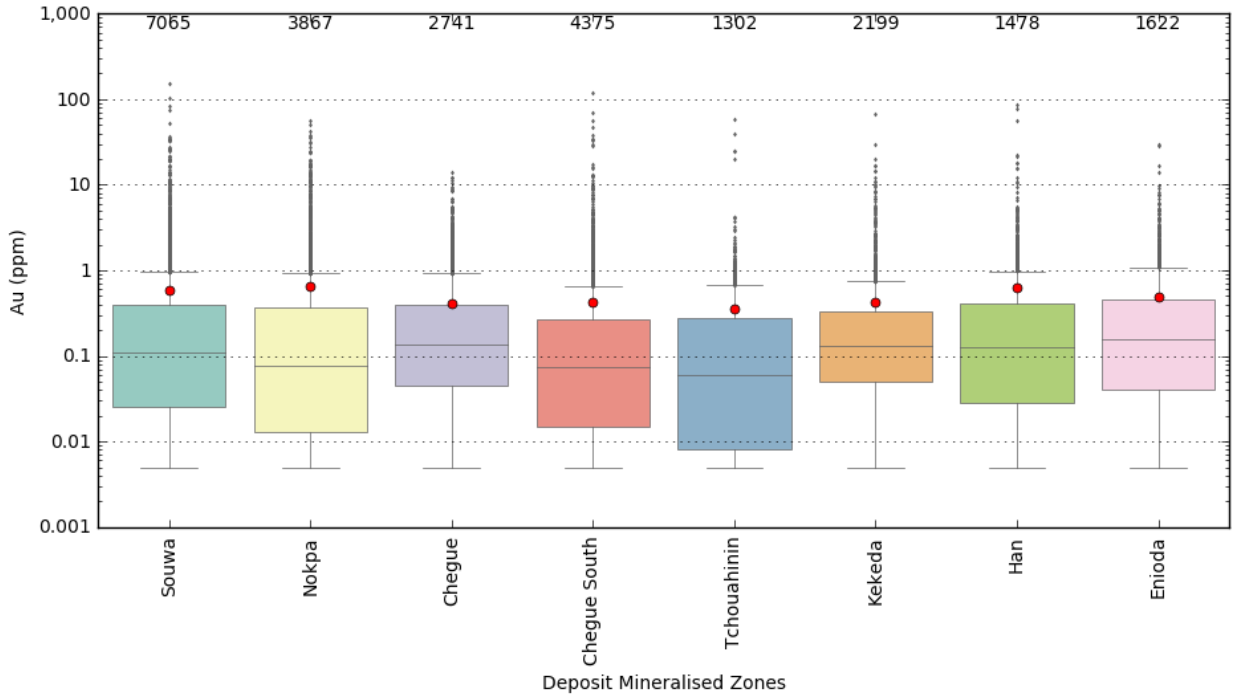

Figure 14-3: Boxplot of gold composites within mineralised domains

Table 14-4: Gold composite sample statistics

Area	Zone	Count	Metres (m)	Mean (ppm)	Min (ppm)	Max (ppm)	Standard Dev	CV
Souwa	**10**	6,146	6,466	0.62	0.005	153.78	3.45	5.56
	11	919	919	0.32	0.005	14.12	0.99	3.12
	Waste	13,172	46,973	0.03	0.005	12.09	0.18	5.48
Nokpa	**20**	318	318	0.65	0.005	49.92	3.00	4.62
	21	2,010	2,018	0.97	0.005	56.33	3.20	3.30
	22	1,539	1,649	0.24	0.005	30.16	1.35	5.59
	Waste	7,343	16,772	0.02	0.005	5.00	0.12	5.43
Chegue	**30**	1,993	1,995	0.46	0.005	13.81	0.96	2.10
	31	605	605	0.29	0.005	11.45	0.87	2.99
	32	143	143	0.20	0.005	1.94	0.34	1.76
	Waste	7,415	7,419	0.02	0.005	3.56	0.08	3.58
Chegue South	**40**	4,375	4,379	0.42	0.005	117.16	2.80	6.59
	Waste	6,344	12,054	0.02	0.005	6.73	0.11	5.16
Tchouahinin	**50**	776	776	0.46	0.005	58.99	2.95	6.34
	51	526	526	0.19	0.005	2.08	0.30	1.60
	Waste	3,781	3,789	0.02	0.005	1.50	0.06	3.30
Kekeda	**60**	2,199	2,245	0.43	0.005	67.93	1.99	4.66
	Waste	4,261	5,464	0.03	0.005	4.76	0.09	3.26
Han	**70**	1,478	1,481	0.63	0.005	86.75	3.66	5.78
	Waste	5,421	7,861	0.02	0.005	1.83	0.07	3.53
Enioda	**80**	1,622	1,622	0.49	0.005	29.80	1.43	2.92
	Waste	6,410	6,410	0.02	0.005	3.87	0.08	3.35

For recoverable MIK estimation, a range of indicators are selected that divide the grade distribution into a series of classes. As much of the contained metal occurs in the higher grade samples, it is preferable that the top end of the distribution is divided into smaller classes to better represent the metal distribution.

A full list of all the indicator statistics for each of the domains in the Doropo deposits is beyond the scope of this report. Table 14-5 shows a breakdown of the indicators for the mineralised domain in Souwa that contains the most data as an example. Indicators 1 to 7 are based on deciles (10% increments of cumulative frequency) of the population, accounting for 70% of the data. Indicators 8 to twelve are based on 5% quantiles, indicators thirteen and fourteen are based on 2% quantiles and the top indicator accounts for the top 1% of grades.

Gold grades were not top-cut as it was deemed unnecessary for MIK estimation. There can be a reasonably large difference between the mean and median of the top indicator bin in zones where the gold grades are highly positively skewed. The choice of using the mean or median can have a large impact on the global and local resource estimates. The sensitivity of the Doropo deposits to this issue is discussed in Section 14.13.1. For the estimates reported here the average of the mean and median values was applied to the top indicator bin for each of the mineralised domains as this was felt to be a good compromise between the conservative median and optimistic mean values. The median value

of the top indicator bin was applied to estimate each of the waste domains. The mean value was applied to all other indicator bins.

Table 14-5: MIK gold indicator statistics for Souwa 101

Indicator	Count	Cumulative Proportion	Grade Threshold	Mean	Median	Indicator Value
1	346	10%	0.008	0.005	0.005	0.005
2	346	20%	0.025	0.016	0.015	0.016
3	346	30%	0.045	0.035	0.035	0.035
4	347	40%	0.080	0.064	0.065	0.064
5	346	50%	0.125	0.102	0.1	0.102
6	346	60%	0.205	0.165	0.165	0.165
7	347	70%	0.325	0.267	0.268	0.267
8	173	75%	0.430	0.378	0.38	0.378
9	173	80%	0.540	0.482	0.48	0.482
10	173	85%	0.700	0.62	0.62	0.62
11	173	90%	0.995	0.819	0.81	0.819
12	173	95%	1.645	1.265	1.235	1.265
13	70	97%	2.385	1.963	1.935	1.963
14	69	99%	7.140	3.663	3.16	3.663
15	35	100%	153.780	22.841	16.86	19.851

14.5 Variogram models

Variography was carried out using the software program GS3 on the two metre composited data from each of the mineralised domains that contained sufficient data in each of the deposits. MIK estimation requires a variogram model for each of the 15 indicator bins. H&SC created a set of variogram models for a total of 13 domains. The domains that lacked sufficient data to produce reasonable variography were estimated using a variogram model from a nearby domain although the axes were rotated to match the local mineralised domain orientation. Variography for Tchouahinin was poor so the variogram models from one of the domains at Kekeda were applied to estimate the Tchouahinin deposit.

Full details of all the variogram parameters used for each domain are beyond the scope of this report. Variography for each deposit showed relatively high continuity in the along strike and down dip orientations and poor continuity in the orientation perpendicular to these.

Figure 14-4 shows three of the variograms and a 3D representation of the variogram model produced for indicator five from one of the mineralised domains at Souwa. The gold indicator variograms for each domain showed decreasing ranges and increasing nugget effect away from the median indicator, signifying that high grade mineralisation is less continuous than lower grade mineralisation.

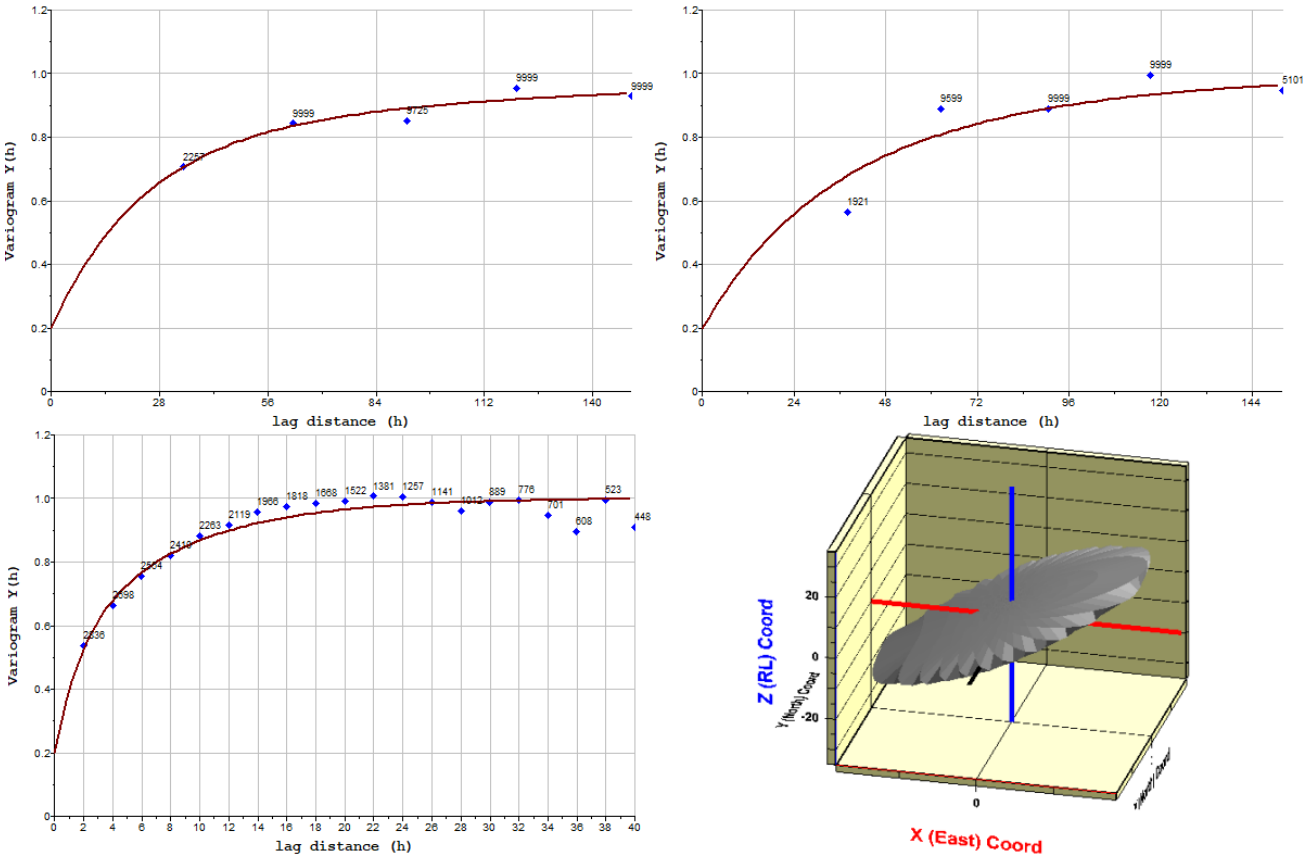

Figure 14-4: Souwa 101 gold variograms for indicator 5

(Top left: along strike, top right: down dip, bottom left: down hole, bottom right: 3d variogram model)

14.6 Block models

The orientation of the mineralisation at the Doropo deposits varies significantly between deposits, due, presumably, to the local strain regime at the time of mineralisation. Each of the deposits show relatively long continuity in the along strike and down-dip directions and short continuity in the direction perpendicular to these. Rotated block models were used where necessary to better reflect the local orientation of the mineralisation. Table 14-6 shows the details of the orthogonal block models and rotation angles. Coordinates represent the position of block centroids in the UTM WGS84 coordinate system. These models were then rotated around the Z axis by the rotation angle shown in the table. The rotation point for each of the models is 476,900E and 1,074,200N.

The drilling at all of the deposits assessed in this study include areas that have been drilled on a nominal 50x50 m grid pattern. Nokpa includes an area that has been drilled on a nominal 25x25 m grid. The vast majority of intervals have been sampled on 1 m intervals. Samples were composited to 2 m intervals whilst honouring the mineralised domain wireframes and with a minimum composite length of 1.0 m. The block dimensions were 50 m along strike, 25 m across strike and 10 m vertically. The along strike dimension was chosen as it is the nominal drill hole spacing (preferable for MIK estimation). The across-strike dimension was shortened to reflect the anisotropy of the mineralisation and inclined drilling. The vertical dimension was chosen to reflect downhole data spacing.

Table 14-6: Orthogonal block model details

Deposit	Parameter	East	North	RL	Rotation
Souwa	Minimum	477537.5	1074625.0	5	20
	Maximum	478887.5	1077925.0	365	
	Size (m)	25	50	10	
	Count	55	67	37	
Nokpa	Minimum	474087.5	1077925.0	-85	65
	Maximum	475512.5	1079425.0	335	
	Size (m)	25	50	10	
	Count	58	31	43	
Chegue	Minimum	474137.5	1078825.0	65	65
	Maximum	475337.5	1081925.0	355	
	Size (m)	25	50	10	
	Count	49	63	30	
Chegue South	Minimum	480912.5	1076575.0	-5	0
	Maximum	482087.5	1078325.0	335	
	Size (m)	25	50	10	
	Count	48	36	35	
Tchouahinin	Minimum	482362.5	1077125.0	85	20
	Maximum	484887.5	1079575.0	335	
	Size (m)	25	50	10	
	Count	102	50	26	
Kekeda	Minimum	482912.5	1076625.0	45	40
	Maximum	483937.5	1078625.0	325	
	Size (m)	25	50	10	
	Count	42	41	29	
Han	Minimum	483812.5	1079025.0	35	40
	Maximum	485037.5	1081775.0	305	
	Size (m)	25	50	10	
	Count	50	56	28	
Enioda	Minimum	491412.5	1073925.0	-5	0
	Maximum	492462.5	1076675.0	315	
	Size (m)	25	50	10	
	Count	43	56	33	

The wireframes representing mineralisation, dykes and weathering zones were used to flag the block model with proportions within each zone. No sub-blocking was used.

14.7 Search criteria

The search criteria used to estimate gold concentrations can be seen in Table 14-7 and consist of three search passes with progressively increasing search radii and/or decreasing data requirements. Declustering was carried out by the use of search octants. The search ellipsoids for each domain are rotated according to the local orientation of the mineralised domains. These rotations are the same as those applied to the variogram. Discretisation of blocks is based on 5 x 5 x 5 (east, north and vertical respectively) points. The maximum distance of extrapolation of reported resource estimates from data points is limited to 80 m and the maximum depth of reported estimates is set to 250 m below surface. These limits were applied following estimation.

Table 14-7: Search criteria

Axis	Pass 1	Pass 2	Pass 3
Axis 1 (Perpendicular to Strike and Dip)	15 m	30 m	30 m
Axis 2 (Along Strike)	60 m	120 m	120 m
Axis 3 (Down Dip)	60 m	120 m	120 m
Composite Data Requirements			
Minimum data points (total)	16	16	8
Max points (total)	48	48	48
Octants Required	4	4	2
Max points (per octant)	6	6	6

14.8 Selective Mining Units and Variance Adjustment

All of the resources reported here have been estimated on the assumption that the deposits will be mined by open-pit. Recoverable MIK allows for block support correction by means of a variance adjustment to account for the change from sample size support to the size of the minimum Selective Mining Unit (SMU) in order to produce estimates of recoverable resources at pre-defined gold cut off grades. This process requires an assumed grade control drill spacing and the assumed size of the minimum SMU. The variance correction factors were estimated from the gold metal variogram models assuming a minimum SMU of 5 by 12.5 by 2.5 metres (across strike, along strike, vertical) with high quality grade control sampling on a 5 by 12.5 by 1.5 metre pattern (across strike, along strike, vertical). This is the same grade control sampling pattern as that applied to Centamin's Sukari Mine, located in Egypt. The variance correction factors are considered to reflect Centamin's view of planned open pit mining selectivity. The variance corrections were applied by means of the direct lognormal method using calculated panel to block adjustments and information effects.

The application of the variance corrections to the resource estimates is expected to provide estimates of recoverable resources without the need to apply internal mining dilution, although some additional external mining dilution and mining recovery factors may be required. If a larger SMU size or a broader grade control drill pattern is implemented the selectivity assumed in the reported resources may not be realised.

14.9 Illegal artisanal mining

Illegal artisanal mining at the Doropo deposits is currently occurring despite efforts to limit the practice. Artisanal mining has occurred on all of the deposits assessed in this report except Chegue South and is most advanced at Tchouahinin and Souwa.

The artisanal miners target the thicker, high grade quartz veins in the weathered saprolite and the depth of mining is limited by the water table (varying between 5m and 20m). The artisanal miners hand dig small shafts and then tunnel a few metres along the quartz veins.

It is difficult to quantify the amount of material that has been extracted and the effects that the artisanal mining has had on the resource estimates. The resource estimates have not been reduced to account for the mined material because exactly where mining has occurred is poorly understood. In addition to this, the majority of the artisanal mining occurred before the majority of drilling has been conducted. This is likely to produce estimates that underestimate the resources as the artisanal miners have targeted the high grade quartz veins so only the lower grade peripheral mineralisation has been intersected by drilling.

14.10 Resource Classification

The resource classification is based on the search pass used to estimate the block. In order to limit small isolated volumes of different classification (spotted dog) the search passes used to populate each block were locally averaged. Pass one nominally equates to Indicated Resources and passes two and three equate to Inferred Resources. The maximum extrapolation of reported resources is limited to 80 m from drill hole data and limited to a depth of 250 m below surface.

This scheme is considered by H&SC to take appropriate account of all relevant factors, including the relative confidence in tonnage and grade estimates, confidence in the continuity of geology and metal values, and the quality, quantity and distribution of the data.

The classification appropriately reflects the Qualified Person's view of the deposit.

14.11 Block model validation

The block models were validated visually in cross section and plan, by comparing the sample and block statistics. As expected, the model represents a smoothed version of the original samples, with less of the local variability present in the sample data. Grade trends within the zones are aligned with the respective search and kriging orientations, and reasonably reflect interpreted trends in the mineralisation.

Only small scale illegal artisanal mining has occurred around the Doropo deposits so mine production data were unavailable for comparison.

14.12 Reported estimates

The Mineral Resources reported here occur in eight separate areas within a rectangle around 14 km east-west and 7.5 km north-south.

The Mineral Resources at Souwa at a cut-off of 0.5 g/t gold form a coherent zone with a strike length of around 2.7 km and a plan width of 500 m. The upper limit of the mineralisation occurs at surface

and the reported resources are limited to a maximum depth of 250 m below surface. The resources form a tabular body between 25 and 80 m thick, which dips around 27° to the east.

The Mineral Resources at Nokpa at a cut-off of 0.5 g/t gold form a coherent zone with a strike length of around 800 m and a plan width of 550 m. The upper limit of the mineralisation occurs at surface and the reported resources are limited to a maximum depth of 250 m below surface.

The Mineral Resources at Chegue at a cut-off of 0.5 g/t gold form a generally coherent zone with a strike length of around 2.7 km and a plan width of up to 450 m. The upper limit of the mineralisation occurs at surface and the reported resources reach a maximum depth of 220 m below surface. The resources form a tabular body between 20 and 40 m thick, which dips around 37° to the north.

The Mineral Resources at Chegue South at a cut-off of 0.5 g/t gold form a coherent zone with a strike length of around 1.3 km and a plan width of 470 m. The upper limit of the mineralisation occurs at surface and the reported resources are limited to a maximum depth of 250 m below surface. The resources form a tabular body between 40 and 100 m thick, which dips around 33° to the west.

The Mineral Resources at Tchouahinin at a cut-off of 0.5 g/t gold form a coherent zone which splits into two lodes. The strike length is around 780 m and the plan width is 370 m. The upper limit of the mineralisation occurs at surface and the reported resources reach a maximum depth of 180 m below surface. The resources form a tabular body between 40 and 100 m thick, which dips around 31° to the east.

The Mineral Resources at Kekeda at a cut-off of 0.5 g/t gold form a coherent zone with a strike length of around 1.6 km and a plan width of 400 m. The upper limit of the mineralisation occurs at surface and the reported resources reach a maximum depth of 150 m below surface. The resources form a tabular body between 10 and 60 m thick, which dips around 32° to the north east.

The Mineral Resources at Han at a cut-off of 0.5 g/t gold form a coherent zone with a strike length of around 1.3 km and a plan width of 340 m. The upper limit of the mineralisation occurs at surface and the reported resources reach a maximum depth of 170 m below surface. The resources form a tabular body between 20 and 40 m thick, which dips around 26° to the north east.

The Mineral Resources at Enioda at a cut-off of 0.5 g/t gold form a coherent zone with a strike length of around 2.3 km m and a plan width of 350 m. The upper limit of the mineralisation occurs at surface and the reported resources reach a maximum depth of 190 m below surface. The resources form a tabular body between 10 and 25 m thick, which dips around 35° to the east.

The reported Mineral Resource Estimates are reported by deposit and classification at gold cut-offs of 0.5, 0.8 and 1.0 g/t in Table 14-8, Table 14-9 and Table 14-10 respectively. The 0.5 g/t gold cut-off is considered the preferred scenario.

Table 14-8: Mineral Resource Estimates at 0.5 g/t gold cut-off

Deposit	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	18.1	1.41	0.82	6.3	1.5	0.30
Nokpa	6.9	1.30	0.29	1.8	1.2	0.07
Chegue	5.7	1.05	0.19	1.4	0.9	0.04
Chegue South	6.8	1.31	0.29	3.4	1.2	0.13
Tchouahinin	1.3	1.44	0.06	1.0	1.0	0.03
Kekeda	4.1	1.17	0.15	1.2	1.2	0.05
Han	3.8	1.48	0.18	1.6	1.4	0.07
Enioda	3.9	1.20	0.15	2.2	1.0	0.07
Totals	**50.5**	**1.31**	**2.13**	**19.0**	**1.3**	**0.76**

Table 14-9: Mineral Resource Estimates at 0.8 g/t gold cut-off

Deposit	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	10.5	1.98	0.67	3.3	2.3	0.24
Nokpa	4.6	1.65	0.24	1.1	1.6	0.06
Chegue	2.9	1.45	0.14	0.5	1.3	0.02
Chegue South	3.7	1.87	0.22	1.7	1.7	0.09
Tchouahinin	0.8	1.87	0.05	0.5	1.5	0.02
Kekeda	2.1	1.67	0.11	0.6	1.8	0.04
Han	2.4	2.01	0.15	0.9	1.9	0.06
Enioda	2.1	1.68	0.11	0.9	1.5	0.04
Totals	**29.1**	**1.82**	**1.70**	**9.5**	**1.9**	**0.57**

Table 14-10: Mineral Resource Estimates at 1.0 g/t gold cut-off

Deposit	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	8.0	2.32	0.60	2.5	2.7	0.22
Nokpa	3.6	1.86	0.21	0.8	1.9	0.05
Chegue	2.0	1.72	0.11	0.3	1.5	0.01
Chegue South	2.8	2.22	0.20	1.2	2.1	0.08
Tchouahinin	0.7	2.11	0.05	0.3	1.7	0.02
Kekeda	1.5	1.99	0.09	0.5	2.1	0.03
Han	1.8	2.35	0.14	0.7	2.3	0.05
Enioda	1.5	2.00	0.10	0.6	1.8	0.03
Totals	**21.7**	**2.13**	**1.48**	**6.8**	**2.3**	**0.49**

Table 14-11 through to Table 14-18 present the estimates for each of the deposits at a range of gold cut-offs.

Table 14-11: Souwa resource estimates by cut-off

Cut-off (Au g/t)	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
0.0	220.2	0.19	1.36	239	0.1	0.74
0.1	70.6	0.52	1.18	45	0.4	0.54
0.2	40.1	0.81	1.05	19	0.7	0.43
0.3	29.1	1.03	0.96	12	1.0	0.37
0.4	22.5	1.22	0.89	8	1.2	0.34
0.5	**18.1**	**1.41**	**0.82**	**6**	**1.5**	**0.30**
0.6	14.8	1.60	0.76	5	1.8	0.28
0.7	12.4	1.79	0.71	4	2.0	0.26
0.8	10.5	1.98	0.67	3	2.3	0.24
0.9	9.1	2.15	0.63	3	2.5	0.23
1.0	8.0	2.32	0.60	3	2.7	0.22
1.5	4.6	3.11	0.46	2	3.6	0.18

Table 14-12: Nokpa resource estimates by cut-off

Cut-off (Au g/t)	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
0.0	89.1	0.16	0.46	145	0.1	0.25
0.1	23.5	0.53	0.40	16	0.3	0.15
0.2	12.8	0.85	0.35	5	0.6	0.10
0.3	9.8	1.03	0.33	3	0.9	0.08
0.4	8.1	1.18	0.31	2	1.1	0.08
0.5	**6.9**	**1.30**	**0.29**	**2**	**1.2**	**0.07**
0.6	5.9	1.42	0.27	1	1.4	0.07
0.7	5.2	1.54	0.26	1	1.5	0.06
0.8	4.6	1.65	0.24	1	1.6	0.06
0.9	4.0	1.75	0.23	1	1.8	0.05
1.0	3.6	1.86	0.21	1	1.9	0.05
1.5	1.9	2.40	0.15	0	2.5	0.03

Table 14-13: Chegue resource estimates by cut-off

Cut-off (Au g/t)	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
0.0	115.2	0.12	0.43	163	0.1	0.28
0.1	27.6	0.38	0.34	18	0.2	0.13
0.2	13.8	0.62	0.27	6	0.4	0.08
0.3	9.8	0.77	0.24	3	0.6	0.06
0.4	7.4	0.91	0.22	2	0.7	0.05
0.5	**5.7**	**1.05**	**0.19**	**1**	**0.9**	**0.04**
0.6	4.5	1.19	0.17	1	1.0	0.03
0.7	3.6	1.32	0.15	1	1.1	0.03
0.8	2.9	1.45	0.14	1	1.3	0.02
0.9	2.4	1.59	0.12	0	1.4	0.02
1.0	2.0	1.72	0.11	0	1.5	0.01
1.5	0.9	2.37	0.06	0	2.3	0.01

Table 14-14: Chegue South resource estimates by cut-off

Cut-off (Au g/t)	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
0.0	109.9	0.15	0.53	109	0.1	0.30
0.1	30.8	0.45	0.45	20	0.4	0.23
0.2	16.5	0.72	0.39	9	0.6	0.18
0.3	11.7	0.92	0.35	6	0.8	0.16
0.4	8.7	1.12	0.31	5	1.0	0.14
0.5	**6.8**	**1.31**	**0.29**	**3**	**1.2**	**0.13**
0.6	5.4	1.50	0.26	3	1.3	0.11
0.7	4.5	1.69	0.24	2	1.5	0.10
0.8	3.7	1.87	0.22	2	1.7	0.09
0.9	3.2	2.05	0.21	1	1.9	0.08
1.0	2.8	2.22	0.20	1	2.1	0.08
1.5	1.5	3.02	0.15	1	2.9	0.05

Table 14-15: Tchouahinin resource estimates by cut-off

Cut-off (Au g/t)	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
0.0	32.2	0.12	0.12	55	0.1	0.13
0.1	6.8	0.45	0.10	9	0.3	0.08
0.2	3.9	0.69	0.09	3	0.5	0.06
0.3	2.7	0.88	0.08	2	0.7	0.05
0.4	1.8	1.16	0.07	1	0.9	0.04
0.5	**1.3**	**1.44**	**0.06**	**1**	**1.0**	**0.03**
0.6	1.1	1.61	0.06	1	1.2	0.03
0.7	0.9	1.74	0.05	1	1.3	0.03
0.8	0.8	1.87	0.05	0	1.5	0.02
0.9	0.7	1.99	0.05	0	1.6	0.02
1.0	0.7	2.11	0.05	0	1.7	0.02
1.5	0.4	2.73	0.03	0	2.4	0.01

Table 14-16: Kekeda resource estimates by cut-off

Cut-off (Au g/t)	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
0.0	77.1	0.14	0.34	113	0.1	0.24
0.1	21.8	0.38	0.27	16	0.3	0.13
0.2	10.8	0.63	0.22	5	0.5	0.08
0.3	7.2	0.83	0.19	3	0.8	0.06
0.4	5.3	0.99	0.17	2	1.0	0.05
0.5	**4.1**	**1.17**	**0.15**	**1**	**1.2**	**0.05**
0.6	3.2	1.34	0.14	1	1.4	0.04
0.7	2.6	1.51	0.12	1	1.6	0.04
0.8	2.1	1.67	0.11	1	1.8	0.04
0.9	1.7	1.83	0.10	1	2.0	0.03
1.0	1.5	1.99	0.09	0	2.1	0.03
1.5	0.7	2.75	0.07	0	2.9	0.02

Table 14-17: Han resource estimates by cut-off

Cut-off (Au g/t)	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
0.0	53.6	0.16	0.27	113	0.1	0.23
0.1	12.0	0.62	0.24	14	0.3	0.14
0.2	7.3	0.93	0.22	4	0.7	0.10
0.3	5.6	1.14	0.20	3	0.9	0.08
0.4	4.6	1.31	0.19	2	1.1	0.08
0.5	**3.8**	**1.48**	**0.18**	**2**	**1.4**	**0.07**
0.6	3.2	1.66	0.17	1	1.6	0.06
0.7	2.7	1.84	0.16	1	1.8	0.06
0.8	2.4	2.01	0.15	1	1.9	0.06
0.9	2.1	2.18	0.14	1	2.1	0.05
1.0	1.8	2.35	0.14	1	2.3	0.05
1.5	1.1	3.07	0.11	0	3.0	0.04

Table 14-18: Enioda resource estimates by cut-off

Cut-off (Au g/t)	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
0.0	79.6	0.12	0.30	193	0.1	0.34
0.1	15.7	0.46	0.23	21	0.3	0.18
0.2	9.2	0.69	0.20	8	0.5	0.13
0.3	6.6	0.86	0.18	5	0.7	0.10
0.4	5.0	1.03	0.16	3	0.8	0.08
0.5	**3.9**	**1.20**	**0.15**	**2**	**1.0**	**0.07**
0.6	3.1	1.36	0.13	2	1.2	0.06
0.7	2.5	1.52	0.12	1	1.3	0.05
0.8	2.1	1.68	0.11	1	1.5	0.04
0.9	1.7	1.84	0.10	1	1.6	0.04
1.0	1.5	2.00	0.10	1	1.8	0.03
1.5	0.7	2.78	0.07	0	2.5	0.02

Table 14-19, Table 14-20, Table 14-21 and Table 14-22 present the estimates split by oxidation domain for each of the deposits at gold cut-offs of 0.3, 0.5, 0.8 and 1 g/t respectively.

Table 14-19: Estimates by deposit and weathering domain at 0.3 g/t gold cut-off

Area	Oxidation	Indicated			Inferred		
		Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	Oxidised	8.5	1.03	0.28	1.3	0.7	0.03
	Transitional	1.4	1.05	0.05	0.1	0.6	0.00
	Fresh	19.1	1.02	0.63	10.6	1.0	0.34
	Sub-total	**29.1**	**1.03**	**0.96**	**12.0**	**1.0**	**0.37**
Nokpa	Oxidised	0.7	0.95	0.02	0.0	0.5	0.00
	Transitional	0.4	1.17	0.02	0.0	0.5	0.00
	Fresh	8.8	1.03	0.29	2.8	0.9	0.08
	Sub-total	**9.8**	**1.03**	**0.33**	**2.8**	**0.9**	**0.08**
Chegue	Oxidised	2.4	0.71	0.06	0.3	0.6	0.01
	Transitional	0.7	0.79	0.02	0.1	0.5	0.00
	Fresh	6.7	0.80	0.17	3.0	0.6	0.06
	Sub-total	**9.8**	**0.77**	**0.24**	**3.3**	**0.6**	**0.06**
Chegue South	Oxidised	1.3	0.87	0.03	0.1	0.6	0.00
	Transitional	0.4	0.99	0.01	0.0	0.7	0.00
	Fresh	10.0	0.93	0.30	6.1	0.8	0.16
	Sub-total	**11.7**	**0.92**	**0.35**	**6.3**	**0.8**	**0.16**
Tchouahinin	Oxidised	1.0	0.81	0.02	0.2	0.8	0.01
	Transitional	0.4	0.95	0.01	0.0	0.5	0.00
	Fresh	1.4	0.91	0.04	1.8	0.7	0.04
	Sub-total	**2.7**	**0.88**	**0.08**	**2.0**	**0.7**	**0.05**
Kekeda	Oxidised	1.4	0.91	0.04	0.3	0.9	0.01
	Transitional	0.7	0.82	0.02	0.2	0.4	0.00
	Fresh	5.1	0.80	0.13	2.1	0.8	0.05
	Sub-total	**7.2**	**0.83**	**0.19**	**2.6**	**0.8**	**0.06**
Han	Oxidised	0.02	1.00	0.00	0.2	1.8	0.01
	Transitional	0.1	2.03	0.01	0.3	1.5	0.01
	Fresh	5.5	1.12	0.20	2.3	0.8	0.06
	Sub-total	**5.6**	**1.14**	**0.20**	**2.8**	**0.9**	**0.08**
Enioda	Oxidised	2.0	0.90	0.06	0.7	0.6	0.01
	Transitional	0.8	0.81	0.02	0.0	0.5	0.00
	Fresh	3.8	0.86	0.10	4.1	0.7	0.09
	Sub-total	**6.6**	**0.86**	**0.18**	**4.8**	**0.7**	**0.10**
Grand Total		**82.4**	**0.95**	**2.53**	**37**	**0.8**	**0.98**

Table 14-20: Estimates by deposit and weathering domain at 0.5 g/t gold cut-off

Area	Oxidation	Indicated			Inferred		
		Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	Oxidised	5.5	1.39	0.25	0.6	1.1	0.02
	Transitional	0.9	1.45	0.04	0.0	0.9	0.00
	Fresh	11.7	1.42	0.54	5.7	1.5	0.28
	Sub-total	**18.1**	**1.41**	**0.82**	**6.3**	**1.5**	**0.30**
Nokpa	Oxidised	0.4	1.32	0.02	0.0	0.8	0.00
	Transitional	0.3	1.47	0.01	0.0	0.8	0.00
	Fresh	6.2	1.30	0.26	1.8	1.2	0.07
	Sub-total	**6.9**	**1.30**	**0.29**	**1.8**	**1.2**	**0.07**
Chegue	Oxidised	1.3	0.98	0.04	0.1	0.9	0.00
	Transitional	0.4	1.11	0.01	0.0	0.8	0.00
	Fresh	4.0	1.07	0.14	1.3	0.9	0.04
	Sub-total	**5.7**	**1.05**	**0.19**	**1.4**	**0.9**	**0.04**
Chegue South	Oxidised	0.7	1.29	0.03	0.1	0.8	0.00
	Transitional	0.3	1.40	0.01	0.0	1.1	0.00
	Fresh	5.9	1.31	0.25	3.3	1.2	0.12
	Sub-total	**6.8**	**1.31**	**0.29**	**3.4**	**1.2**	**0.13**
Tchouahinin	Oxidised	0.4	1.28	0.02	0.1	1.3	0.00
	Transitional	0.2	1.39	0.01	0.0	0.7	0.00
	Fresh	0.6	1.58	0.03	0.9	1.0	0.03
	Sub-total	**1.3**	**1.44**	**0.06**	**1.0**	**1.0**	**0.03**
Kekeda	Oxidised	0.8	1.27	0.03	0.2	1.3	0.01
	Transitional	0.4	1.15	0.02	0.0	0.8	0.00
	Fresh	2.8	1.14	0.10	1.0	1.2	0.04
	Sub-total	**4.1**	**1.17**	**0.15**	**1.2**	**1.2**	**0.05**
Han	Oxidised	0.0	1.30	0.00	0.2	2.2	0.01
	Transitional	0.1	2.33	0.01	0.2	1.8	0.01
	Fresh	3.7	1.46	0.18	1.2	1.2	0.04
	Sub-total	**3.8**	**1.48**	**0.18**	**1.6**	**1.4**	**0.07**
Enioda	Oxidised	1.2	1.21	0.05	0.3	1.0	0.01
	Transitional	0.5	1.11	0.02	0.0	0.7	0.00
	Fresh	2.2	1.21	0.08	1.9	1.0	0.06
	Sub-total	**3.9**	**1.20**	**0.15**	**2.2**	**1.0**	**0.07**
Grand Total		**50.5**	**1.31**	**2.13**	**19**	**1.3**	**0.76**

Table 14-21: Estimates by deposit and weathering domain at 0.8 g/t gold cut-off

Area	Oxidation	Indicated			Inferred		
		Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	Oxidised	3.3	1.91	0.20	0.3	1.6	0.01
	Transitional	0.5	2.08	0.03	0.0	1.4	0.00
	Fresh	6.8	2.00	0.44	3.1	2.3	0.23
	Sub-total	**10.5**	**1.98**	**0.67**	**3.3**	**2.3**	**0.24**
Nokpa	Oxidised	0.2	1.79	0.01	0.0	1.2	0.00
	Transitional	0.2	1.85	0.01	0.0	1.1	0.00
	Fresh	4.1	1.63	0.22	1.1	1.6	0.06
	Sub-total	**4.6**	**1.65**	**0.24**	**1.1**	**1.6**	**0.06**
Chegue	Oxidised	0.6	1.39	0.03	0.0	1.4	0.00
	Transitional	0.2	1.55	0.01	0.0	1.1	0.00
	Fresh	2.1	1.46	0.10	0.5	1.3	0.02
	Sub-total	**2.9**	**1.45**	**0.14**	**0.5**	**1.3**	**0.02**
Chegue South	Oxidised	0.4	1.88	0.02	0.0	1.2	0.00
	Transitional	0.2	1.93	0.01	0.0	1.6	0.00
	Fresh	3.2	1.87	0.19	1.7	1.7	0.09
	Sub-total	**3.7**	**1.87**	**0.22**	**1.7**	**1.7**	**0.09**
Tchouahinin	Oxidised	0.3	1.76	0.01	0.1	1.9	0.00
	Transitional	0.2	1.65	0.01	0.0	1.2	0.00
	Fresh	0.4	2.03	0.03	0.4	1.4	0.02
	Sub-total	**0.8**	**1.87**	**0.05**	**0.5**	**1.5**	**0.02**
Kekeda	Oxidised	0.5	1.78	0.03	0.1	1.8	0.01
	Transitional	0.2	1.63	0.01	0.0	1.5	0.00
	Fresh	1.4	1.64	0.07	0.5	1.8	0.03
	Sub-total	**2.1**	**1.67**	**0.11**	**0.6**	**1.8**	**0.04**
Han	Oxidised	0.0	1.78	0.00	0.1	2.6	0.01
	Transitional	0.1	2.64	0.01	0.2	2.2	0.01
	Fresh	2.3	1.99	0.15	0.6	1.7	0.03
	Sub-total	**2.4**	**2.01**	**0.15**	**0.9**	**1.9**	**0.06**
Enioda	Oxidised	0.7	1.66	0.04	0.1	1.4	0.01
	Transitional	0.2	1.57	0.01	0.0	1.1	0.00
	Fresh	1.2	1.72	0.06	0.8	1.5	0.04
	Sub-total	**2.1**	**1.68**	**0.11**	**0.9**	**1.5**	**0.04**
Grand Total		**29.1**	**1.82**	**1.7**	**10**	**1.9**	**0.57**

Table 14-22: Estimates by deposit and weathering domain at 1.0 g/t gold cut-off

Area	Oxidation	Indicated			Inferred		
		Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	Oxidised	2.5	2.24	0.18	0.2	1.9	0.01
	Transitional	0.4	2.48	0.03	0.0	1.7	0.00
	Fresh	5.1	2.35	0.39	2.3	2.8	0.21
	Sub-total	**8.0**	**2.32**	**0.60**	**2.5**	**2.7**	**0.22**
Nokpa	Oxidised	0.2	2.06	0.01	0.0	1.4	0.00
	Transitional	0.2	2.08	0.01	0.0	1.4	0.00
	Fresh	3.2	1.84	0.19	0.8	1.9	0.05
	Sub-total	**3.6**	**1.86**	**0.21**	**0.8**	**1.9**	**0.05**
Chegue	Oxidised	0.4	1.66	0.02	0.0	1.7	0.00
	Transitional	0.1	1.82	0.01	0.0	1.4	0.00
	Fresh	1.4	1.72	0.08	0.3	1.5	0.01
	Sub-total	**2.0**	**1.72**	**0.11**	**0.3**	**1.5**	**0.01**
Chegue South	Oxidised	0.3	2.23	0.02	0.0	1.4	0.00
	Transitional	0.1	2.24	0.01	0.0	2.0	0.00
	Fresh	2.4	2.21	0.17	1.2	2.1	0.08
	Sub-total	**2.8**	**2.22**	**0.20**	**1.2**	**2.1**	**0.08**
Tchouahinin	Oxidised	0.2	1.99	0.01	0.0	2.2	0.00
	Transitional	0.1	1.82	0.01	0.0	1.4	0.00
	Fresh	0.3	2.30	0.02	0.3	1.7	0.02
	Sub-total	**0.7**	**2.11**	**0.05**	**0.3**	**1.7**	**0.02**
Kekeda	Oxidised	0.3	2.09	0.02	0.1	2.2	0.00
	Transitional	0.2	1.94	0.01	0.0	2.0	0.00
	Fresh	1.0	1.97	0.06	0.4	2.1	0.03
	Sub-total	**1.5**	**1.99**	**0.09**	**0.5**	**2.1**	**0.03**
Han	Oxidised	0.0	2.11	0.00	0.1	2.9	0.01
	Transitional	0.1	2.83	0.01	0.2	2.4	0.01
	Fresh	1.7	2.33	0.13	0.4	2.1	0.03
	Sub-total	**1.8**	**2.35**	**0.14**	**0.7**	**2.3**	**0.05**
Enioda	Oxidised	0.5	1.95	0.03	0.1	1.7	0.00
	Transitional	0.2	1.87	0.01	0.0	1.3	0.00
	Fresh	0.8	2.05	0.05	0.5	1.8	0.03
	Sub-total	**1.5**	**2.00**	**0.10**	**0.6**	**1.8**	**0.03**
Grand Total		**21.7**	**2.13**	**1.48**	**7**	**2.3**	**0.49**

14.13 Sensitivity analysis

14.13.1 Sensitivity to treatment of top indicator bin default grade

There can be a reasonably large difference between the mean and median of the top indicator bin in zones where the gold grades are highly positively skewed. The choice of using the mean or median

can have a large impact on the global and local resource estimates. For the estimates presented in this report the average of the mean and median values was applied to the top indicator bin for each of the mineralised domains as this was felt to be a good compromise between the conservative median and optimistic mean values. In order to assess the sensitivity of the estimates to this assumption H&SC conducted estimates using the mean and median top indicator bin values. The results of this study are presented in Table 14-23 as percentages relative to the reported estimates.

Using the mean, median or the average of the two for the top indicator bin impacts the estimated tonnages and grades, which is compounded in estimates of the contained metal. Larger differences indicate that the estimates are more sensitive to the approach to the top indicator class, owing largely to the skewedness of the gold grade populations.

Table 14-23: Difference to reported estimates using different top bin statistics

Deposit	Mean			Median		
	Tonnes	Au Grade	Au Metal	Tonnes	Au Grade	Au Metal
Souwa	101%	105%	106%	98%	94%	93%
Nokpa	102%	102%	106%	97%	97%	94%
Chegue	101%	102%	104%	99%	98%	100%
Chegue South	105%	113%	120%	94%	87%	83%
Tchouahinin	101%	103%	111%	106%	118%	133%
Kekeda	104%	106%	110%	95%	94%	90%
Han	102%	113%	116%	97%	88%	84%
Enioda	100%	101%	100%	100%	99%	100%
Total	**102%**	**105%**	**108%**	**98%**	**95%**	**93%**

14.14 Comparison to previous estimates

The previous estimate was carried out by Rupert Osborn of H&SC in December 2017. This estimate used similar estimation procedures although it was based on slightly different domaining. These estimates are presented in Table 14-24. The Chegue North and Chegue Main deposits in Table 14-24 are equivalent to the deposit currently referred to as Chegue. These estimates agree reasonably well with the current estimates presented in Table 14-8. There has been an increase in estimated tonnages and confidence due to the additional drilling carried out over the course of 2018.

Table 14-24: January 2018 resource estimates at 0.5 g/t gold cut-off

Deposit	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Moz)	Tonnes (Mt)	Au (g/t)	Au (Moz)
Souwa	15.4	1.4	0.65	7.2	1.3	0.29
Nokpa	5.1	1.4	0.22	4.9	1.3	0.20
Chegue North	1.2	0.9	0.04	1.1	0.9	0.03
Chegue Main	1.1	1.2	0.04	1.2	0.9	0.03
Chegue South	4.6	1.4	0.20	3.6	1.1	0.12
Kekeda	2.0	1.2	0.07	2.0	1.2	0.07
Han	3.2	1.3	0.13	1.5	1.2	0.06
Enioda	-	-	-	3.2	0.9	0.10
Total	**32.6**	**1.3**	**1.35**	**24.8**	**1.2**	**0.90**

The previous resource estimates were presented in a report produced by MPR Geological Consultants Pty Ltd (MPR) and reported at a gold cut-off of 0.5 g/t in January 2017 (MPR Geological Consultants, 2017) as in Table 14-25. The resources were also estimated using recoverable MIK. These estimates covered a significantly smaller volume as Centamin has conducted a large amount of additional drilling (more than 600 drill holes) since these estimates were produced. There has been a large increase in overall resources and the confidence categories due to the additional drill hole data.

Table 14-25: January 2017 resource estimates at 0.5 g/t gold cut-off

Deposit	Indicated			Inferred		
	Tonnes (Mt)	Au (g/t)	Au (Koz)	Tonnes (Mt)	Au (g/t)	Au (Koz)
Souwa	3.41	1.71	187	12	1.4	540
Nokpa	2.34	1.49	112	3.5	1.3	146
Chegue	-	-	-	1.2	0.9	35
Kekeda	-	-	-	4	1.1	141
Han	-	-	-	4.8	1.1	170
Total	**5.75**	**1.62**	**300**	**26**	**1.26**	**1,032**

(MPR Geological Consultants, 2017)

23 Adjacent Properties

There are no 3rd party projects currently adjacent to the Doropo Project. To the west of Doropo, there are applications by other companies which have not been granted to date. These cover the Tehini and Hounde Greenstones belts and fill the gap between the frontier to Burkina Faso and the Comoe National Park. Gold exploration and mining is prohibited in the Comoe National Park. There are no adjacent properties to the South of Doropo.

The Burkina Faso border lies to the north and west of the Doropo Project. Centamin West Africa, a 100% owned subsidiary of Centamin, holds a group of 8 exploration permits and one exploitation permit, collectively known as the Batie Project, on the Burkino Faso side of the border. One deposit,

the Napelepera deposit, from the Batie Project, is the direct continuity of the Enioda deposit from the Doropo Project. The other deposits are hosted in a different structural environment, in the greenstones.

The details of the Batie Project are not presented here as the property is owned by Centamin and therefore does not meet the definition of an 'adjacent property' in the NI 43-101 Definitions (1.1.a) (National Instrument 43-101F1, 2011). Information relating to the Batie Project was summarised in the NI 43-101 report titled "Technical Report on the Konkera Gold Project for Ampella Mining Limited" completed on March 18th 2014. The Qualified Persons of this report have not verified the information and the mineralisation in the Batie Project and the mineralisation is not necessarily indicative of the Doropo mineralisation.

24 Other Relevant Data and Information

It is considered that all relevant information and explanations have been provided in the body of this report to make it understandable and not misleading.

25 Interpretation and Conclusions

H&SC is of the opinion that the Mineral Resource estimates are suitable for public reporting and are a fair representation of the in-situ gold concentration and contained metal for the Doropo Project.

An uncertainty that may affect the Mineral Resource estimates involves the amount of material that has been extracted by illegal artisanal mining of the Doropo deposits. It is believed that the amount extracted is not significant in terms of the global resource estimates. The majority of the artisanal mining occurred before the majority of drilling had been conducted. If significantly more material has or will be extracted through illegal mining then the Mineral Resource estimates will be impacted, resulting in decreased estimates of tonnage and grade as well as a possible decrease in the classification of the near-surface mineralisation.

The current estimates are considered to compare well with the previous Mineral Resource estimates of the Doropo Project, with differences in tonnages and classification dominantly due to the significant increase in drill hole data coverage.

26 Recommendations

H&SC have been informed that Centamin plans to deliver a Preliminary Economic Assessment (PEA) report in the second half of 2019. The 2019 Doropo PEA report will involve the independent 3rd party contributions of Australia Mine Design and Development (AMDAD), H&SC, SRK UK, Lycopodium, ALS-AMMTEC, Elms Metallurgical Services (ELMSMET), GCS, Knight Piesold, Digby Wells, PAH Consulting, Australasian Mining Services (AMS), AUSDRILL, MAXAM and BCM International Ltd.

Table 26-1: 2019 Doropo PEA report budget

Doropo PEA 2019 BUDGET	USD	January	February	March	April	May	June	July	August	September	October
Geology support	30,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Suvey - Collars, Pillars	20,000	5,000		5,000	5,000			5,000			
DW/PAH - Enviro-Community	25,000	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
PAH - Social-Compensation	15,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Knight Piesold - Tailings	27,500		5,500		5,500		5,500	5,500	5,500		
GCS - Hydrology	35,000	7,000	7,000	7,000	7,000	7,000					
Drilling Water bore holes	25,000				12,500	12,500					
H&S Resources	50,000	25,000						25,000			
AMDAD Mining Engineering	80,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
AMMTEC-ARD Metallurgy	30,000		5,000	5,000	5,000	5,000	5,000	5,000	5,000	- 5,000	
LYCOPODIUM - Process Design	62,500		6,250	6,250	6,250	6,250	6,250	6,250	12,500	12,500	
DEM-Photogammetry	100,000			50,000	50,000						
2019 PEA BUDGET TOTAL	500,000										

A 2019 PEA budget has been approved and is expected complete and report by 15th October. The various contributing consultancies have been aligned and a PEA workflow and schedule agreed.

Table 26-2: 2019 Doropo PEA Activity Schedule

1. 2018 Resource Models	January, 2019
2. LYCO Preliminary Process Design & PCosts	January, 2019
3. 2018 Pit Optimisations & Resource DD	February, 2019
4. EIA & Compensation Fatal Flaws	February, 2019
5. Preliminary Mine Design & RAP	February, 2019
6. Draft Mine Schedule and Financial Model	March, 2019
7. PEA Review & Greenlight	March, 2019
8. Doropo DEM & Cadastral GIS preparation	March, 2019
9. GCS and PTAH Hydro baseline studies	March, 2019 Dry August, 2019 Wet
10. CDI EIA Dust, Noise & ASM baseline studies	March, 2019
11. KP Tailings design, budget & scheduling	March, 2019
12. KP ARD tailings, water & waste testwork	April, 2019
13. GCS Process Water & Management studies	April, 2019
14. GCS-KP Water Infrastructure & Design	June, 2019
15. PEA MRE update and reporting	July, 2019
16. GCS hydro model, production BoQ and reporting	August, 2019
17. KP Tailings Dam design and reporting	August, 2019
18. LYCO Plant design, schedule capex and reporting	August, 2019
19. AMDAD PEA 2019-2 Designs, Reserves & DCF	September, 2019
20. Centamin PEA direction and final deliverables	September, 2019
21. AMDAD-LYCO-Centamin PEA report compilation	September, 2019
22. PEA Report Draft 2 AP	1st October, 2019
23. PEA Report Final	15th October 2019

In addition to this work, H&SC recommends that a portion of the assay results from Bureau Veritas Minerals Laboratory are checked by sending sample pulps to a second, independent, internationally recognised laboratory. It is recommended that at least 200 samples (1%) are selected for reassay, covering a range of grades, from the within the mineralised zones. It is expected that this will cost around USD $4,500.

CERTIFICATE OF QUALIFIED PERSON

I, Rupert Osborn, do hereby certify that:

1. I am a Senior Consultant of H&S Consultants Pty Ltd, 3/6 Trelawney Street, Eastwood, NSW, 2122, AUSTRALIA.
2. This certificate applies to the technical report titled "NI 43-101 Technical Report, Mineral Resource Estimates of the Doropo Project, Cote d'Ivoire" with an Effective Date of December 10, 2019.
3. I graduated with a degree in Geology from University of Edinburgh, UK in 2003. In addition, I have obtained a Masters degree (MSc) in Mining Geology from Camborne School of Mines, University of Exeter, UK in 2004 and have worked as a geologist for a total of 14 years since my graduation from university. I am a member of the Australian Institute of Geosciences (AIG) (Membership Number 4917).
4. I have read the definition of "qualified person" set out in National Instrument 43-101 (NI 43-101) 2011 and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a "qualified person" for the purposes of NI 43-101.
5. I visited the Doropo project site for three full days in November 2017 and again for a full day in December 2018
6. I am responsible for the preparation of Sections 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 23, 24, 25 & 26 of this report as well as the summary of this information that is contained in Section 1.
7. I am independent of the issuer applying all of the tests in section 1.5 of NI 43-101.
8. I have had prior involvement with the Doropo Project. The nature of my prior involvement was limited to conducting independent Mineral Resource Estimates for the Doropo Project in January 2018. This work involved a site visit.
9. I have read NI 43-101 and Form 43-101F1 and the sections of the Technical Report for which I am responsible and have ensured that these have been prepared in compliance with that instrument and form.
10. As of the aforementioned Effective Date, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading

Dated March 29, 2019.

"Signed" .

Rupert Osborn, MSc, MAIG

Senior Consultant at H&SC

27 References

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