Columbus Gold Corporation

Paul Isnard Project

Montagne d'Or Prospect

4 August 2014

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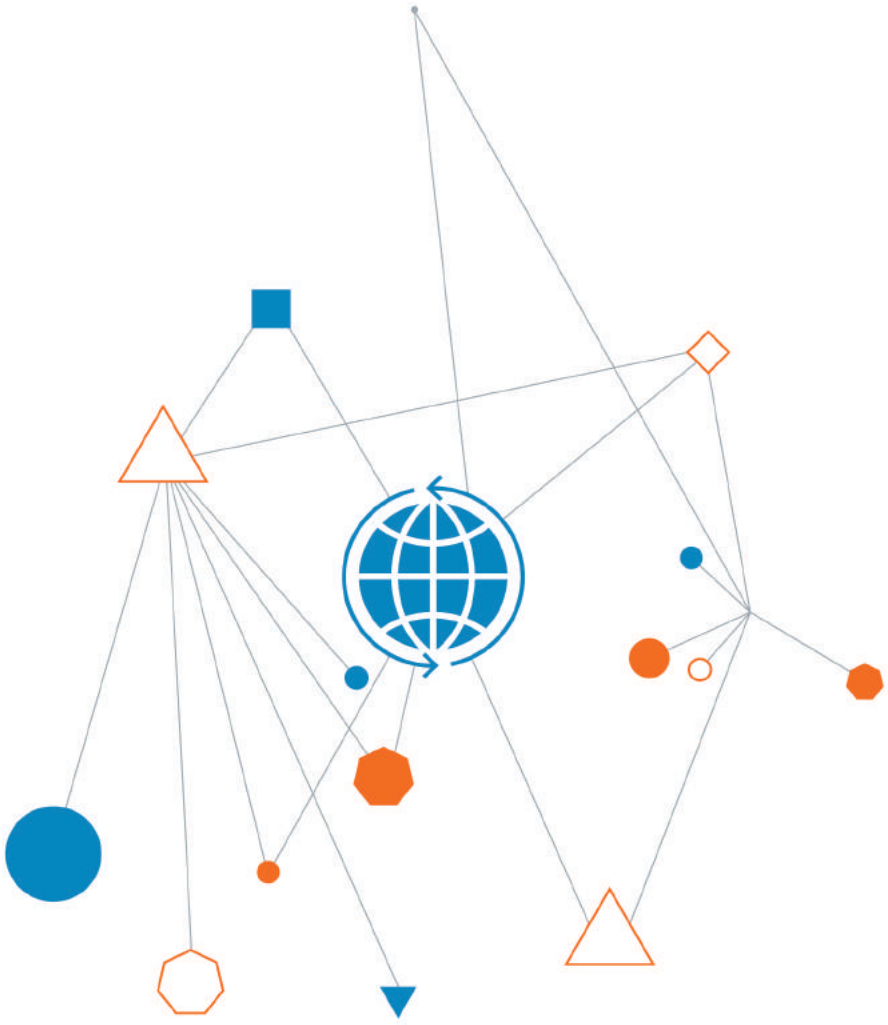

When you think with a global mind problems get smaller

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Paul Isnard Project

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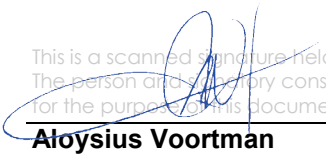

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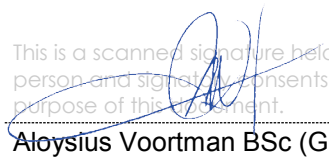

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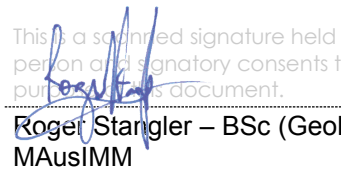

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1. Summary

Columbus Gold Corporation (Columbus) is developing its 100% owned Paul Isnard gold project in French Guiana. Coffey Mining in Perth, Western Australia (Coffey) has been requested by Columbus to prepare, from existing and new drillhole data, a National Instrument 43-101 Technical Report (NI43-101) on an updated Resource Estimate for the Paul Isnard Project.

The Paul Isnard Project is located in the north western portion of French Guiana, 180km west of the capital Cayenne and 80km south of the department capital Saint Laurent du Maroni. A total of eight mining concessions with a total extent of 13,609 hectares (as re-calculated by Columbus) comprise the property. On 13 March 2014 Columbus signed a joint venture memorandum with Nordgold which gives Nordgold the right to buy in to a holding of 50.01%.

Drilling by Columbus on the Paul Isnard Project has mainly been in the area of the Montagne d'Or Prospect. Most of the region is covered by a thick canopy of primary and secondary tropical forest. The mean elevation is approximately 130m ASL. To the south of the Montagne d'Or Prospect, at a distance from 550m to 1,050m from the southern boundary, the boundary of a biological reserve (Dékou Dékou biological reserve) exists.

The Paul Isnard concessions have been a regional centre of alluvial and colluvial gold production since 1873 with some minor underground development in a few places. The area was previously explored by the Bureau Minier Guyanais and later the Bureau de Recherches Géologiques et Minières. This work confirmed the alluvial mining potential of the region and also located the primary Montagne d'Or Prospect as a result of a regional geochemical program in 1976. The BRGM undertook detailed surficial geochemical work and geological mapping.

Exploration activities in and around Montagne d'Or were carried out by Guyanor since 1994. Diamond drilling by Guyanor from 1996 to 1998 resulted in a total of 56 drillholes for 10,916 meters. Mineral Resource estimates made prior to Columbus acquiring the property in November 2010 are considered historic in nature and are not reported. The previous NI 43-101 report was compiled by Coffey Mining in Canada. This report was published on 15 March 2013 and lists an Inferred Mineral Resource in four separate mineralised fresh domains.

In addition to the earlier diamond drillholes completed by Guyanor, a total of 56 holes for 10,916m, Columbus completed a total of 101 diamond drillholes in two campaigns for 22,906.45m (45 holes for 15,721.45m, and 56 holes for 7,185.0m). Holes start at HQ from surface and reduce to NQ in fresh material. Assay results from the Guyanor drillholes are of lower quality than the more recent Columbus drillholes but are considered as fit-for-purpose for the resource estimate. SRK have repeatedly recommended all Guyanor drilling be re-sampled. However, a combination of core being mixed up upon return to core trays during the 2007 re-sampling programme, and oxidation caused by exposure to high humidity, has resulted in the remnant Guyanor core no longer being fit for re-sampling.

The Paul Isnard concessions occur within the Guiana Shield, a large segment of the Amazonian Craton of South America. The majority of the Guiana Shield formed during Proterozoic periods of intense magmatism, metamorphism and deformation that culminated in the Transamazonian tectono-thermal. Major structural features include the Central Guiana Shear Zone, a large-scale ductile shear zone, extending from French Guiana westerly through central Suriname and north-central Guiana. The North Guiana Trough is interpreted to be a sinistral strike-slip structure formed during the Transamazonian Orogeny and is interpreted to have formed as a "pull-apart basin".

In general, the Montagne d'Or Prospect consists of a number of strongly deformed, linear, tabular mineralised bodies within laminated felsic and mafic volcanic and volcaniclastic rocks intruded by narrow mafic to felsic dykes. Mineralisation has been encountered over a strike length of approximately 2,500m and to a vertical depth of at least 200m. The mineralisation is open at depth, along strike and internally between widely spaced holes. The Montagne d'Or Prospect is composed of a bimodal felsic and mafic igneous units with lesser volcaniclastics towards the base of the sequence, overlain to the north by stratified grey pelites, greywacke, and siltites of the Armina Formation. The units strike east-west and dip steeply towards the south.

The area has experienced two distinct deformational events; the first involved ductile deformation during the Lower Proterozoic accretionary arc tectonism that formed the Guiana Shield, and the second related to more brittle deformation associated with the faulting. Gold mineralisation at the Montagne d'Or Prospect is accompanied by pervasive alteration products that are the result of partial replacement of the lithologies by Fe and sulphide rich fluids. The predominant additions to the rock geochemistry were sulphur and iron, as well as potassium, gold, and base metals, with a concomitant removal of sodium and calcium.

The gold mineralisation has been interpreted to be the result of possibly very different processes. The earliest interpretation was that gold was deposited in a syngenetic, exhalative, volcanogenic, massive sulphide-affiliated mineralisation. A later hypothesis suggested that the gold was deposited in an epigenetic, quartz porphyry-related hydrothermal system, which was strongly deformed within a high strain shear zone. The current interpretation of the mineralisation is that of a metamorphosed gold-bearing volcanic massive sulphide (VMS) deposit with syn-volcanic characteristics observed in the mineralisation. The nugget effect of the gold mineralisation is high.

Coffey is of the opinion that the Columbus sample preparation, logging and security methodologies employed are acceptable and sufficient for a project of this size and that suitable precautions are being taken to identify and address irregularities in these activities. Coffey is also of the opinion that the QAQC methodologies employed by Columbus at the Montagne d'Or Prospect are acceptable and sufficient and that the results of the assays of standards, blanks and duplicates support the use of the assay database in a resource estimation.

A site visit was conducted by Mr Roger Stangler, Principal Resource Geologist with Coffey based in Perth, Western Australia, from 17 to 20 June 2014, with additional time in the Columbus Office in Cayenne on 21 June 2013. Issues with the integrity of the original Guyanor core samples were observed regarding sorting of the core trays, sample mixing and lack of certain sample intervals. The criteria used by Guyanor for core logging were different from the Columbus criteria and it was verified that there has not been a programme of re-logging or re-validation of the Guyanor core to current Columbus logging standards.

Follow-up drilling, commencing in July 2014, is expected to consist of the completion of the authorised 89 infill drillholes, without any depth restrictions, distributed along strike throughout the mineralisation. This programme is expected to improve the interpretation of geology and mineralisation on closer spaced north-south cross sections, the definition of a detailed lithological, geological, weathering / alteration model and a redefinition of the spatial distribution of mineralised domains for low grade and high grade zones.

Coffey did not carry out an independent chemical analysis of drillcore samples during the site visit in 2014 and did not visit the analytical laboratory in Paramaribo. Columbus has not undertaken any metallurgical test work since they acquired the property in November 2010. Results of earlier metallurgical testwork indicate that the gold is predominantly free but that gravity concentrating methods alone will not recover a sufficient amount of the gold into a product that can be directly smelted. A satisfactory gold recovery of greater than 85% can be achieved by direct cyanidation or a combination of gravity and cyanidation of gravity tailings or flotation and cyanidation of flotation tailings.

Coffey completed a new Mineral Resource Estimate in June 2014 using drillhole details provided by Columbus. A total of eight distinct, parallel, closely spaced sub-vertical mineralised domains were modelled. Compositing to 3m sample length was selected for the resource estimation and grade interpolation for gold was completed using Ordinary (Block) Kriging.

Mineralised Domains were defined by digitising and snapping wireframes to drillholes and avoiding the inclusion of internal waste (defined by assay values lower than 0.25g/t Au). The Domains bifurcate and amalgamate to capture most of the mineralisation. The Domains are basically low grade Domains with a continuity that is reasonable for the current drillhole spacing. The definition of higher grade Domains within these low grade zones is currently not feasible. The statistical assessment of the gold distributions within the Domains shows that for practical purposes they are close to 2-parameter log-normal distributions. Dry rock density was interpolated into the block model through Ordinary Kriging after allocation of average dry density values to the lithologies logged in the drillholes.

The continuity of the gold composite values within the mineralised Domains can be defined using a correllogram model that cross-validates well. Block estimation was completed in Maptek Vulcan software applying a top-cut of 16g/t au to the composite data and restricting composite values above 10g/t during estimation to a distance of 35m along strike and down depth, and of 10m across strike to avoid smearing of high values. A number of different block models was estimated to assess the influence of the search neighbourhood on Kriging Efficiency and the theoretical regression slope. In general, Kriging efficiencies achieved are low or negative and regression slopes in the second and third estimation passes are low. Therefore, an unavoidable amount of conditional bias is present in the block model at the current drillhole spacing and this is taken into account during classification.

The parent cell size was varied from 25mEx25mRLx10mN to 25mEx10mRLx10mN to assess the degree of smoothing inherent in the OK block estimation. Block model validation was completed visually on the computer screen by comparing the location of high grade drillhole intersections with estimated model blocks for each Domain, by a statistical comparison of mean composite values with average Domain block results and by slicing through the block model along Easting, Northing and Elevation.

Key criteria for establishing confidence levels for resource classification were formulated. They include diamond drilling, sample recovery, database integrity, Domain definition, block modelling and open pit mining assumptions with high confidence. Surveying, core logging, density measurement, density interpolation, geological understanding and sample verification score moderate to high confidence, while data quality and drillhole spacing still provide some concern. The 25mEx10mRLx10mN block size was selected for the final block model and this represents a global in-situ resource model that is fit for purpose for conceptual pit design.

Table 1 – Montagne d'Or Prospect Inferred Resource Report at Three Cutoffs – Total Resources in all Mineralised Domains

Cut-off (g/t)	Million Tonnes	Grade (g/t)	MOzs	Density (t/m^3)
0.3	169.2	0.9	4.64	2.86
0.4	140.1	1.0	4.31	2.87
0.5	116.0	1.1	4.00	2.87

Note: Figures are rounded

Based on the confidence levels as established by Coffey the resource within the mineralised Domains is classified in its total as an Inferred Resource. Coffey believes that by replacing the Guyanor drillholes with new drillholes, by using a nominal 50m by 50m spacing along the full strike length, covering all the mineralised Domains now recognised from south to north, by obtaining successful drilling results along strike and down dip, and by defining a plausible lithology/geology model as a support for an improved density model, a proportion of the Inferred Mineral Resource could be upgraded.

Coffey recommends further work should concentrate on converting as much as possible of the known Inferred Mineral Resource to at least the Indicated Mineral Resource category as well as to continue to explore strike and dip extensions.

Metallurgical testing should be conducted to follow-up and confirm previous work and further refine the recovery process. Baseline environmental studies should be undertaken during future drilling phases along with a study of flora and fauna. Upon completion of additional drilling the mineral resource estimate should be updated, with a geological, lithological and structural modelling associated to the resource model. This should also taking into account realistic ways to model higher grade portions located within the currently defined mineralised Domains, and using a non-linear estimation method to define recoverable resources at a series of specific and realistic Selective Mining Unit volumes. If results are sufficiently encouraging, a Preliminary Economic Assessment (PEA) could then be undertaken.

2. Introduction

Columbus Gold Corporation (Columbus) is developing its Paul Isnard gold project in French Guiana in partnership with Nordgold. Coffey Mining in Perth, Western Australia (Coffey) has been requested by Columbus Gold Corporation (Columbus) to prepare, from existing and new drillhole data in progress, a National Instrument 43-101 (NI43-101) Technical Report on an updated Resource Estimate for the Montagne d'Or Prospect which is part of the Paul Isnard Project. This report complies with disclosure and reporting requirements set forth in the Toronto Stock Exchange Manual, National Instrument 43-101 Standards of Disclosure for Mineral Projects (NI 43-101), Companion Policy 43-101CP to NI 43-101, and Form 43-101F1 of NI 43-101.

This report is a statement of Mineral Resources as of 29 June 2014 and updates the most recent Technical Report estimated by Coffey entitled "Paul Isnard, French Guiana (Latitude 4° 46′ S, Longitude 53° 58′ W) Mineral Resource Estimate, NI 43-101 Technical Report" for Columbus Gold Corporation prepared by Robert Fraser Bsc MSc PGeo and Hassan Waberi BSc PGeo, dated November 23, 2012.

This update incorporates the results of new drilling, a data review, and the selection of an appropriate geostatistical methodology to update the Resource. The report is for an exploration property and reviews the geology and the previous exploration activities based on historical documentation related to the project, a site visit completed from June 17 to June 20, 2014, and discussions with project management.

All monetary figures expressed in this report are in European Currency (€; Euros) unless otherwise stated.

This report provides a mineral resource estimate and a classification of resources in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum NI 43-101 (National Instrument 43-101 Standards of Disclosure for Mineral Projects, Companion Policy 43-101CP and Form 43-101F1-Technical Report) effective 30 June 2011.

2.1. Principal sources of information

The sources of information and data include project reports and public domain data (conventional publications, "Open File", internet) and information acquired by Columbus Gold which are not generally available in the public domain. All documents that were supplied by Columbus to Coffey are listed in Section 27 (References).

2.2. Qualifications and experience

Coffey Mining is part of Coffey International Limited, a publicly-traded consulting company listed on the Australian Stock Exchange. Coffey International Limited consists of a range of specialist companies working in geosciences, social infrastructure and physical infrastructure and operates in more than 60 countries around the world.

Coffey Mining is an integrated Australian-based consulting firm, which has been providing services and advice to the international mineral industry and financial institutions since 1987.

Mr Louis Voortman was appointed as the primary author and Qualified Person (QP) for the purpose of preparing an update and reporting this in a National Instrument 43-101 Resource Report. Mr Voortman was the QP appointed to undertake the resource estimation.

Mr Roger Stangler was appointed to carry out a site visit and complete aspects of the National Instrument 43-101 Report. Mr Stangler visited French Guiana and the project site from June 17 to June 20 2014, with additional time in Cayenne on 21 June 2013. The site visit provided the opportunity to meet with the Columbus Gold project team, collect project reports and data, tour the project site and collect data validation information. Mr Stangler is a signing QP for this study.

The qualifications and appropriate experience of the authors are detailed in the Authors' Certificates.

Columbus personnel in Montréal and French Guiana assisted with the technical review. In particular, Mr R. Lefrançois, Mr Michel Broudie, Ms Élodie Lieber and Mr Yoann da Rocha are thanked for their input.

All sections 1 to 27 were compiled by Mr Voortman with exception of Section 12.1 which was compiled by Mr Stangler. Mr Stangler is also co-responsible for Sections 4, 5, 7, 10, 11 and 12 as described in Table 2.

Table 2 – Responsibility of Qualified Persons

Qualified Person	Association	Responsible for Sections	Co-Responsible for Sections
Louis Voortman	FAusIMM(CP)	All sections	All sections
Roger Stangler	MAIG, MAusIMM	12.1	4, 5, 7, 10, 11 and 12

2.3. Independence

Neither Coffey nor the QP's nominated for this review have any interest in Columbus or its mineral properties. The proposed work, and any other work done by Coffey for Columbus, is strictly in return for professional fees. Payment for the work is not in any way dependent on the outcome of the work or on the success or otherwise of Columbus' own business dealings. As such there is no conflict of interest in Coffey undertaking the Qualified Person's roles.

3. Reliance on other experts

This report was prepared as a National Instrument 43-101 Technical Report, in accordance with Form 43-101F1, for Columbus Gold by Coffey Mining. Coffey Mining's services in respect to this report are consistent with the quality of information available from Columbus Gold at the time of preparation, with conclusions and interpretations contained in that information, and are based on:

- technical reports prepared by, or on behalf of, Columbus and provided by Columbus to Coffey;
- other relevant published and unpublished third party information; and
- the assumptions, conditions, and qualifications set forth in this report.

This report is intended to be used by Columbus, subject to the terms and conditions of its contract with Coffey. This contract permits Columbus to file this report as a Technical Report with Canadian Securities Regulatory Authorities pursuant to National Instrument 43-101 Standards of Disclosure for Mineral Projects. Any other use of this report by any third party is at the sole risk of that party.

Coffey has limited its discussion to scientific and technical information and offers no comment on legal matters related to tenure and environmental liability. Neither Coffey nor the author of this report are qualified to provide extensive comment on legal aspects associated with ownership and other rights pertaining to Columbus' mineral property. Coffey did sight documents related to the legal title of Columbus to the property as outlined in Section 4.4.

Similarly, neither Coffey nor the authors of this report are qualified to provide extensive comment on environmental issues associated with Columbus' mineral property and provided by Columbus, as discussed in Section 4.

A final draft of this report was provided to Columbus, along with a written request to identify any material errors or omissions, prior to lodgement.

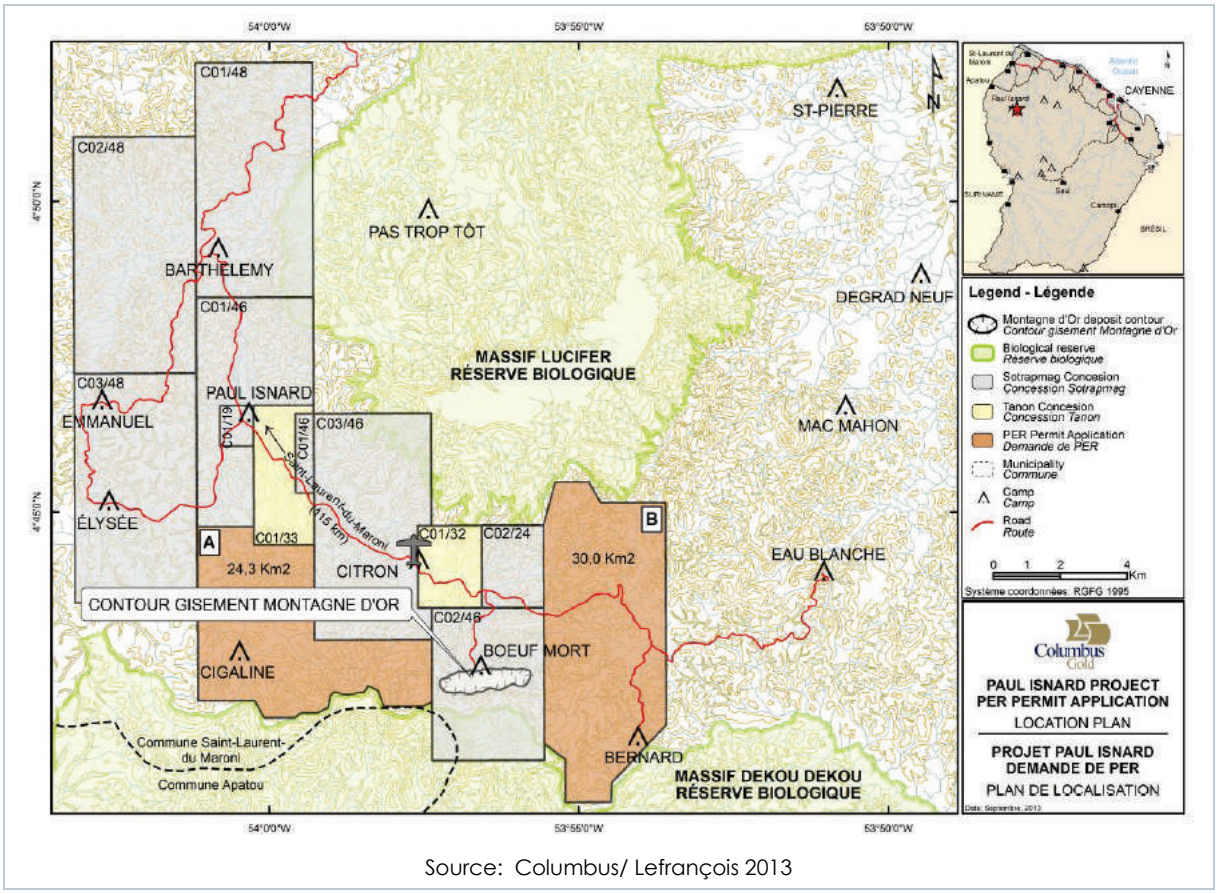
4. Property description and location

The Paul Isnard Project is located in the north western portion of French Guiana, 180km west of the capital Cayenne, and 80km south of the department capital Saint Laurent du Maroni (Figure 1). A total of eight mining concessions with a total extent of 13,609 hectares (Figure 2) comprise the Paul Isnard property.

Figure 1 – Location of the Paul Isnard Project in the western part of French Guiana

Source Columbus/Lefrançois 2013

Figure 2 - Overview of Paul Isnard Concessions



Source: Columbus/ Lefrançois 2013

Most of the Paul Isnard concession area, including the Montagne d'Or Prospect, lies within the "Area in which Mining Activity is Authorized" (refer Sections 4.4 and 4.5). Conditions to mining (embracing large scale mining) include:

- A viable mineral deposit;
- Completion of an Environmental Impact Study and Reclamation Plan; and
- Possible additional reclamation or environmental investigations as may be required.

4.1. Description and acquisition history

Columbus entered into an Option Agreement dated 30 November 2010 with Auplata SA (Auplata), SOTRAPMAG SAS, and Pelican Venture SAS (together named the "Optioners"), which was amended on 25 May 2011, 6 June 2011, 15 June 2011, and 5 December 2011 (as amended, the "Option Agreement"). Under the Option Agreement, Columbus has the right to acquire a 100% interest in SOTRAPMAG (or the Project directly, at Columbus' election) which holds the eight mining concessions and pending PEX application comprising the Paul Isnard Project.

The Option Agreement required Columbus, among other things, to issue a total of 30,276,266 shares in the capital of Columbus to the Optioners, and also complete a private placement to Pelican Venture SAS of 10,092,089 shares in the capital of Columbus. These share issuances were completed on 29 June 2011. Columbus acquired the property in November 2010.

On 13 March 2014, Columbus and Nordgold signed a definitive option agreement whereby Nordgold has the right to acquire 50.01% interest in 3 Paul Isnard Concessions (C03/46, C02/24, C02/46) and the pending PER application (54.3km²). The PER application defines the AOI of the option agreement (CGT - PI - Nordgold Option Agreement - 2014-03 (Fully Executed)).

4.2. Royalties and other agreements

The Paul Isnard Project is subject to a 1.0% net smelter returns royalty payable to Sandstorm Gold Ltd. In addition, there is a net smelter returns royalty of 1.8% on the first 2 Moz ounces of gold produced, reduced to 0.9% on the next 3 Moz of gold produced payable to Euro Ressources SA (Euro), an 86%-owned indirect subsidiary of IAMGOLD Corporation.

In addition, on November 7, 2013, Columbus acquired from Euro a gross smelter return royalty on the first 5 Moz gold produced from the Paul Isnard Project, payable as follows:

- 10% of (gold sales price less US$400/oz.) on the first 2 Moz gold produced, and
- reduced to 5% of (gold sales price less US$400/oz.) on the subsequent 3 Moz gold produced.

Under the agreement between Columbus and Nordgold, this royalty will be extinguished prior to Nordgold earning its 50.01% interest in the concessions pursuant to its option.

Pursuant to an agreement dated November 19, 2009 between Golden Star Resources Ltd. (Golden Star) and Auplata, Auplata agreed to pay to Golden Star US$1 million on the date when gold is produced on the Paul Isnard Project (the Production Payment). Under an acknowledgement and guarantee agreement dated November 22, 2011, Columbus agreed that it would be jointly and severally liable with Auplata for the Production Payment. However, pursuant to the amendment dated December 5, 2011 to the Option Agreement, Auplata agreed that it would be solely responsible for paying the entirety of the Production Payment to Golden Star in the event its activities on the Paul Isnard Project trigger such obligation.

On 24 July 2014, the Official French Journal published the Decree of 21 July 2014, which changes the rate of the mining tax on gold. The tax is due by gold mining companies in French Guiana in 2014 is as follows: small and medium enterprises = 341.75€/kg and other (large) = 683.50€/km. In addition, there is a Communal tax of 132€/kg and Departmental tax of 26.30 €/kg (2014).

4.3. Environmental liabilities

The Montagne d'Or Prospect area is an intermittently active exploration property centred in dense tropical rain forest. Exploration activities require manual or mechanized line cutting for construction of access tracks, trenching, drill pads and camps. Environmental liabilities resulting from exploration activities are minimal, as natural vegetation regeneration and a high precipitation rate contributes to the rapid natural rehabilitation of project excavations and drill sites.

Prior to its acquisition by Auplata (and the current agreement with Columbus), SOTRAPMAG had entered various agreements, none of which remain in effect, with local alluvial gold mining companies to carry out operations at Paul Isnard under terms of small mine permits designated Authorization d' Exploitation (AEX). Holders of these permits are required by law to remediate worked areas, control downstream silting, and are prohibited from using mercury. These activities are monitored by Government authorities and are not expected to create any liability to Columbus. Areas of environmental degradation of concern to Columbus are mainly associated with illegal artisanal placer mining. Some of the environmental damage is visible from aerial reconnaissance and includes clearing of forest adjacent to streams, severe downstream silting, and potential mercury contamination.

Auplata, and by extension Columbus, has reached agreement with French regulatory authorities to dedicate up to €350,000 (US$452,000) to reclamation of the illegal mining sites. The 350,000€ in reclamation is directed to the rehabilitation of unrestored alluvial mining sites left behind by local miner COTMIG. The mining operations were allowed by COTMIG under an "amodiation" contract (mining lease agreement under the French Mining Code) signed with SOTRAPMAG on 8 August 2003. COTMIG is now defunct.

A new Environmental Permit (Prefectural Order dated 16 June 2014) was obtained during the week of the site visit, granting authorisation (AOTM) for the completion of an additional 89 drillholes without a depth restriction. A total of 70 of the 89 holes have been already been planned for an infill drilling program; the remaining 19 drillholes will be located after results from the initial drillholes have been received. The completion of this additional drilling programme will allow a more detailed geological interpretation on north-south cross sections to refine the geological model and to delineate lithological, weathering and alteration zones. This, in turn, will refine the definition of the mineralised domains.

A team from WSP Canada Inc. coordinated by the Biologist Mr Bernard Massicotte has currently been contracted by Columbus that undertakes a baseline study on flora and fauna conditions in the area, together with an assessment of soil sediments, hydrology, hydrogeology, ecology, biodiversity, and the impact of road construction, land use, climate and meteorology, air quality, legal and illegal alluvial mining, the use of natural resources, noise and vibration. The baseline study also includes archaeological and cultural heritage studies.

The overall baseline study covers the full group of concessions and access roads. During the next few months an information session will be held with the local community involved, followed by two successive public consultation sessions towards the end of 2014. Basically, there are no residents living at the forest site area, and the local community considered as affected by the project is located in the village of Saint Laurent de Maroni, at a distance of approximately 100km from the project site. Saint Laurent de Maroni is easily accessible. The local population is likely to positively accept the project activities as it will promote the creation of job opportunities.

4.4. Permitting

French Guiana is a Department of France and subject to French laws, with certain modifications and differences applicable to the Overseas Departments. The local administration is governed under the direction of the Préfet as the representative of the French government. In overseas departments, the Préfet has more extensive powers than their counterpart in mainland France.

Mineral exploration and mining are subject to the provisions of the Code Minier (Mining Code), which specifies that the State can grant to an operator a right to prospect or exploit the mineral resources over a specified area and specified period. Special regulations have been established for the Department of French Guiana to take into account certain distinctions specific to this territory (Law no 98-297 of April 21, 1998). In addition to the Code Minier, that include Exclusive Research Permits (PER) for prospecting and Concessions for mining, the regulations concerning French Guiana provide for Mining Research Authorisations (ARM) in areas managed by the National Forestry Office (ONF), Exploitation Authorisations (AEX) and Exploitation Permits (PEX).

Mineral rights and mining are administered under authority of the Préfet by the Direction de l'Environnement, de l'Aménagement et du Logement (DEAL).

In general, the PER is the initial permit to apply for when conducting prospecting. There is no restriction on the maximum area but generally an application is for 25km^2, open to competitor bidding if covering more than 50km^2; valid for a period of 15 years (5yr, twice renewable for up to 5yr which possible reduction of area by 50% in each application; then required to apply for a PEX). Mining is permitted under the following permits: Concession, PEX and AEX; PEX and AEX are exclusive to the Départements d'Outre-Mer, such as French Guiana.

A Concession also has no restriction on the maximum area and dimension and form; valid for a period of 50yr, renewable by 25-year tranches if mining operations are active at time of renewal but open to competitor bidding unless arising from a PEX or PER. The various permits are listed in Table 3 and shown on a map in Figure 2.

Table 3 - Mining titles applicable in French Guiana.

Type of Permit	Nature of the Title	Maximum Surface Area	Period of Validity	Government Authority
ARM Mining Research Authorisation *)	authorisation to enter territory managed by ONF	1x1km or 0.5x2km	max 4 months	National Forestry Office (ONF)
PEX Exploitation Permit *)	medium-scale alluvial / small-scale vein-type	None	5yr, twice renewable, the converted to Concession	Minister in charge of mines
AEX Exploitation Authorisation *)	small-scale artisanal mining	1x1km	4yr / renewable once / max 3 AEX per 4yr period	Préfet
PER Exclusive Research Permit	exclusive right for prospecting	None	5yr / twice renewable	Minister in charge of mines
Concession	mining	None	50yr max / renewable by 25yr tranches	Granted by Decree of Conseil d'État / Denied by Minister in charge of mines

**) Exclusive to Department of French Guiana (Law 98-297 21 April 1998)*

French Guiana is an “overseas department” (Départements d’Outre Mer) of France and subject to French laws with some modifications specific to the overseas departments. French Guiana has been an Overseas Department of France since 1946, as accorded in the French Constitution of 28 September 1958.

Within the French Government a special department is responsible for the overseas departments, the Ministre des Départments et Territoires d’Outre Mer (DOMTOM). The local administration is run under the direction of the Préfet, who is the representative of the French government. In overseas Départements, the Préfet has more extensive powers than their counterpart in mainland France (Suter, 1999).

The Paul Isnard property covers 13,609 hectares and consists of eight mining concessions and a Permis Exclusif de Recherche (PER) held by SOTRAPMAG which is held 100% by Columbus. The mining concessions were transferred to SOTRAPMAG by Décret ministerial on 27 December 1995 and are valid until 31 December 2018. The joint venture will have the right to extend this permission for periods of 25 years if the property is in production by this date. During March 2014 Columbus signed the definitive option agreement with Nordgold of the Netherlands, giving Nordgold the right to buy in to a holding of 50.01%.

All mineral rights are administered by the Direction de l’Environnement, de l’Aménagement et du Logement (DEAL), a branch of the Ministère de l’Ecologie, du Développement Durable, des Transports et du Logement. The locations of the mining concessions, exploitation permits (PEX) and exclusive exploration permits (PER) are reported in UTM, World Geodetic System (WGS) 84, Zone 22. Table 4 shows details of the 8 concessions held by Columbus at the Paul Isnard Project; the drilled Montagne d’Or deposits lies entirely within Concession C02/46.

Table 4 – Details of the concession holdings of Columbus (source: Columbus/Lefrançois 2013)

Type of Permit	Permit Number	Registration Number	Surface (km^2)	Application Date	Transfer Date	Effective Date
Concession	692	C01/19	1.2	25/10/1919	27/12/1995	31/12/2018
Concession	25	C02/24	4.5	27/11/1924	27/12/1995	31/12/2018
Concession	214	C01/46	17.4	21/05/1946	27/12/1995	31/12/2018
Concession	215	C02/46	15.2	21/05/1946	27/12/1995	31/12/2018
Concession	216	C03/46	22.6	21/05/1946	27/12/1995	31/12/2018
Concession	217	C01/48	24.5	14/06/1948	27/12/1995	31/12/2018
Concession	218	C02/48	25.7	14/06/1948	27/12/1995	31/12/2018
Concession	219	C03/48	24.8	14/06/1948	27/12/1995	31/12/2018
PER		Application	54.3			
Total extent			190.2			

Information received from Columbus and reviewed by Coffey includes the following:

The original PEX mining permit has now been replaced by a larger (approximately 54.3km^2) PER exploration permit application submitted to the DEAL and the Ministère de l'écologie, du développement durable et de l'énergie (MEDDE) on the 4th of December 2013. The application file is located in a Lettre de demande PER Bernard-Cigaline_Lettre Préfet_2013-12-04.pdf delivered by Sotrapmag on 4 December 2013. The DEAL and MEDDE require that mining permits in French Guiana be reported in RGFG95 CRS.

Ownership of the mineral rights and land property is described in the files CGT - PI - Auplata - 2013-01-16 - SOTRAPMAG Share Purchase (Closing) Agreement_fr.pdf and CERFA + Ordre de Mouvement de Titres - 25096040_1.pdf provided to Coffey by Columbus. Columbus acquired a 100% interest in SOTRAPMAG and the property on January 16, 2013 (CGT - PI - Auplata - 2013-01-16 – Extension of Surface Rights Agreement). SOTRAPMAG holds 100% in the eight Paul Isnard mining concessions as described in the files Concessions PIS_Décret du 27 décembre 1995_Cession SOTRAPMAG.pdf and Concessions PIS_J.O. du 29 décembre 1995_Cession SOTRAPMAG.pdf.

Authorization for drilling the already completed shallow holes (less than 100m vertically) was obtained as drilling to a depth of lesser than 100m vertical is subject to a work declaration (DOTM) not submitted to an environmental impact study and public inquiry. Such work is allowed to proceed if no response is given by the DEAL following 2 months after submittal of the declaration. The most recent authorization for further deeper drilling (89 holes) was given by Prefectural Order dated 16 June 2014 granting the authorisation and was provided to Coffey in the file AOTM_2103_Arrêté Préfectoral_2014-06-16.pdf. This permit has been sighted by Coffey Mining during the site visit.

Documentation from the France/French Guiana Mining Department regarding legal land holdings was provided by Columbus to Coffey in the files:

- Code minier_Partie législative_2012-03-20.pdf
- Code minier_Textes réglementaires_2013-03-19.pdf
- CGT_French Guiana_Mineral Title Summary.pdf

Royalty Agreements are described in the files:

- CGT-PI-Euro Ressources-2010-10-22-Royalty Agreement_AUPLATA & EURO.pdf
- CGT-PI-Euro Ressources-2011-12-02-Option to Assign Royalty Agreement EXECUTED.pdf
- CGT-PI-Euro Ressources-2012-07-25-Amendment #1 to Option Over Royalty Agreement (Fully Executed).pdf
- CGT-PI-Euro Ressources-2013-01-16-Transfer of Royalty Obligation (fully executed).pdf

- CGT-PI-Euro Ressources-2013-11-07-Assignment Agreement-(executed).pdf
- Euro Notice to Auplata re Assignment of Royalty Nov 12 2013.pdf
- CGT-PI-Sandstorm-2013-05-17-Royalty Agreement (Executed)

4.5. SDOM mining scheme

New mining legislation, referred to as the Schéma Départemental d'Orientation Minière de la Guyane (SDOM), was approved in December 2011 by the Conseil d'État (State Council), the highest administrative court in France, and went into effect on 1 January 2012.

Under the SDOM legislation, the territory of French Guiana is divided into four land use classifications, defined as Zones 0, 1, 2 and 3 (the SDOM Zones), that clearly outline areas where the possibility of prospecting and mining are defined in accordance with Article L.621-1 of the code minier. The classification take into consideration the necessity to protect sensitive natural environments, landscapes, sites and populations, a balanced management of the land and the natural resources, economic interests, and sustainable development of the mining resources, within the limits of current knowledge of the biodiversity and the mineral wealth. The areas where mining activity are permitted represents 55% of the territory, in which 20% is subject to constraints and 35% to conditions of common laws:

Zone 0: Banned for prospecting and mining.

Zone 1: Open to airborne surveys, underground mining authorised under constraints.

Zone 2: Open to prospecting, underground and open pit mining authorised under constraints.

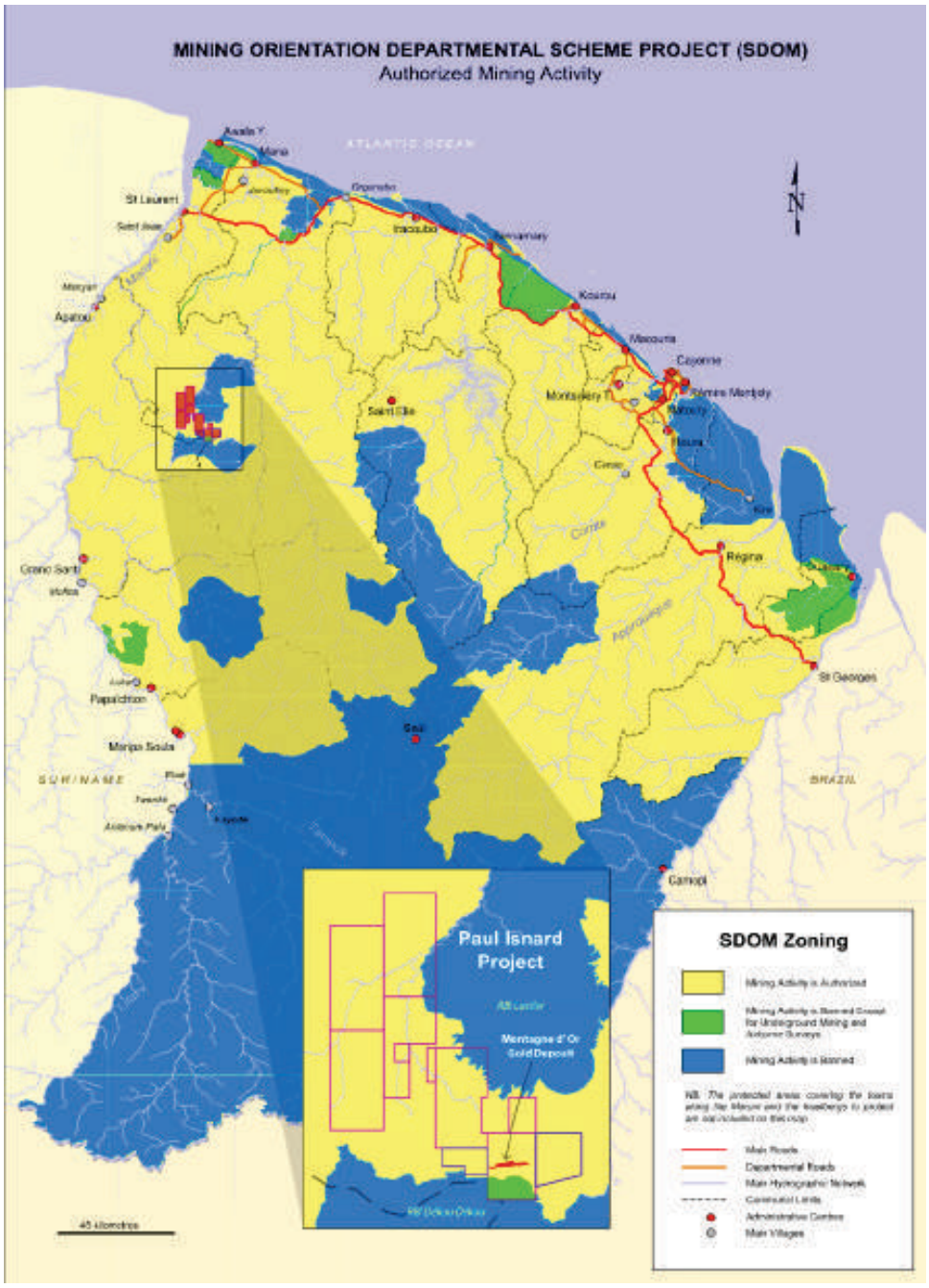
Zone 3: Open to prospecting and underground and open pit mining.

The Montagne d'Or gold deposit is located within an area classified as Zone 2, where mining activity is authorised under certain constraints as it lies between the proposed biological reserves (Figure 3). This biological reserve is separated into two domains, referred to as Lucifer and Dékou Dékou, located immediately to the north, east and south of the Paul Isnard concessions.

Conditions to mining in these areas, which in actual fact would be applicable to large scale mining operations anywhere in the Department include:

- Demonstration of a viable mineral deposit;
- Completion of an Environmental Impact Study and Reclamation Plan; and
- Possible additional reclamation or environmental investigations as may be required for the public interest, on or off site.

Figure 3 – Authorised mining activity zoning in the Paul Isnard Area



Map provided by Columbus Gold

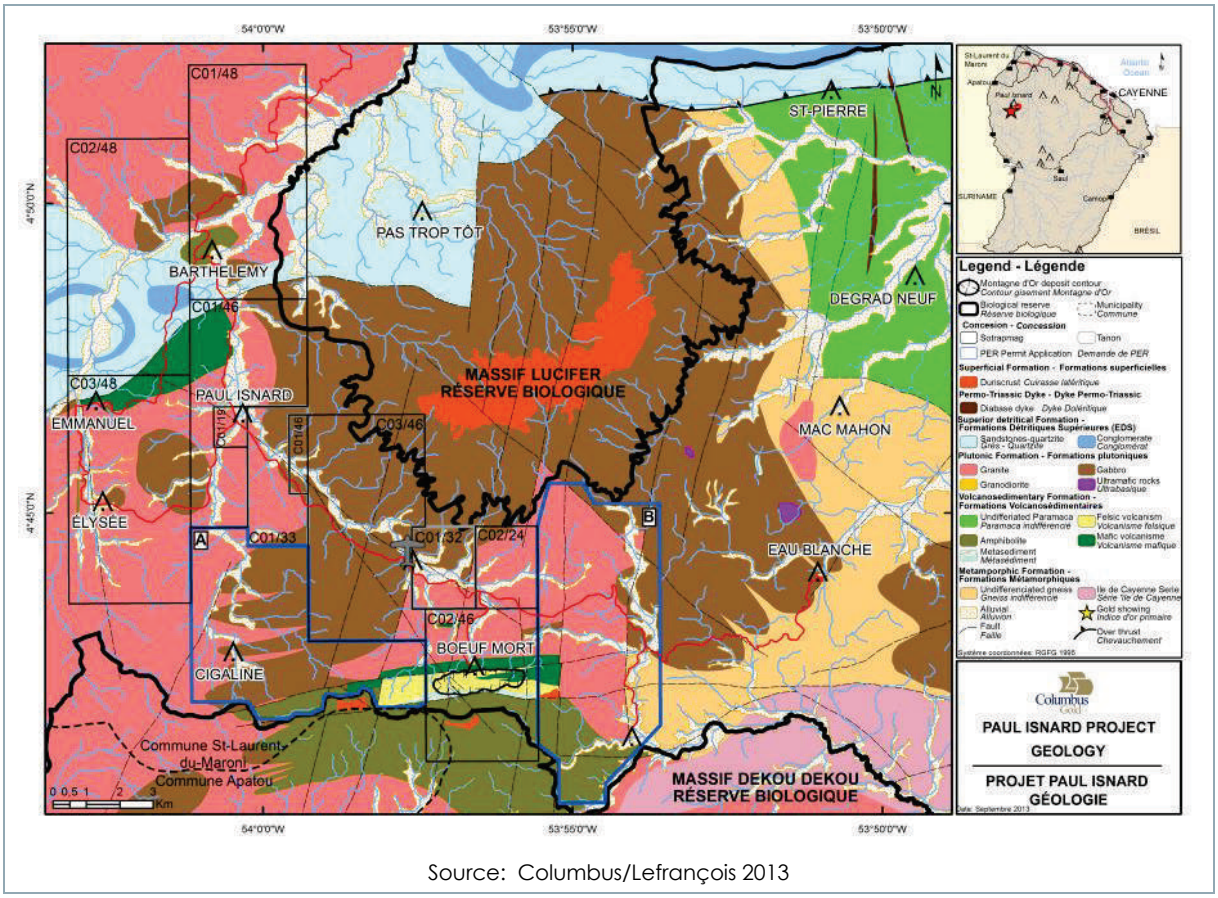
4.6. Lucifer and Dékou-Dékou biological reserves

Following the implementation of the SDOM legislation, an Order by MEDDE and the Ministère de l'agriculture, de l'agroalimentaire et de la forêt (METL), referred to as the 'Arrêté du 27 juillet 2012', was issued in July 2012 to create and established the boundaries of the Lucifer and Dékou Dékou biological reserves. The biological reserves cover 64,373ha and are administered by the ONF.

The principal objectives of the biological reserves are to permit the evolution of the natural forest ecosystem, the preservation of the biological diversity and improving scientific knowledge on the Lucifer and Dékou Dékou massifs. To attain these goals, human activities within the biological reserves are regulated, and logging, prospecting and mining are prohibited.

In the area of the Montagne d'Or Prospect, the boundary of the Dékou Dékou biological reserve is defined by the 420m elevation line located 550m to 1,050m from the southern boundary of the deposit (Figure 4). The Montagne d'Or Prospect falls within the elongated area within C02/46 in this figure.

Figure 4 – Location of Biological Reserves in Relation to the Paul Isnard Project



Source: Columbus/Lefrançois 2013

4.7. Miscellaneous risks

There are a number of old alluvial mining operations in the Paul Isnard Project area and environmental liabilities for Columbus are documented in Section 4.3. There are no other known hindrances to title, access or operations.

5. Accessibility, climate, local resources, infrastructure and physiography

5.1. Accessibility

The Montagne d'Or Prospect is located in the north-western portion of French Guiana, not far from the Maroni River that forms the border with Surinam. The property is accessible throughout the year by charter aircraft and seasonally by road. At Camp Citron, where the base camp is located at a distance of approximately 5km from the Prospect area, there is a 500 meter grass runway that can accommodate small aircraft. Alternatively, a helicopter charter service is available from Cayenne. The flight from Cayenne to Paul Isnard takes approximately 55 minutes.

A forest road leads for a distance of approximately 120km from St. Laurent on the Maroni River to the Montagne d'Or Prospect area. The first 65km from St Laurent to Croisée d'Apatou is maintained by the State and supports all season travel. SOTRAPMAG has an exclusive right to use of the final 55km of the road. This road section is currently being maintained by Auplata to accommodate normal vehicle access for servicing the site.

Several roads that crisscross the mining concessions provide reasonable access for larger pickup trucks. Four wheel ATVs are used where access is prohibitive to pickup trucks. Access from Cayenne to the project area is possible either by small plane or by helicopter (Figure 5), and takes approximately 50 to 55 minutes flying time to Citron.

Figure 5 - Picture of Helipad at Camp Citron

5.2. Climate

The climate is equatorial, with daytime temperatures between 29°C and 33°C, decreasing to 19°C to 23°C at night. There are two wet seasons; the main period is typically from April to the end of August, and the lesser period lasts from mid-November to mid-March. Average annual rainfall is in excess of 2,000mm with a minimum monthly rainfall of 50mm. Humidity is constantly high and typically ranges between 78% and 92%. The operating season is year-round.

5.3. Resources and infrastructure

Skilled, semi-skilled and unskilled labour is readily available in Cayenne, with most professional and technical personnel being trained in Metropolitan France. Unskilled labour is also available in St. Laurent du Maroni. As French Guiana is a Département of France, French labour laws apply, resulting in relatively high salaries and restrictive employment contracts when compared to the neighbouring countries of Surinam and Brazil.

Camp Citron infrastructures are 100% owned by SOTRAPMAG. A land use permit for the camp area and airstrip was obtained by Euro on 24 April 2009. The permit is valid until 31 December 2018, on expiry date of the concessions (ONF-Euro_Convention_2009-04-24). A sub-contractor of Auplata, Minéa Sarl, presently occupies 3 cabins in camp.

Sufficiency of surface rights for mining operations, the availability and sources of power, water, mining personnel, potential tailings storage areas, potential waste disposal areas, heap leach pad areas, and potential processing plant sites have not yet been established for this exploration project.

5.4. Physiography

Most of the region is covered by a thick canopy of primary and secondary tropical forest. The larger valleys have been extensively worked by alluvial miners in the past and are generally covered by thinner secondary forest or grassy-scrub and bamboo. Thick areas of bamboo are also present in many streams especially on the steeper slopes and in areas of old mine workings. The mean elevation is approximately 130m ASL.

The general relief of the region is dominated by three geomorphological features:

- The east - west trending Massif Dékou-Dékou Range.
- The southwest - northeast trending duricrust plateau of Montagne Lucifer.
- The northwest - southeast drainage system of the Roche River.

The Montagne d'Or Prospect occupies the northern flank of the Dékou Dékou Range, of which Montagne d'Or forms the northern flank.

There are numerous broad valleys, many of which have been exploited for their alluvial gold deposits. These are separated by areas of moderately rugged to more rounded hilly relief and often deeply incised valleys.

6. History

The Paul Isnard concessions have been a regional centre of alluvial and colluvial gold production since 1873 with some minor underground development in a few places. Beginning about 1890 bucket type dredging was undertaken and was replaced by dragline operations in 1949. Due to government permitting issues, little if any work was undertaken except by small illegal miners from 1950 to 1965 when placer mining recommenced and continued until approximately 1997.

The area was previously explored by the Bureau Minier Guyanais (MBG) and later the Bureau de Recherches Géologiques et Minières (BRGM), the French Geological Survey. This work confirmed the alluvial mining potential of the region and also located the primary Montagne d'Or Prospect as a result of a regional geochemical program in 1976. This was not recognized as such until the data was reinterpreted in 1984. The BRGM undertook detailed surficial geochemical work and geological mapping.

The Paul Isnard Mine was started in 1956 by a company called SERMIG; gravel mining commenced in 1966 and continued for 20 years through an American company. Recovery was through an amalgamation plant and must have been poor. From 1986, a new owner (Pichet-Driss) obtained control, improved the process and operated the mine until 1993. SOTRAPMAG was involved in the gravel mining operation as a partner with the SGM, CERMI and Pichet-Driss.

In May 1993 Golden Star Resources Ltd endeavoured to acquire title to the mine properties of the Paul Isnard Mine of SOTRAPMAG who was the owner of the mine and carried out a 2-week evaluation of the operation. Total production from 1987 to 1993 was at this stage reported at 5,142 ozs of gold and 354 ozs of silver. This would roughly indicate a 7% average silver content of the gold doré.

Intensive exploration did not begin until 1994 when Guyanor Ressources SA (approximately 70% owned by Golden Star Resources) had acquired the concessions and undertook regional scale remote sensing (LandSat, geophysics), geological examinations and geochemical surveys. Guyanor acquired the property in October 1994 through the 100% acquisition of the mining company SOTRAPMAG (Société de Travaux Publiques et de Mines Aurifères de Guyane). Guyanor Ressources is registered in French Guiana with the right to explore deposits of gold, precious metals, base metals, and precious stones.

When Guyanor purchased SOTRAPMAG, it paid off an interest of Alcatel Alsthom Compagnie Générale d'Electricité (ALCATEL) in a primary deposit in the area to the BRGM while the company La Source Développement (LaSource) received an initial 25% participating interest. It is reported that LaSource did decide not to participate as a minority partner and that its interest was subsequently diluted.

From June 1996 until May 1998 exploration on the property was operated as a joint venture between SOTRAPMAG en Asarco Guyane Française with LaSource as a non-contributing partner. An Exclusive Exploration Permit (PER) was granted by Ministerial Decree (Official Bull. dated November 30, 1999) 100% to Guyanor Ressources (later named Euro Ressources) on 26 November 1999 for a period of three years from 1 December 1999 to 30 November 2002. Following the formation of the Joint Venture with Asarco and La Source, detailed geology, geochemistry and geophysics was completed along with 56 drillholes totalling for 10,916 meters. In September 1999 the LaSource interest is reported as approximately 10% and that when it falls to below 10% it will convert to a 2.5% net proceeds royalty.

In 2001 a program of drilling was completed by Guyanor in conjunction with a JV agreement signed between Guyanor and Rio Tinto Mining and Exploration Ltd. Rio Tinto however concluded that the deposit did not have sufficient potential (more than 10 million ounces) within saprolitic and near surface material to be mined by open pit methods followed by a cyanide recovery process.

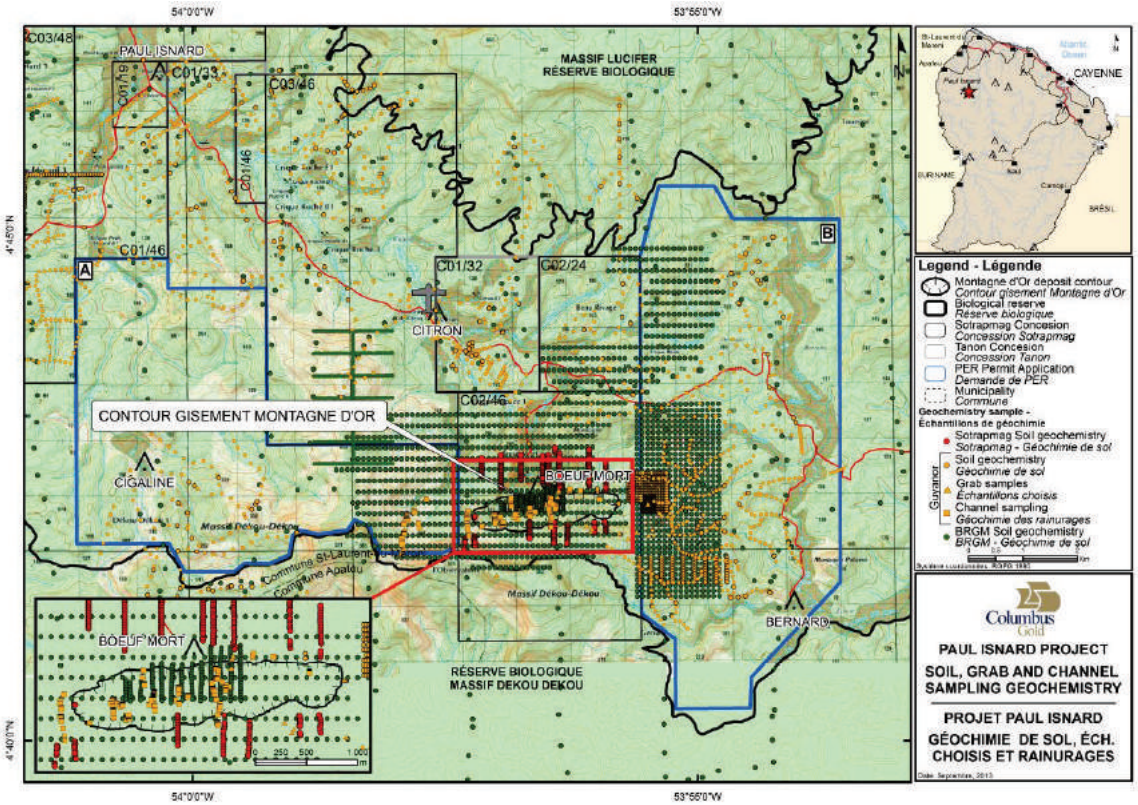
Input to this study was mainly a re-interpretation of all available structural, geological and geophysical data (e.g. Aérodat 1994, BRGM 1996) and a study of older drill core obtained by Élysée (6 diamond drillholes for 598.45m) and Apollon (3 diamond drillholes for 405,40m), a regional geochemical soil programme covering areas that were not previously covered (total of 1,058 soil samples) and a follow-up soil geochemistry and ground geophysics programme (69km) investigating the located anomalies. Selected anomalies were followed-up in 2001 with a limited diamond drilling programme (Élysée 6 additional drillholes for 636.50m, Paul Isnard 3 drillholes for 358.95m, Citron 3 diamond drillholes for 343.50m). One drillhole at Paul Isnard (Montagne d'Or) intersected a 7.0m mineralised interval at 1.03g/t Au. After completion of the programme, Rio Tinto decided to withdraw from the JV.

Guyanor has carried out exploration activities in the areas at and around Montagne d'Or since 1994. Diamond drilling by Guyanor from 1996 (in JV with Asarco) to 1998 resulted in a total of 56 drillholes for 10,916 meters. Guyanor also drilled 18 holes in 2001 in a JV with Rio Tinto and in 2007 a company by the name of Euro drilled one additional drillhole at Paul Isnard. Guyanor became Euro Ressources.

Until the property was acquired by Columbus in 2010, work done largely consisted of desktop evaluation of the resource potential and possible economic viability, and little additional exploration work was undertaken.

Since before 1900 up to around 1950, small scale alluvial mining has taken place in the area. This was followed by large scale alluvial mining from 1965 while the Bureau de Recherches Géologiques et Minières (BRGM) undertook geological mapping and regional geochemistry from 1930 to around 2000. Guyanor started work on the property in 1994. A regional overview of the various soil sampling, grab sampling and channel sampling programmes is provided by the map in Figure 6.

Figure 6 - Plan map overview of historic exploration campaigns (source Columbus/Lefrançois 2013)



Source Columbus/Lefrançois 2013

There have been four previous resource estimations made of the Montagne d'Or Prospect. These are summarised in Table 5.

Table 5 - Previous resource estimates for the Montagne d'Or deposit

Year	Source	CIM Compliant	Classification	Cutoff (g/t)	Tonnes	Au (g/t)	Contained ozs
2004	RSG Global	Yes	Inferred Resource	0.8	60,500,000	1.5	2,860,000
2008	SRK	Yes	Inferred Resource	0.5	33,200,000	1.7	2,000,000
2011	SRK	Yes	Inferred Resource	0.4	36,700,000	1.6	1,900,000
2012	Coffey Mining(Canada)	Yes	Inferred Resource	0.3	115,173,000	1.44	5,312,800

Columbus acquired the property in November 2010. With the exception of the estimates in 2011 and 2012, the resource estimates were made prior to Columbus entering into an agreement to acquire an interest in the property and are considered historic in nature. The previous NI43-101 report was compiled by Coffey Mining in Canada. This report was published on 15 March 2013 and lists an Inferred Mineral Resource in four separate mineralised fresh domains. Columbus is not treating any of the historical estimates as current mineral resources as defined in sections 1.2 and 1.3 of NI 43-101.

7. Geological setting and mineralisation

The Montagne d'Or Prospect is composed of a bimodal felsic and mafic igneous units with lesser volcaniclastics towards the base of the sequence. These are overlain to the north by stratified grey pelites, greywacke, and siltites of the Armina Formation. The units strike east-west and dip steeply south. The eastern portion contains a preponderance of mafic volcanics relative to felsic volcanics. The mineralised units have been strongly deformed, as evidenced by a penetrative S_1 foliation that locally transposes S_0 and in places is mylonitic. The S_1 foliation is constant throughout the section, striking 080° to 100° with a 70°S to sub-vertical dip. The intensity of deformation varies significantly over the distance of a few meters. The shear displacement is interpreted as dip slip movement. The project area is cross cut by post deformation swarms of mafic dikes. A major east-west shear zone forms the contact between the upper meta-sedimentary rocks and the bimodal igneous units.

In general, the Montagne d'Or Prospect consists of a number of linear tabular mineralised bodies within laminated felsic and mafic volcanic and volcaniclastic rocks intruded by narrow mafic to felsic dykes. Mineralisation has been encountered over a strike length of almost 2,500m and to a vertical depth of at least 200m. The mineralisation is open at depth, along strike and internally between widely spaced holes.

The mineralisation appears as narrow elongated lenses and zones within broader zones of low grade but anomalous mineralisation, (0.25 – 0.4g/t Au). The main area of gold mineralisation occurs in a series of generally east-northeast striking parallel zones with overall dimensions of 2,200m x 400m wide and to at least 200m vertical. However, gold mineralisation has been encountered outside the main zone of mineralisation in the host rocks over a strike length of at least 3,500m. At least four distinct anomalous mineralised domains can be recognized separated by barren intercalated mafic and felsic rocks. The mineralisation occurs in two principal zones along with a lesser well defined hanging wall and footwall zone. The two principal zones referred to in the resource estimation as Domain 2 and 3 average about 50 and 17.5m in thickness respectively. Mineralisation consists of semi-massive sulphide bands, and as stringers and disseminated through the host rock. Visible gold is rarely observed; preliminary mineralogical work suggests that it occurs along micro-fractures and on sulphide grain boundaries.

7.1. Regional geology

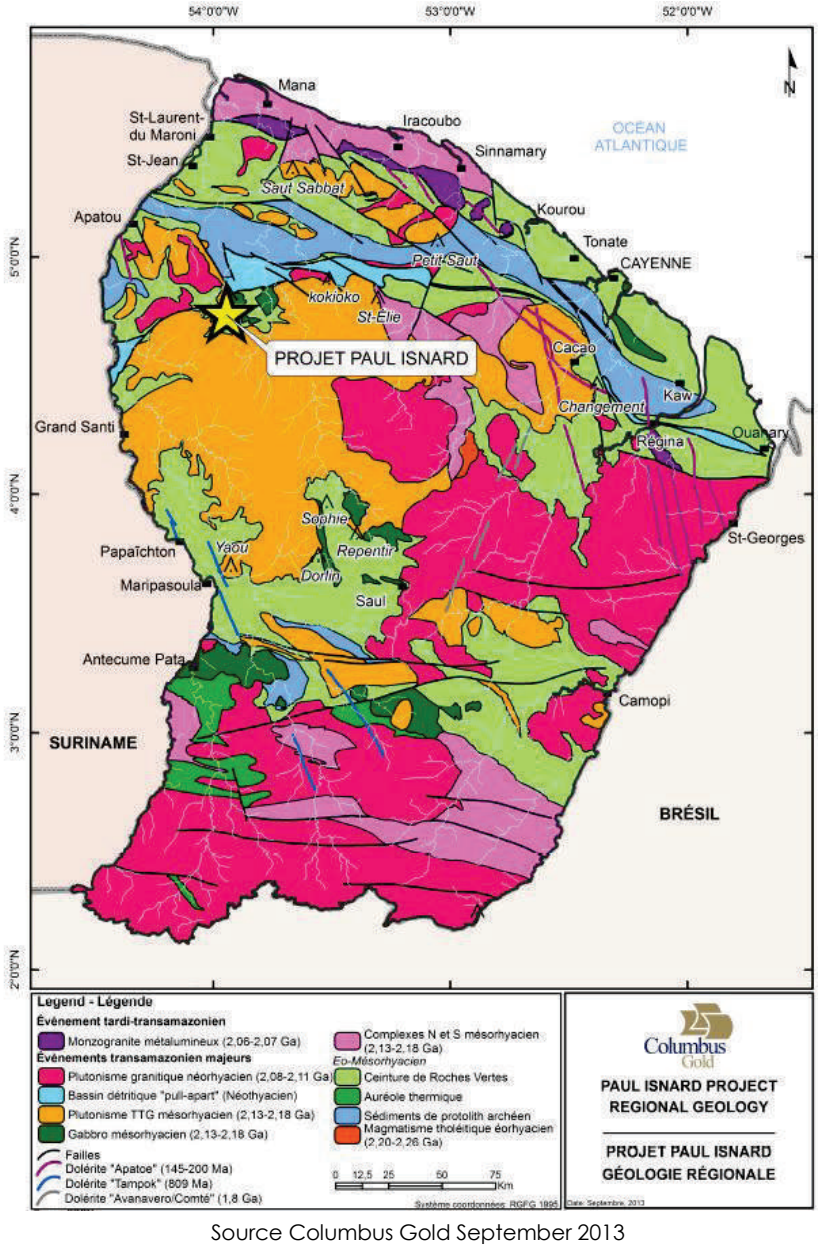
The following is based mainly on work published by Milesi et al (2003), from Delors et al (2001) and from the most recent geological and structural interpretations carried out by a team from the Université du Québec à Montréal (UQÀM) and published in 2014 (Giraud et al 2014). The latter studies also use and discuss historic and important geological interpretations by Vanderhaeghe et al (1998), and Franklin et al (2001). An earlier publication important for understanding the evolution of the geological interpretation of the French Guiana geology is the exploration report by N Suter prepared for Guyanor in 1999.

The Paul Isnard concessions occur within the Guiana Shield, a large (approximately 900,000km^2) segment of the Amazonian Craton of South America (Figure 7). The majority of the Guiana Shield formed during Proterozoic periods of intense magmatism, metamorphism and deformation that culminated in the Transamazonian tectono-thermal event of 2.1 Ga[1] to 1.9 Ga. The low-grade, volcanic-sedimentary greenstone sequences and affiliated granite intrusives that comprise the shield yield U-Pb age dates between 2.25 Ga and 2.08 Ga.

[1] 1 Ga is 1*10^9 years or 1 billion years.

Major structural features include the Central Guiana Shear Zone (CGSZ) and the North Guiana Trough (Sillon Nord Guyanais NGT). The CGSZ is a large-scale ductile shear zone, extending from French Guiana westerly through central Suriname and north-central Guiana. The NGT is interpreted to be a sinistral strike-slip structure formed during the Transamazonian Orogeny (Voicu et al, 2001) and is interpreted to have been formed as a "pull-apart basin".

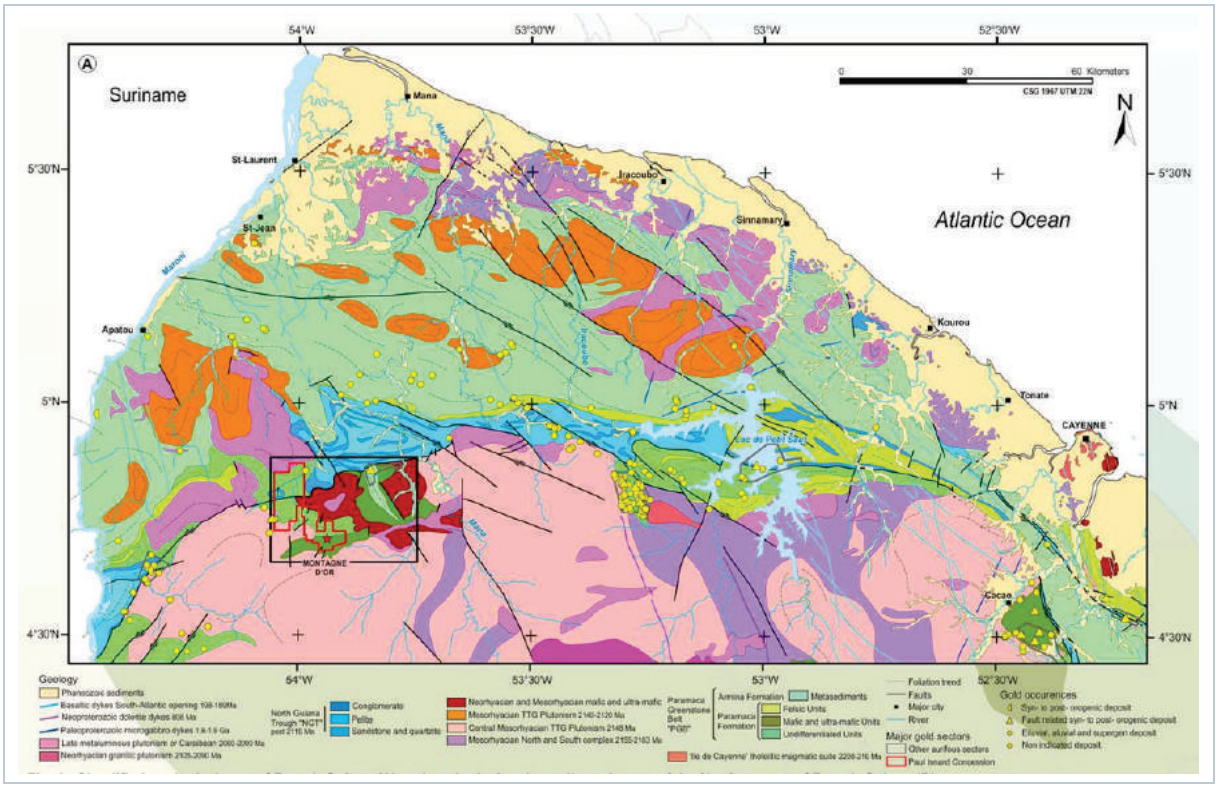
Figure 7 - Large Scale Geological Map of French Guyana



Source Columbus Gold September 2013

The greenstone belts of French Guiana are divided into two major groups. The northern group is associated with the NGT and includes the Lower Proterozoic Paramaca Greenstone Belt (PGB), a formation consisting of volcanic, volcaniclastic and sedimentary units. The PGB trends roughly from the west to the east through British Guiana, Dutch Guiana (Surinam) and French Guiana (Figure 8).

Figure 8 - Large scale overview of the geology of Northern French Guiana, showing the location of the Paul Isnard Project



Together with intrusive complexes of tonalite, trondhjemite and granodiorite, the PGB forms the Guiana Shield which was connected during the Paleozoic to the West African Shield (after Guiraud, Jébrak and Tremblay, UQÀM, April 2014). The PGB is interpreted as the remnant of a volcanic island-arc sequence that was subjected to structural deformation during the Transamazonian Orogeny which is interpreted as the result of plate convergence between the West African and the Guiana Shields.

This PGB occurs extensively across northern French Guiana, striking N110°E and hosting a number of gold deposits including Paul Isnard, Camp Caiman, St. Elie, Koolhoven and Rosebel in Surinam. The southern group is associated with the CGSZ and extends from Surinam through French Guiana. It includes sedimentary rocks of the Lower Orapu Formation and volcanic-sedimentary units of the Arima Formation (2.11 to 2.09 Ga), which unconformably overlie volcanic units of the PGB and the granite-gneiss complex of the Guianese Massif Central (2.3 to 2.2 Ga and 2.13 to 2.08 Ga). This southern group hosts gold mineralisation at Benzdorp in Surinam, Yaou and Dorlin in French Guiana, and numerous other smaller workings. Most of the remainder of French Guiana is composed of the Lower Proterozoic granite-gneiss metamorphic complex of the Guianese Massif Central, and a central belt of Paramaca volcanic, volcaniclastic, and sedimentary lithologies.

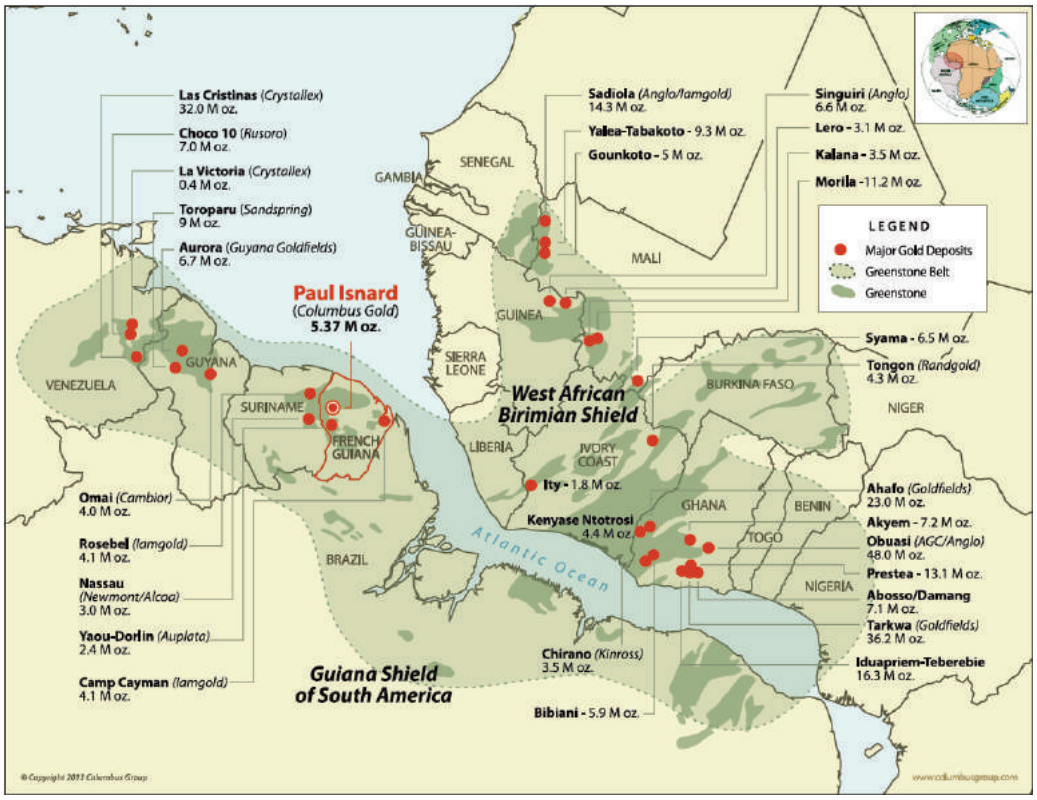
The northern and southern domains of the PGB are separated by the intrusions of tonalite, trondhjemite and granodiorite (TTG). Along the northern boundary, at a distance of approximately 15km from the Montagne d'Or Prospect, the PGB is bounded by sandstones and conglomerates of the NGT. Along the southern margin, the Greenstone Belt is in contact with large intrusive domes of TTG.

The PGB is locally limited to the south and west by regionally extensive post-orogenic granites and to the east by inferred high-grade metamorphic rocks of migmatitic and granitic gneiss. To the north, a narrow band of Paramaca-Armina Formation is unconformably overlain by the Upper Detrital Series (Ensemble Detrique Superieur EDS), silici-clastic sediments comprised of the Bonidoro, Orapu and Rosebel Formations. The EDS are surrounded by gabbro and granite and are interpreted as having been deposited in pull-apart basins associated with the NGT.

The felsic-mafic metavolcanic rocks of the PGB are underlain by the Armina Formation, a series of alternating sedimentary rocks (sandstones, grauwackes and pelites), however this formation has not been intersected by drilling in the project area. The BRGM obtained a radiometric age in the project area of 2,152 ± 8Ma from a rhyolite which provides a possible date for the volcanic series however the age of the mineralisation is unknown. Locally, gabbro intrusions occur which have yielded radiometric dates of 2,150Ma to 2,145 Ma, similar to the TTG.

The PGB and EDS are probable equivalents or correlatives of respectively the Birimian and Tarkwaian sequences of the West African Shield and may have been co-extensive prior to the separation of Gondwanaland in the Mesozoic (Figure 9). The Paul Isnard Project lies within the northern PGB and is comprised of mafic metavolcanics of the Paramaca Formation.

Figure 9 - Map showing correlation of the Guiana Shield with the West African Birimian Shield



Source NI 43-101 report 2012

7.2. Property geology

7.2.1. General

The Montagne d'Or Prospect occurs within a bimodal felsic-mafic series of Proterozoic volcanic rocks. The gold mineralisation is hosted within a 400m thick sequence of intercalated felsic and mafic volcanics with subordinate volcaniclastics. The units strike east-west, dipping steeply south and are exposed on the northern slopes of Dékou-Dékou Mountain.

The eastern portion contains dominantly mafic volcanics with only minor amounts of felsic volcanics. The mineralised units have been strongly deformed, as evidenced by a penetrative S1 foliation that locally transposes S0 and in places is mylonitic. The S1 foliation is constant throughout the section, striking 080° to 100° with a 70°S to sub-vertical dip. The intensity of deformation varies significantly over the distance of a few meters. The shear displacement is interpreted as dip slip movement. The project area is cross cut by post deformation swarms of mafic dikes.

The volcanic complex of the Montagne d'Or is bounded in the north by granite and gneiss and is along the southern margin from amphibolites by a left-lateral shear. This shear is coincident with the east-west trending and south-dipping direction of schistosity which occurs pervasively throughout the volcano-sedimentary sequence. The volcano-sedimentary sequence is facing southwards and has been interpreted as the result of an isoclinal fold; minor faults are also defined in the drillholes. The sequence has been metamorphosed to Upper Greenschist Facies.

The entire region has undergone Tertiary age lateritic weathering which resulted in a saprolite cover of varying thickness and in which variable lateral movements have taken place.

7.2.2. Lithology

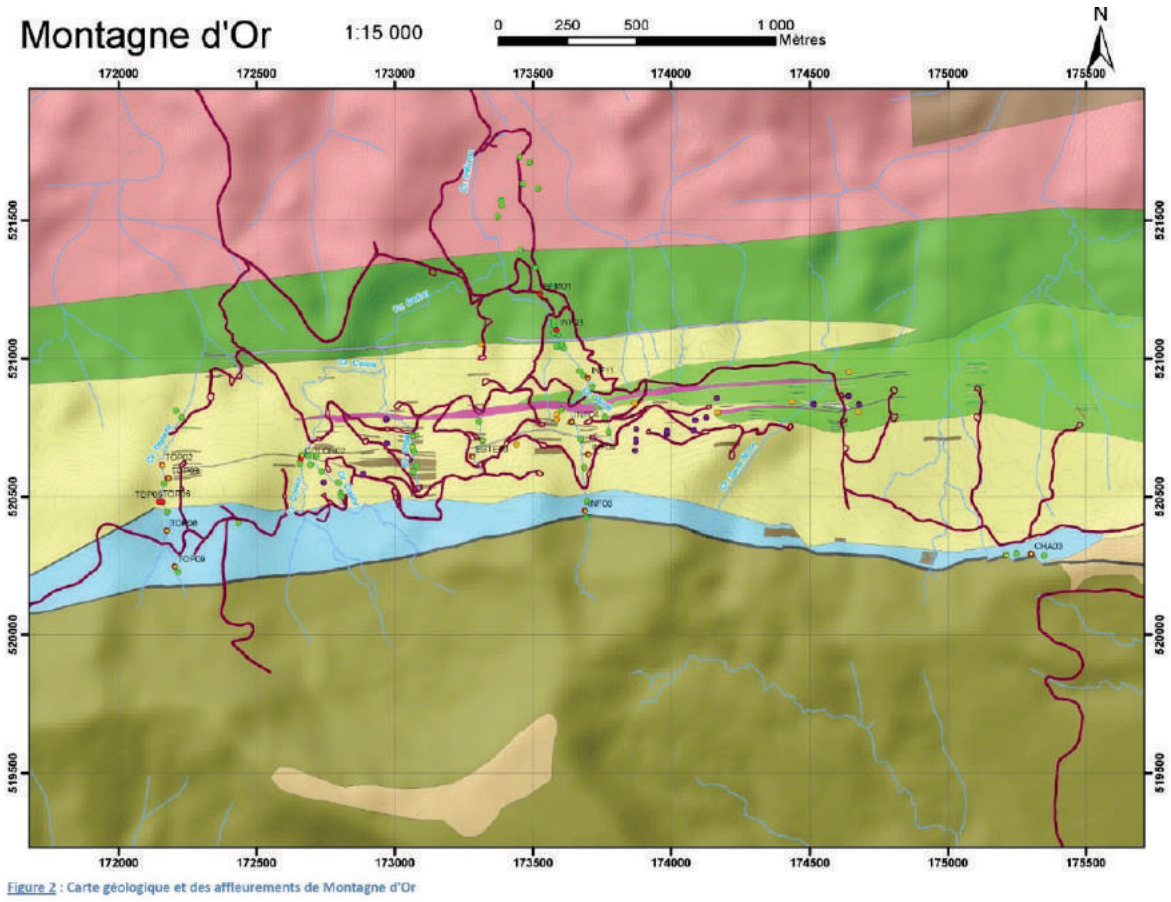
The Montagne d'Or Prospect occurs within felsic-mafic volcanic rocks assigned to the PGB, with lesser volcani-clastics towards the base. The series is overlain to the north by stratified grey pelites, greywacke, and siltites of the Armina Formation. A major east-west shear zone forms the contact between the upper meta-sedimentary rocks and the bimodal volcanic rocks. All lithologies have been subjected to a least low grade Greenschist Facies metamorphism.

The stratigraphy of the felsic-mafic volcanic series appears to change along strike from west to east, but can be divided from bottom to top into four major "units":

- Lower Mafic Unit
- Felsic Unit
- Upper Mafic Unit
- Sedimentary Unit

This series is intruded in both the mafic and felsic portions by two stratigraphically-distinct tabular intermediate intrusive bodies that occur as thin sills and locally crosscut the volcanic series. Quartz veins that transect the schistosity occur throughout the felsic and mafic portions of the deposit but do not contain major mineralisation.

Figure 10 - Schematic Overview of Main Local Geological Units in the Paul Isnard Project Area



Details in Text – Source - Columbus

A schematic of the local geology of the Montagne d'Or Prospect in shown in Figure 10. From north to south the sequence consists of a lower rhythmic mafic tuff unit (darker green) with intercalated sedimentary units (pelitic and graphitic horizons), a more massif upper mafic unit (light green), a felsic unit with massive quartz-feldspar rhyolite flows and felsic tuffs (yellow), an intermediary feldspar porphyry unit (intrusion, purple), and a sedimentary unit of quartzite, greywacke and chlorite-sericite schists (blue). The sequence is intruded by a network of later mafic dykes and exhibits intensely deformed "shear zones" of elongate euhedral feldspar crystals and evidence of rapidly changing deformation intensity.

Lower mafic unit

The unit of mafic and intermediate mafic-banded tuffs consists of meter-scale rhythmically banded tuffs in its basal part and sedimentary pyrrhotite-rich pelites and graphitic schists in its upper part. The Lower Mafic Unit is an excellent stratigraphic marker. Near the top of the unit, an East-West fault is defined by a graphitic marker unit.

Other units within the Lower Mafic Unit are composed of intercalated mafic and felsic horizons that are interpreted to mark a hiatus in volcanic activity. Such felsic/intermediate sections are intercalated with sediments and graded bedding that consistently indicate a south-facing younging direction of the sequence. Some of the units may represent tectonised sills and the units are often altered to hyperchlorite bodies (Franklin, 1999).

Whole rock geochemistry shows that the mafic rocks are calc-alkaline and mostly dioritic to weakly gabbroic in composition (Gold Fields 2001).

Felsic unit

This Felsic Unit consists predominantly of rhyolitic to dacitic rocks and locally contain feldspathic masses. The groundmass is essentially quartz and sericite, light grey in colour and strongly foliated; stretched quartz eyes (augens) are common, with a bluish variety being distinctive. The rock is characterized by the ubiquitous and defining presence up to 10% subhedral to euhedral bipyramidal quartz phenocrysts, enmeshed in a holocrystalline matrix of fine-grained quartz-feldspar-biotite-(sericite-chlorite) and lacking primary magnetite.

Core logging at the Montagne d'Or Prospect has differentiated three visually distinct felsic units: "felsic tuff", "lapilli tuff", and "welded tuff". These unit names are project designations assigned to the felsic lithologies for logging and mapping purposes. Franklin (1999) described the three varieties as facies of a pyroclastic ash-flow sequence, and interprets the felsic section in terms of a sub-aerial, volcanogenic, bimodal sequence.

Franklin defines a basal "felsic lapilli tuff" as a coarse basal sequence composed of matrix-supported juvenile clasts up to 5cm in diameter. Most occurrences contain abundant quartz crystals and have apparent reverse-graded bedding at their bases. His "felsic agglomerates" are interpreted as the coarsest facies of ash-flow sequences, with large quartz crystals within lapilli tuff units. These comprise the central portion of ash-flows, composed of fine-grained to medium-grained ash units. Large quartz crystals similar to those in the "felsic agglomerates" are scattered through the section. The upper portion of each flow is composed of very fine material, with an aphanitic groundmass hosting quartz crystals in about the same abundance as in the lower portions.

The felsic rocks are geochemically akin to highly evolved rocks of the Canadian shield (Franklin, 1999). These textural interpretations have been re-interpreted in light of the deformational history of the region. The felsic lithologies are alternatively interpreted as quartz porphyry units, which have been altered, mineralised and subject to varying degrees of deformation.

Whole-rock geochemistry data show that the felsic lithologies have a calc-alkaline chemistry and are likely emplaced or deposited in an arc or back-arc basin environment. Whole rock compositions range between granite and granodiorite (Suter 1999, Gold Fields 2001).

Over 80% of the mineralisation at the Montagne d'Or Prospect is hosted in the felsic units. These define a major stratigraphic package hosting all varieties of the felsic lithologies which predominates in the western and central portions of Montagne d'Or Prospect.

Upper mafic unit

This unit occurs predominantly in the eastern portion of the area and appears to intercalate with the felsic unit. It consists of alternating sequences of mafic flows, and intermediate to mafic tuffs and mafic dikes. The flows are generally non-schistose, fine grained, massive, finely feldspar phyric, weakly to moderately magnetic, and dark-grey to black in colour. Occasional, vesicle and hyalopilitic zones have been interpreted as evidence for a flow origin for the unit.

The mafic dikes are very fine grained and slightly chloritized along margins. Contacts are slightly oblique to schistosity. They are deformed, indicating emplacement early in the geological evolution of the site. These are interpreted as synvolcanic dikes and sills petrogenetically related to upper mafic units. The dikes show very poor to no lateral continuity.

Re-interpretation of the geochemistry, mineralogy, and structural setting of the mafic units suggests they may be a calc-alkaline dioritic complex related to the larger gabbro/diorite complex located to the north of Paul Isnard. The “flows” are also re-interpreted as portions of a dioritic plutonic complex. The mafic units are interpreted as pre-quartz porphyry in timing of their emplacement, and conceptually represent the basement to the system, possibly a marginal phase of the large gabbro complex located to the north of the Montagne d’Or Prospect.

Sedimentary unit

Sedimentary rocks occur predominantly in the southern part of the property. They overlie felsic units and form a sedimentary cap to the section. They are interpreted to represent a hiatus or waning stage in felsic volcanism, and occur at both the base and top of the section. On the northern side of the Montagne d’Or Prospect, sediments form rhythmically-banded fine-grained, occasionally graphitic intercalations. To the south, a series of quartzites (metamorphosed cherts), black shales and pelitic and graphitic schists become more dominant in the upper part.

Intermediate intrusive

This unit occurs in both the mafic and felsic lithologies of the Paul Isnard Project area. It is a unique and easily identifiable unit that forms an apparent stratigraphic or structural marker. Two stratigraphically-distinct intermediate intrusive units have been identified. These units form tabular bodies parallel to schistosity but locally cross-cut the volcano-sedimentary package. The unit was originally logged and described as a lapilli-stone or a welded tuffaceous unit. Petrographic examination shows the lapilli are actually relict feldspar crystals replaced by albite, epidote, and quartz, while the groundmass is composed of a fine-grained aggregate of quartz, feldspar, mica, and carbonate. The feldspar phenocrysts are deformed into sub-rounded ovoid masses, typically with quartz and carbonate pressure shadows. Biotite grains are aligned in the plane of foliation. The textures and mineralogy indicate it is clearly an intrusive occurring as thin, distinct sills (Franklin, 1999). The unit is also described as a feldspar ± quartz porphyry. The rock carries from 2 to 10% sodic plagioclase phenocrysts contained within a holocrystalline fine-grained phaneritic feldspar-quartz-biotite-(sericite-chlorite) matrix, and very few and rare quartz phenocrysts (Gold Fields 2001).

Quartz veins

Quartz veins, *per se*, are not generally associated with mineralisation and vary in width from millimetre to meter scale. Larger veins are more common in the mafic units, likely due to late brittle deformation. Within mafic flows and intrusions, they occur as white, meter scale veins that cross-cut lithologic layering. The quartz veins within the felsic units are thin, white or blue-grey colour and transect S1 schistosity.

Alteration

Gold mineralisation at the Montagne d’Or Prospect is accompanied by pervasive alteration which includes sericite, secondary biotite (retrograded to chlorite) and secondary K-feldspar with locally quartz. Alteration products are the result of partial replacement of all lithologies by Fe and sulphide rich fluids. The predominant additions to the rock geochemistry were sulphur and iron, as well as potassium, gold, and base metals, with a concomitant removal of sodium and calcium. The precipitation mechanism was likely direct interaction of hydrothermal fluids with the country rocks.

Sericite is the dominant alteration phase in the shallower part of the drillholes, from approximately 40m to 120m down-hole depth. It transitions into secondary biotite below 150m. The most pervasive alteration is dominantly a phyllic assemblage. This includes quartz-sericite-pyrite and veinlet-controlled potassic assemblages of secondary biotite, and associated pervasive secondary K-feldspar. A less common, propylitic assemblage consists of chlorite-epidote-calcite. Veinlet assemblages include; quartz-pyrite-pyrrhotite-chalcopyrite, secondary biotite-pyrite-pyrrhotite, and magnetite-pyrrhotite- chalcopyrite-quartz-chlorite-minor red garnet

Chloritization occurs as a pervasive alteration of mafic units, and as millimetre-scale veinlets within felsic lithologies. The chlorite is Fe-rich, in contrast to Mg-rich chlorite typically associated with VMS type alteration. There is no correlation noted between chloritisation and gold content. There is, however, a weak correlation between hypochlorite zones and gold mineralisation. The hyperchlorite zones are typically deficient in gold but commonly located adjacent to strongly auriferous zones. The prominent addition to the mafic rocks is Fe^{3+}, as well as gold. This is in part due to addition of sulphide, and perhaps to formation of Fe rich chlorite. The addition of K_2O, as either sericite, secondary biotite, or secondary K-feldspar is also present. Alteration is typically strongest at the margins of the mineralised zones.

Chlorite alteration within mafic and intermediate units may include some secondary biotite. The overlapping phyllic, potassic, and propylitic assemblages and quartz-sulphide veinlets are strongly suggestive of an intrusive porphyry–related epigenetic deposit. Zonation of peripheral Pb-Zn disposed about an Au-Cu centre is also suggestive of a porphyry-type system. Late stage, narrow quartz veins are planar and cross cut the foliation and mineralised veinlets. They typically have a broad selvage of carbonate-chlorite alteration.

“Hyperchlorite” alteration zones at Montagne d’Or are composed of variably chloritized portions of nearly all lithologies. They occur predominantly in the mafic volcanic units, intermittently in the felsic units and rarely in mafic intrusive units. The mineralogical and textural characteristics of the zones are quite similar in both mafic and felsic units. The hyperchlorite alteration zones are composed of well foliated biotite (with incipient chlorite replacement), and locally contain a calc-silicate-rich assembly of calcite actinolite, garnet, quartz, calcite-dolomite and magnetite + pyrite, chalcopyrite and pyrrhotite. The magnetite within this assemblage appears to be hydrothermal, and some magnetite rich intervals with sulphides can be highly auriferous. These zones are interpreted as reflecting primary mineralisation as opposed to post-mineralisation processes.

Within felsic rocks, the edges of the felsic unit are characterized by chlorite veining. Quartz phenocrysts are preserved while most of the primary textures are destroyed, particularly within central parts. Sulphide rich zones up to 50% can be associated with the chloritic alteration. Some units logged as mafic tuff may actually represent highly chloritized felsic units. Visual separation of hydrothermal and metamorphic chlorite is very difficult.

Silicification is fairly pervasive in all volcanic units. Within the centre of the Montagne d’Or Prospect, less silicified units tend to have a higher sulphide content.

Sericitization is a major and widespread alteration feature within the felsic units. It is interpreted as a later overprinting alteration stage on an earlier secondary K-feldspar. There does not appear to be any association between sericitic alteration and gold content. However, the early BRGM regional geochemistry showed that K and Ba are elevated proximal to faults and shear systems. This feature in time provided the pathfinder to the Montagne d’Or Prospect gold mineralisation.

Carbonate alteration occurs within felsic rocks as fine stringers and replacements. Within mafic units, calcite development is more pervasive, occurring as massive replacement within rhythmically banded tuffs, and as carbonate-chlorite or quartz-carbonate veinlets. It is difficult to separate the hydrothermal alteration carbonates from that derived by metamorphic processes. No correlation has been noted between carbonate alteration and gold content.

Studies of epidote-chlorite-tourmaline hydrothermal alteration have been interpreted as typical of a mesothermal system with temperatures in the 300° - 350°C range (Suter, 1999).

7.2.3. Structure

The Paul Isnard Project area has experienced two distinct deformational events. The first involved ductile deformation during the Lower Proterozoic accretionary arc tectonism that formed the Guiana Shield. The second is related to more brittle deformation associated with the faulting within the NGT.

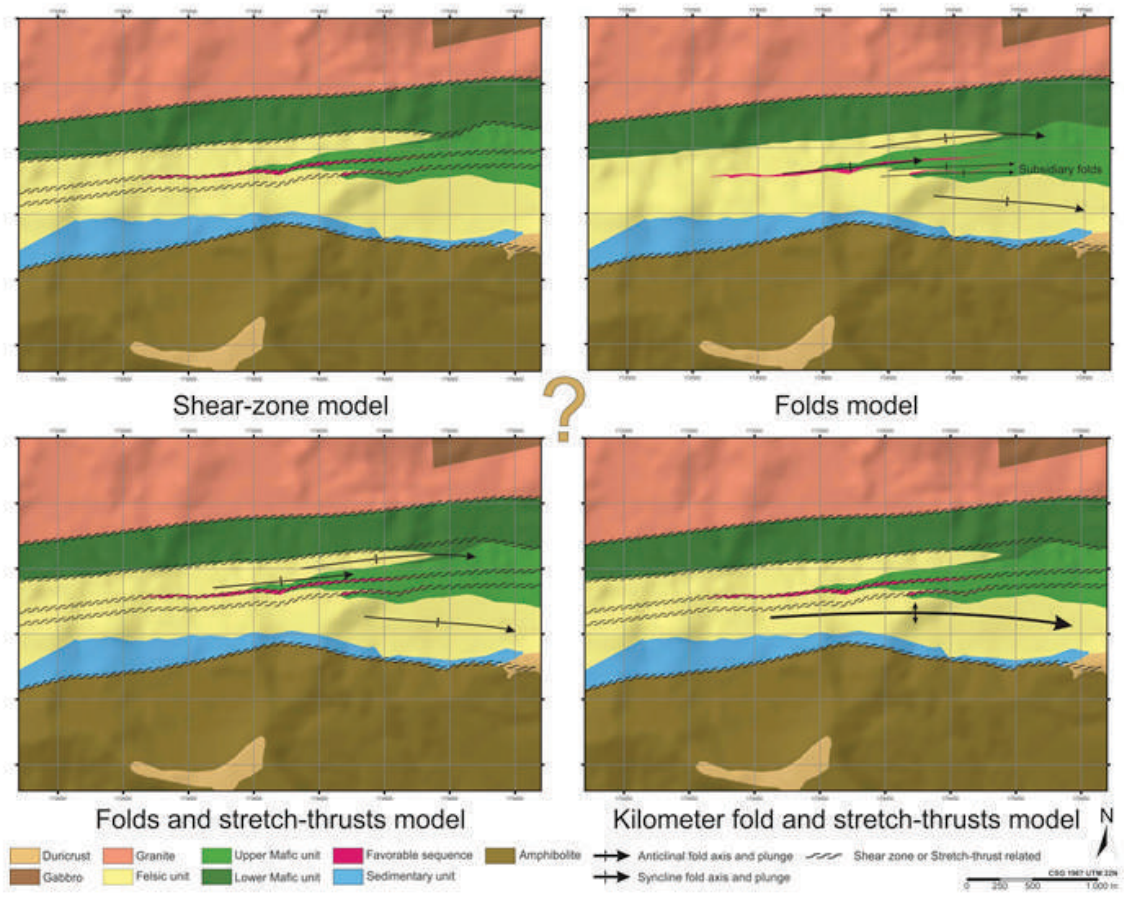
The first phase of regional deformation is associated with northeast-southwest compression developing the pervasive S1 schistosity striking 080° to 100° and dipping steeply south. This event postdates mineralisation as evidenced by the highly deformed sulphide fabric. The development of the S1 schistosity was accompanied by Upper Greenschist Facies and Lower Amphibolite Facies metamorphism affiliated with the emplacement of granitic plutons and migmatites.

The second phase of regional deformation postdates the EDS sediments and is related to sinistral transcurrent tectonism, marking the contact between the NGT and PGB. As a result of the second deformation, the earlier S1 schistosity is locally crenulated. A weak S2 fabric is characterized by a spaced cleavage, which strikes 060°. A well-developed set of faults and fractures with four principal orientations were also developed. The relative intensity of these brittle structures listed from strongest to weakest are:

- North-south (48%);
- Northeast-southwest (28%);
- Northwest-southeast (16%); and
- East-west (7%).

At Montagne d'Or, the east-west fracture systems follow the well-developed ductile fabric as shown by the major fault marking the contact between PGB and EDS units, and the contact between altered greenstones that host the Montagne d'Or gold mineralisation and amphibolites to the south. The effects of shearing, folding, and metamorphism clearly overprint and postdate mineralisation. The structural relations present at Montagne d'Or indicate that the mineralisation is neither shear-hosted nor metamorphic in origin and that different structural interpretations are possible (Figure 11).

Figure 11 - Different structural interpretations were brought forward during the extended exploration period



Source - Columbus

Detailed structural and petrological studies have been carried out in association with the Université du Québec à Montréal (UQÀM). Felsic and mafic rocks appear to follow the same predominant geometry as interpreted for all mineralised zones, however a further definition of lithology on cross sections and the creation of an eventual geological model are imperative in future. This is likely to enable the wire-framing of geological envelopes, a further refining of wire-framing of both lower and higher grade envelopes and the building of a well-constrained block model for lower and higher grades.

The ongoing geological and structural studies by UQÀM are of critical importance for a better understanding of the genesis of the mineralisation. At this stage the importance of several corridors of intense deformation is not fully understood but may explain the regional distribution of the major lithologies, while folding may provide an explanation for the repetition of the mineralised domains and the remobilisation of sulphides. A combination of the two models may explain both the lithological sequence and the repetition of mineralised domains.

7.3. Mineralisation

The Paul Isnard Property and the Montagne d'Or Prospect occur within the Guiana Gold Belt which stretches from western Venezuela eastward through Guiana, Surinam and French Guiana (refer Figure 8). Plate tectonic reconstruction indicates that this belt continues into West Africa. All rocks are Proterozoic in age and the mineral deposits are typical of those in other greenstone terrains such as in Canada, Australia and South Africa. Many significant gold deposits and prospects have been identified, including Las Cristinas over 32Moz, Choco10 over 7Moz, Toropoaru over 9Moz, Aurora over 6.7Moz, Omai over 4Moz, Rosebel over 4Moz, Merian over 3Moz and Camp Caiman over 4Moz. Numerous other prospects, mostly in Guiana and Surinam are undergoing active exploration.

The gold mineralisation has been interpreted to be the result of very different processes. The earliest interpretation was that the gold was deposited in a syngenetic, exhalative, volcanogenic, massive sulphide-affiliated mineralisation. A later hypothesis suggested that the gold was deposited in an epigenetic, quartz porphyry-related hydrothermal system, which was strongly deformed within a high strain shear zone.

In October 2008 Newmont carried out an assessment of the geology and prospectivity of the Paul Isnard area in an agreement with Golden Star Resources. They interpreted the geology at Paul Isnard as the result of the creation of large scale fold structures with a south-south-west to north-north-east trending "structural grain" as a second regional phase of deformation.

Newmont interpreted this fabric as high strain corridors that transposed all sulphide mineralisation at Montagne d'Or and extending for several kilometres. A gradient IP/resistivity survey was interpreted to indicate to lie on the contact of two distinct lithological units with a possible high graphite/magnetite contact zone often associated with regional shear structures and the possible presence of sulphides. Repetition of chargeable features was interpreted as the possible occurrence of a stacked sulphide system.

7.3.1. Montagne d'Or Mineralisation

The Montagne d'Or Prospect consists of a series of linear mineralised tabular bodies that form closely-spaced sub-parallel east-west-striking and steeply south-dipping mineralised horizons. Mineralisation has been encountered over a strike length of more than 2,500m and to a vertical depth of at least 300m. Only a small portion of the gold mineralisation has been subjected to upper level oxidation. The significant fine-grained gold mineralisation is affiliated with sulphide veins and masses within fresh country rock that begins at shallow depths.

Historically, on a macroscopic scale, two significant styles of gold mineralisation have been recognised although they show a gradational relationship between each other:

- Semi-massive sulphide (SMS) with gold mineralisation, and
- Sulphides in disseminated stringers with gold mineralisation.

SMS was a term coined by previous operators and was used to support a "VMS" type model for the mineralisation. It is characterised by a high sulphide content (>20%) and occurs over intervals ranging from tens of centimetres to up to 4 metres. This mineralisation was later interpreted to represent zones of thicker, deformed and transposed sulphide ± quartz-rich veins and a denser distribution of disseminated sulphide as compared to that of the disseminated type.

The SMS also includes sulphide-rich breccia dykes, which host rolled and milled clasts of host rock within a ductile, deformed pyrite-chalcopyrite-pyrrhotite matrix. In addition, bornite is present, and minor amounts of arsenopyrite have been identified petrographically. There is a clear correlation between sulphide veinlets and sulphide-rich breccia zones and gold grades. Relatively minor amounts of total sulphide (i.e. disseminated + vein and veinlet + breccia – hosted sulphide representing 2 to 5% total rock volume), locally resulting in significant although erratic, high gold concentrations, commonly attain values of tens of grams per tonne gold over standard 1m sample intervals.

Disseminated mineralisation is characterized by the presence of finely disseminated to finely fracture controlled sulphides chiefly pyrite but with lessor and locally important chalcopyrite and pyrrhotite. Close inspection of core and outcrop indicate that gold associated with this style of mineralisation is in part controlled by the abundance of fine sulphide-quartz veinlets and fracture fillings which have been strongly (isoclinally) folded, sheared and transposed into an almost ubiquitous “S1” fabric. Grades for this mineralisation type are dependent upon disseminated sulphide and sulphide-quartz veinlet density, but are generally low, in the 0.5g/t Au to 3g/t Au range, over sample intervals which average approximately 1m in length.

Mineralisation is hosted by felsic, mafic and intercalated mafic/felsic rocks to varying degrees. However, approximately 80% of the gold mineralisation in the deposit occurs within the more felsic units, both a felsic tuff and a quartz porphyry.

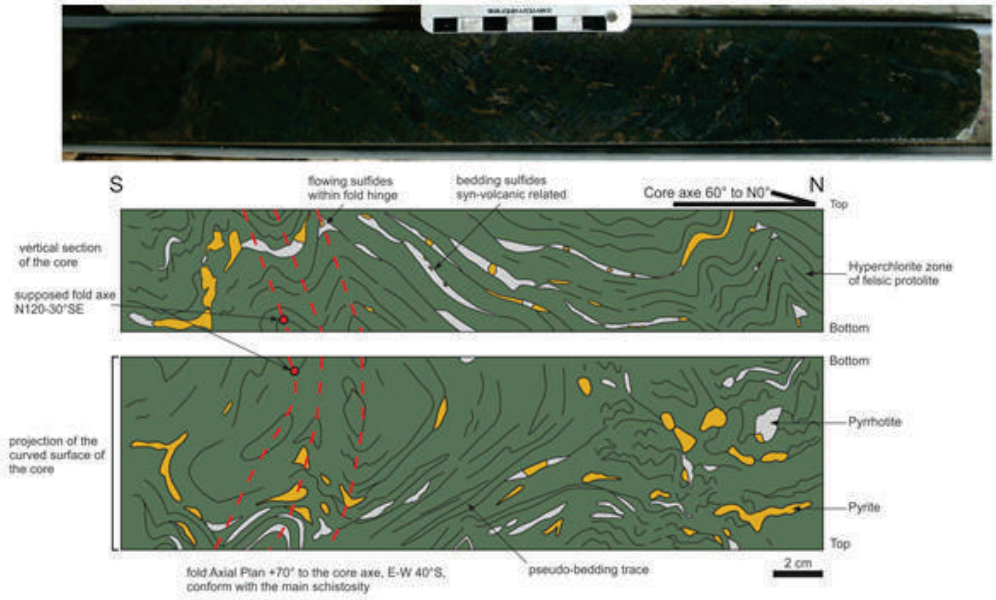
The mineralisation appears as narrow elongated lenses and zones within broader zones of low grade but anomalous mineralisation (0.25g/t Au to 0.4g/t Au). From north to south at least five distinct anomalous mineralised domains are recognised, separated by barren intercalated mafic and felsic rocks. In addition, three additional but smaller mineralised domains have been recognised from drilling to date and currently the mineralisation is modelled as eight different mineralised Domains.

A typical favourable horizon unit recognised to date consists of a basal sequence of intercalated felsic, intermediate and mafic tuffs passing up into a hyperchlorite unit. The upper part of the sequence consists of lapilli tuffs and welded felsic tuffs with well developed, centimetre scale, blue quartz eyes. The semi-massive sulphide zones are generally associated with the lower part of the sequence. Gold mineralisation is also associated with these horizons although its position within the sequence is more variable. It is common for one or more components described above, to be absent from this assemblage.

Disseminated sulphide mineralisation is hosted within a fairly homogenous felsic quartz-eye porphyry or tuffaceous unit. Mineralisation appears to be pre-tectonic to syn-tectonic (Figure 12). The coarse quartz eyes are contained within a sericite-pyrite matrix possessing a pronounced shear fabric. The quartz eyes are frequently blue, indicative of high strain, rotation and stretching. Disseminated pyrite crystals are coarse and also stretched or transposed. Deformed sulphide grains tend to be coarse-grained rather than the product of comminution, indicating recrystallization by annealing following deformation. Some mafic units carry similar mineralisation, but at a notably lower sulphide vein density.

Recent work carried out by Giraud and others from UQÀM is most comprehensive (refer Section 29) and is also based on all earlier work by other researchers specifically Franklin, Vanderhaeghe, Milési and Delor, but emphasises the volcanogenic massive sulphide (VMS) origin of at least the majority of the mineralisation.

Figure 12 - Example of Drillcore Description Showing Relationship between Primary Bedding and Sulphides

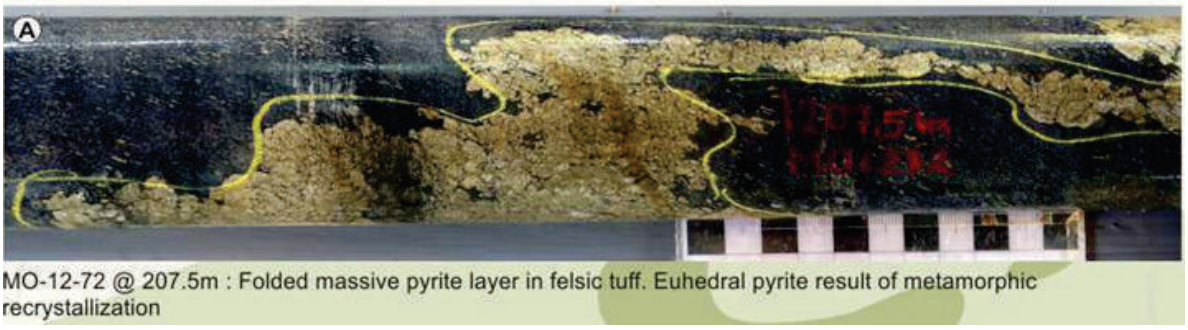


From J Guiraud et al - 2014

Different types of gold deposits are known to occur with the PGB and have been described as gold-bearing conglomerates, orogenic deposits and minor stratiform/stratabound deposits. The Montagne d'Or deposit is now thought to be part of a stratiform/stratabound deposit type. Mineralisation consists of pyrite, pyrrhotite and chalcopyrite with minor sphalerite, magnetite and arsenopyrite. Arsenopyrite assemblages, although observed, do not appear to have an obvious relationship with either gold and copper mineralisation. Pre-deformation as well as syn-deformation patterns are observed (Figure 13). Distinct phases are reported as stratiform disseminated sulphides, stockwork sulphide veinlets and layers of semi-massive sulphides that are tectonically transported.

The latter facies is considered as syn-volcanic in origin and as the most favourable occurrence for sulphide mineralisation. The sulphides veins could be related to feeder zones and/or remobilised on fold hinges and shear zones. In addition, evidence is found for tectonic remobilisation with sulphides concentrated within fold hinges and pressure shadows, and cross-cutting sulphide-bearing veins.

Figure 13 – Example of Semi-massive Sulphide Occurrence



From Giraud et al. 2014

Visible gold occurs in chlorite-rich zones or is spatially related to sulphide mineralisation (after Giraud, Tremblay, Jébrak and Lefrançois, 2014). Figure 14 shows a photograph of native gold hosted by mafic volcanic rocks in drillhole MO1266 at a depth of 245m. This particular one meter interval ran 80.75g/t Au, uncut. There is generally an increase in gold grades as sulphide (excluding pyrrhotite) content increases. Microscopic studies indicate that gold occurs as very fine grains in the host rock groundmass and at the junctions of quartz crystals. Gold has only very rarely been seen as inclusions within sulphide minerals.

Figure 14 – Example of Visible Gold Occurring within Mafic Volcanics (MO1266)

Source Columbus

Retrograde metamorphism has resulted in recrystallization patterns in the sulphides. Chlorite alteration is reported as characterised by patches of chlorite and silica, and breccia pipes of chlorite and silica with a chlorite halo. During the site visit however, the hydrothermal alteration was not evident as strongly associated with the bulk of felsic tuff mineralisation, except in portions of mineralisation close to mafic intrusions. Massive magnetite may also be present close to mafic intrusions and locally lead to a comparatively higher rock density.

Field inspection of core samples of a total of eight (8) selected drillholes of the Columbus Phase 1 and Phase 2 drilling campaign, together with a visit to different portions of the deposit, has verified that the mineralisation is preferentially associated with felsic lithologies or with mafic intrusions that occur near the contact or inter-fingering with felsic tuffs. Such intercalations are more continuous in the eastern portion of the deposit and may possibly be defined individually into separate mineralised domains. The presence of dolerite dikes is frequently observed along these contact zones.

Higher-grade gold mineralisation appears for a major part macroscopically associated with centimetre wide bands of massive sulphides, exhibiting strong shearing textures in the form of eye quartz bands with a well-marked schistosity that are also often micro-folded and transposed. Stretched crystals of quartz, magnetite and more locally garnet, pyrite, chalcopyrite and pyrrhotite appear often as shadow pressure features surrounding eye quartz crystals.

In the same way, proportionally very minor and localised quartz feldspar porphyry was observed to be associated with the mineralised zones.

The saprolite horizon presents a more erratic layer of mineralisation and has been subjected to different controls on the mineralisation as the fresh rock. There is local evidence for some physical colluvial remobilisation down the slope of the steeper hills. An irregular saprolite-saprock intercalation associated with very nuggety mineralisation is locally observed. The location of the older illegal but now inactive workings that are frequent in the region have exploited such saprolite/colluvial deposits. In addition, a frequent sericite weathering alteration was observed in these shallow and highly weathered horizons, while the original structural rock foliation remains commonly preserved. Therefore, a precise delimitation of the saprolite/saprock horizon from the fresh rock is critical and as soon as sufficient drilling data is obtained from the saprolite horizon, this horizon will require separate grade interpolation.

Visually, there appears an evident correlation of gold mineralisation with high copper values, however copper has not been estimated to date. The distribution of copper throughout the deposit will need additional investigation.

Mineralogical studies of the deposit carried out by the University of Liskolc, Hungary, also appear to support a submarine exhalative model but may also point at a high silver content of the gold implying a different epithermal magmatic source for at least a portion of the mineralisation. Therefore, further studies with further information from additional drilling (e.g. generation of detailed structural sections, better definition of deformation corridors, zonation of trace elements) will provide a more complete geological/structural understanding of the deposit and the controls on mineralisation.

The current overall consensus on the genetic origin and depositional type of the Montagne d'Or deposit is of an original volcanogenic massive sulphide (VMS) deposit with a strong and complex shearing history and posterior gold remobilisation. Locally, minor quartz veins and quartz pockets are associated with the mineralisation. A strong structural conditioning is evident, with a nearly east-west orientated strike geometry dipping at a high angle towards the south.

The current interpretation of the gold mineralisation is that of a metamorphosed gold-bearing volcanic massive sulphide (VMS) deposit with syn-volcanic characteristics observed in the mineralisation. A significant proportion of the mineralisation appears to pre-exist deformation and thus gives credibility to the VMS mineralisation model originally proposed by Franklin (1999, 2001). Primary textures however are overprinted by a long history of metamorphism, deformation and remobilisation and there are a number of plausible structural interpretations (refer Figure 11). The nugget effect of the gold mineralisation is high in the fresh volcano-sedimentary rocks and is interpreted to be even higher in the saprolite zone which has locally been subjected to transport of colluvial material.

8. Deposit type and genesis

In French Guiana, three types of Proterozoic gold deposits can be recognized (gold-bearing tourmalinites, gold-bearing conglomerates, and mesothermal ore deposits) and used as metallogenic markers in the two-stage geodynamic evolution proposed by Vanderhaeghe et al. (1998) and updated at the Guiana Shield scale by Delor et al (2000, 2001, 2003).

French Guiana's Transamazonian orogenic evolution is complex in terms of multi-stage crustal growth including Archean recycling and juvenile Paleoproterozoic accretion and reworking. As a complement to the 1:500,000-scale Geological Map of French Guiana (2nd edition), Delor et al presented a detailed overview of the Paleoproterozoic terrains on the basis of an airborne geophysical survey, geological field investigations, and isotopic data.

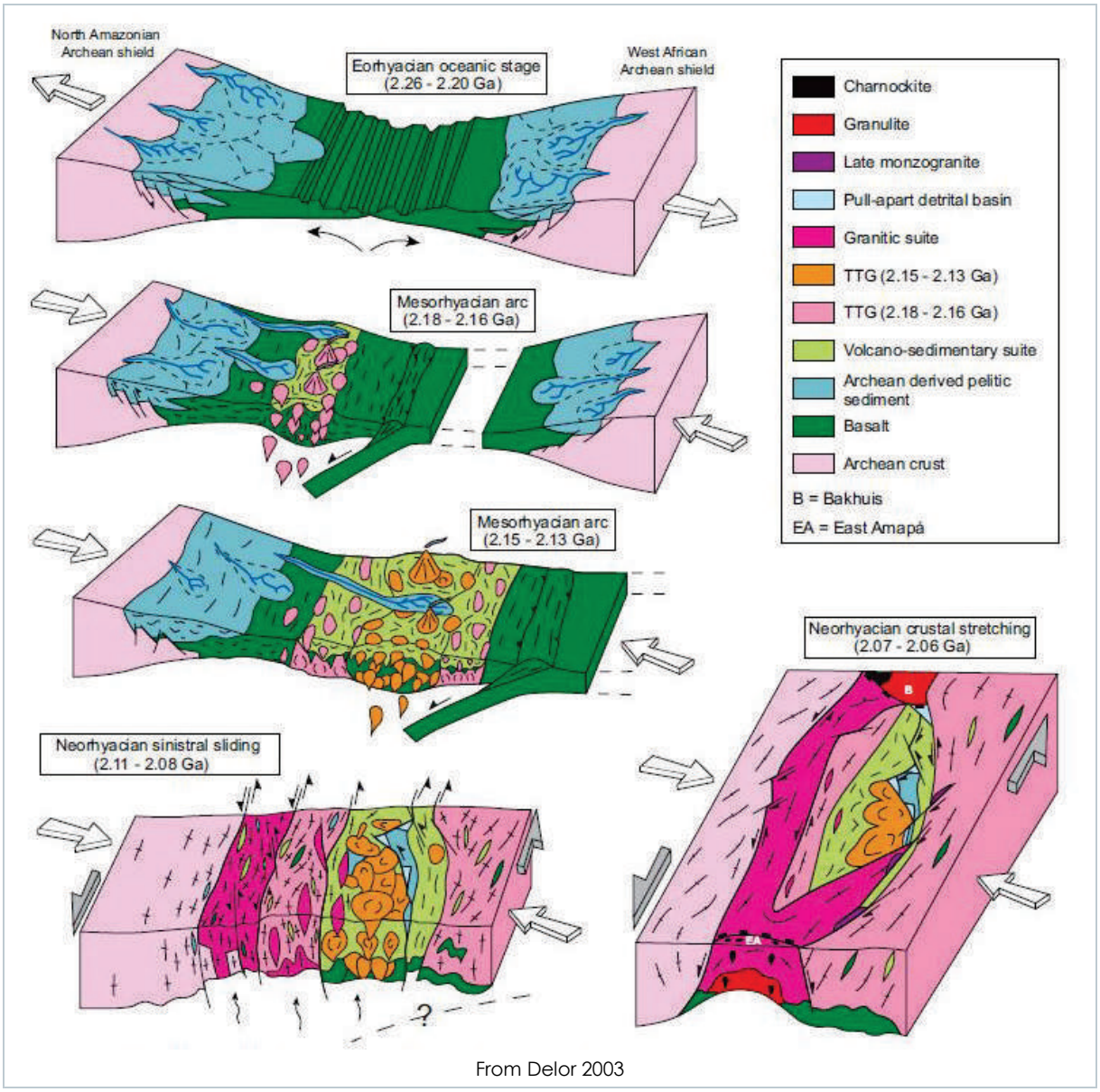
After the formation of juvenile oceanic crust at 2.26 Ga to 2.2 Ga came a period of dominant TTG type magmatism and regionally associated greenstone belts with ages from 2.18 Ga to 2.13 Ga in response to subduction during a D1 event related to the convergence of the African and Amazonian Archean blocks. The age distribution of the TTG magmatism seems to be roughly dependent on the geographical location of rocks within an intra-arc younging direction: older migmatitic TTG is found exposed in northern and southern French Guiana while the youngest generation occupies an inner position known as the Central TTG Complex. The greenstone deposits were synchronous with the TTG magmatism as indicated by emplacement of volcanics from 2.16Ga to 2.14Ga. Low-pressure type metamorphism is also associated with D1 in the northern and southern branches of the PGB. Granitic magmatism and minor gabbroic intrusions occurred at around 2.11 Ga to 2.08 Ga in response to the closure of the island-arc basins, with an evolution from southward-directed subduction to sinistral wrenching.

During the first stage of crustal growth by calc-alkalic and TTG magmatic accretion, an early (pre-D1 deformation) stock of gold and disseminated sulphides associated with regional tourmalinization accumulated in the PGB volcaniclastic sequences under subaquatic conditions. These gold-bearing tourmalinites were locally modified under upper–middle crust conditions during emplacement of discordant mesothermal quartz veins.

During the second stage of crustal recycling and tectonic accretion, a wide variety of syntectonic ore deposits including gold-bearing conglomerate and gold mesothermal types were emplaced during all increments of D2 transcurrent deformation, which was responsible for the progressive deformation of the North Guiana Trough, from its creation through to its burial and final exhumation (Figure 15).

The known gold deposits of the Guiana Shield are all located in close proximity to major structures, and occur within low to medium metamorphic- grade granitoid-greenstone belts. Most of the deposits appear to be epigenetic in origin, although some tend to be affiliated with specific stratigraphic units. These deposits occur within lithologic units that are rheologically more brittle than the adjacent country rocks.

Figure 15 - Geodynamic Crustal Evolution Model and the Development of Large Zones of Crustal Stretching



From Delor 2003

The Guiana Shield has not endured high erosion rates, thus deposits that formed at relatively shallow levels remain preserved. The age range of the Guiana greenstone belts are correlated with the Birimian System in West Africa, where major gold deposits are associated with shear zones within greenstone belts. Conceptual reconstruction strongly suggests that these continental terrains were geologically linked and developed simultaneously prior to the opening of the Atlantic Ocean approximately 90 million years ago. (refer also Figure 9).

9. Exploration

Exploration work on the Montagne d'Or Prospect prior to the acquisition by Columbus Gold is reviewed by Suter (1999). A brief summary and tabular presentation of the data has been presented in Section 6.

Since acquiring the property in 2011 Columbus Gold has only undertaken diamond drilling on the Montagne d'Or Prospect. The latest drilling programme was completed in 2014, and further diamond drilling is ongoing at the time of this report. Currently available drilling results are reported in Section 10.

10. Drilling

The Montagne d'Or Prospect is currently in an “exploration stage”, with a recent completion (2013 and 2014 drilling) of 58 additional shallow (less that 100m vertically) diamond drillholes distributed along what was known as the mineralised Zone 3 (LFZ, Lower Favourable Zone, similar to but re-modelled as Domain 130 in this study).

Since the inception of exploration by Columbus, a total of 105 drillholes have been completed on the Paul Isnard Concessions, principally testing the Montagne d’Or Prospect. Of these 105 drillholes, only 101 holes are reported; the other four holes have no influence on the resource estimate (note: all holes drilled by Columbus are within the deposit, however, there are three Guyanor holes, hole numbers MO57,MO58,and MO59, which were drilled in 2001 on the Apollon target located to the southeast of the deposit, and drillhole MO60, the only hole drilled in 2007, which is not included in the database as it is a twin of a previous hole).

Earlier drilling completed by Guyanor consists of a total of 56 drillholes (MO9601 to MO9856) totalling 10,916m on from 1996 to 1998. Assays from these drillholes are of lower quality (a characteristic that has been taken into account during resource classification) but are considered as relevant and fit-for-purpose for the resource estimate.

10.1. Guyanor drilling program: 1996 to 1998

From 1996 to 1998 Guyanor completed a total of 56 drillholes (MO9601 to MO9856) totalling 10,916m on the Montagne d’Or Prospect. Drilling was done under contract by Major Drilling Company of Canada. Drill pads and access were prepared using bulldozers and/or excavators; every attempt was made to limit deforestation and for this reason, use of an excavator was preferred for construction of drill pads.

Drilling procedures were to collar each hole with HQ bits (core diameter 6.35cm) and reduce to NQ (core diameter 4.76cm) when hard and not oxidized rock was intersected. Core recovery was routinely measured and recorded for each core run. Core recoveries overall were generally excellent. Major Drilling used Longyear 38 wireline diamond drilling rigs. Drillhole spacing is variable, from 50m to 250m. Drill fences are spaced 100m to 200m apart. The presence of clearly visible, regionally-consistent, and well-defined S_1 fabric allowed the core to be manually oriented in the core boxes, although local variations have, on occasion, caused incorrect orientation. Saprolite was not oriented due to the absence of a clearly defined fabric. Core was placed in plastic core boxes at the drill site, with core markers placed at the start and end of each core run, and boxes securely covered. Core boxes were transported back to camp for detailed logging and core splitting. Core photography was carried out infrequently. All drillhole collars were a surveyed for X, Y, Z coordinates tied to the mine grid shortly after completion so as to provide an accurate location for resource estimation. The mine grid was tied to the X, Y UTM grid and the Z coordinates were shifted 1,000m above mean sea level so that no negative elevations were present within the drillholes. Drillhole location surveys were performed by Guyanor survey crews and external surveyors from SATTAS using TDS equipment.

The first 47 drillholes were surveyed downhole for deviation and deflection by Major Drilling, mainly using acid bottle etch or Pajari /Tropari mechanical instruments. Downhole survey intervals were at 50m. The final eight drillholes were surveyed in with Sperry Sun equipment. The downhole surveys using acid bottle etch and Tropari equipment were criticized within internal Guyanor documents as poorly suited to the task as only dip and no azimuth is recorded. The inaccuracy of the early downhole surveys is considered in mineral resource classification although it should be noted that due to the relatively short length, significant drillhole deviation and deflection at Montagne d’Or are minimal, with deflection of 5° to 10° over 200m typical. Four drillholes were not collar surveyed however the planned hole co-ordinates have been used. Details for the drilling completed by Guyanor from 1996 to 1998 (56 holes in total) are listed in Table 6.

Table 6 – Drillholes (56 in Total) Drilled by Guyanor from 1996 to 1998

Drillhole	Easting	Northing	Elevation	Azimuth	Dip	Depth (m)	Operator	Year
MO9601	173091.8	520520.8	260.89	0	-60	199.8	Guyanor	1996
MO9602	173096.5	520499.6	268.60	0	-60	52.5	Guyanor	1996
MO9603	173051.7	520634.9	220.88	0	-57	271.6	Guyanor	1996
MO9604	173311.3	520611.1	269.68	0	-61	208.6	Guyanor	1996
MO9605	173298.7	520711.7	229.45	0	-61	201.3	Guyanor	1996
MO9606	173706.1	520583.6	273.74	0	-60	199.6	Guyanor	1996
MO9607	173717.2	520708.8	258.57	0	-60	202.6	Guyanor	1996
MO9608	173703.7	520765.8	227.79	0	-60	199.6	Guyanor	1996
MO9609	173703.5	520873.9	180.19	0	-60	199.6	Guyanor	1996
MO9610	173331.9	520908.4	173.50	0	-60	199.6	Guyanor	1996
MO9611	173302.2	520802.4	191.95	0	-63	201.6	Guyanor	1996
MO9612	173014.3	520820.4	163.98	0	-61	201.55	Guyanor	1996
MO9613	172973.3	520738.8	182.53	0	-60	59.7	Guyanor	1996
MO9614	172969.8	520742.4	182.30	358	-61	205.6	Guyanor	1996
MO9615	172763.0	520800.2	186.52	0	-59	193.6	Guyanor	1996
MO9616	172730.8	520700.8	189.25	0	-60	199.6	Guyanor	1996
MO9617	173335.5	521128.7	120.17	0	-60	151.6	Guyanor	1996
MO9618	173312.4	521000.7	151.73	0	-60	156.6	Guyanor	1996
MO9719	174129.7	520732.4	296.82	0	-60	199.5	Guyanor	1997
MO9720	174136.4	520822.6	247.89	0	-60	200	Guyanor	1997
MO9721	173540.1	520678.7	273.57	0	-60	200	Guyanor	1997
MO9722	173534.4	520755.3	237.60	0	-60	199.5	Guyanor	1997
MO9723	172233.0	520519.2	233.78	0	-60	199.5	Guyanor	1997
MO9724	172236.9	520619.4	219.33	0	-60	198.5	Guyanor	1997
MO9725	172766.0	520594.6	228.71	0	-60	199.5	Guyanor	1997
MO9726	174626.3	520774.4	204.39	0	-60	199.5	Guyanor	1997
MO9727	174619.1	520860.7	184.97	0	-60	199.5	Guyanor	1997
MO9728	174225.2	520750.7	300.96	0	-60	199.5	Guyanor	1997
MO9729	172337.5	520852.9	172.76	0	-60	202.6	Guyanor	1997
MO9730	172441.8	520929.5	141.84	0	-60	199.6	Guyanor	1997
MO9731	172897.2	520696.3	208.28	0	-60	199.6	Guyanor	1997
MO9732	172819.0	520493.9	251.18	0	-60	277.6	Guyanor	1997
MO9733	172601.1	520591.9	231.09	0	-60	199.6	Guyanor	1997
MO9734	173522.6	520581.7	321.30	0	-60	22.7	Guyanor	1997
MO9735	173528.4	520578.9	321.39	1	-61	295.6	Guyanor	1997
MO9736	173919.9	520736.5	285.07	0	-60	199.6	Guyanor	1997
MO9737	174222.9	520641.5	298.81	0	-60	271.6	Guyanor	1997
MO9738	174430.2	520753.1	262.39	0	-60	263.9	Guyanor	1997
MO9739	174627.0	520672.8	218.79	0	-60	249.6	Guyanor	1997
MO9740	172969.6	520672.7	227.21	0	-59.5	229.6	Guyanor	1997
MO9741	173051.5	520732.8	177.60	0	-60	196.6	Guyanor	1997
MO9742	173013.2	520736	179.61	358	-60	190.6	Guyanor	1997
MO9743	174806.0	520885	203.38	0	-60	187.6	Guyanor	1997
MO9744	174808.3	520780.7	209.90	0	-60	199.6	Guyanor	1997
MO9745	175107.2	520887.9	193.47	0	-60	193.6	Guyanor	1997

Drillhole	Easting	Northing	Elevation	Azimuth	Dip	Depth (m)	Operator	Year
MO9746	175107.0	520788.2	203.67	0	-60	238.4	Guyanor	1997
MO9747	175479.7	520760.9	184.40	90	-60	120.06	Guyanor	1997
MO9748	175479.7	520760.9	184.40	0	-60	193.6	Guyanor	1997
MO9849	172826.3	520709.3	205.80	0	-60	178.6	Guyanor	1998
MO9850	174331.3	520751.2	296.62	0	-60	150.9	Guyanor	1998
MO9851	174025.5	520755.9	277.46	0	-60	199.6	Guyanor	1998
MO9852	173923.2	520780.7	266.02	0	-60	151.6	Guyanor	1998
MO9853	173834.6	520751.4	257.74	0	-60	190.6	Guyanor	1998
MO9854	172895.1	520592.8	260.41	0	-60	199.6	Guyanor	1998
MO9855	173975.4	520754.1	277.44	0	-60	202.6	Guyanor	1998
MO9856	174075.4	520762.1	270.31	0	-60	211.6	Guyanor	1998

Coordinate System: CSG 167 datum UTM Zone 22

10.2. Columbus drilling programme: 2011 to 2012

From the end of 2011 until August 2012 Columbus drilled 45 drillholes (MO11061 to MO12105) totalling 15721.45m, named as Phase I of Columbus drilling Drilling was done under contract by Performax Drilling of Val d'Or, Quebec, Canada.

Drilling procedures were very similar to those in the previous dill programs. All drillholes were collared using HQ equipment, downsizing to NQ after intersecting solid generally un-oxidized rock. Core recovery at the drill site averages 87.5% in HQ core (saprolite zone) increasing to 99.6% in NQ core (fresh material). Performax used a containerized Longyear 38 drill.

The drill program was designed to provide infill drillholes in known mineralised areas and to continue exploring strike extensions of the mineralisation. Drillhole spacing in the central part of the mineralised zone varies between about 35m and 75m and 100m to 200m on the extremities.

The drillholes are, in general, inclined moderately to the north whereas the mineralisation dips at 65° to the south. Therefore, the drillholes intercepts do not represent true thickness but true thickness averages approximately 75% of the intercept distance. Down-hole surveying of the drillholes was performed by the drill crew using a Reflex instrument. In some cases the Reflex instrument did not function correctly. For these holes an average was taken of measurements from 10 holes and these values were used where data could not be measured. Given that the deviation in all of the drillholes is very consistent this method is considered acceptable with minimal risk to the resource estimate.

A private contractor was hired to undertake surveying of all collars for holes MO1161 to MO11105 using CGS1967 datum. All drillhole collars were surveyed using GPS Total Station equipment. All previous drillhole coordinates were converted to CGS 1967 format, the 1,000m elevation addition removed that was present in the earlier data and four older drill collars checked by re-surveying.

Details for the drilling completed by Columbus from 2011 to 2012 (45 in total) are provided in Table 7.

Table 7 - Drillholes (45 in total) completed by Columbus (Phase 1) in 2011 and 2012

Drillhole	Easting	Northing	Elevation	Azimuth	Dip	Depth (m)	Operator	Year
MO11061	173870.5	520648.2	299.21	0	-70	350	Columbus	2011
MO11062	173984.3	520647.0	318.16	0	-70	399.3	Columbus	2011
MO11063	174072.9	520652.0	323.75	2	-60	378.5	Columbus	2011

Drilhole	Easting	Northing	Elevation	Azimuth	Dip	Depth (m)	Operator	Year
MO11064	172972.3	520539.8	287.46	2	-60	419	Columbus	2011
MO11065	172891.8	520514.1	272.39	0	-60	356	Columbus	2011
MO12066	173770.8	520701.9	260.19	0	-60	329	Columbus	2012
MO12067	173637.9	520647.7	267.48	0	-60	361	Columbus	2012
MO12068	173441.4	520625.4	302.83	0	-60	380	Columbus	2012
MO12069	172745.1	520503.5	256.82	0	-60	257	Columbus	2012
MO12070	173025.8	520633.6	231.30	0	-60	302	Columbus	2012
MO12071	173206.0	520874.6	177.80	180	-50	308	Columbus	2012
MO12072	173057.3	520786.8	182.46	180	-50	350	Columbus	2012
MO12073	172615.6	520814.2	197.01	180	-50	440	Columbus	2012
MO12074	174676.1	520781.4	214.08	0	-60	275	Columbus	2012
MO12075	174516.8	520766.1	220.82	0	-60	251	Columbus	2012
MO12076	174435.1	520938.4	197.49	180	-50	322	Columbus	2012
MO12077	174641.4	520982.6	175.94	180	-50	429	Columbus	2012
MO12078	173868.8	520909.9	204.46	180	-50	411	Columbus	2012
MO12079	173647.8	520914.1	180.94	180	-50	375	Columbus	2012
MO12080	173438.0	520852.2	203.50	180	-50	387	Columbus	2012
MO12081	174275.9	520736.9	306.87	0	-60	345	Columbus	2012
MO12082	174168.4	520723.3	307.91	0	-60	351	Columbus	2012
MO12083	174377.1	520732.0	282.60	0	-60	317	Columbus	2012
MO12084	174383.6	520739.2	282.61	180	-50	152	Columbus	2012
MO12085	174131.7	520647.2	332.27	0	-60	425	Columbus	2012
MO12086	174177.0	520640.8	324.31	0	-60	425	Columbus	2012
MO12087	173436.6	520764.9	239.73	0	-60	302	Columbus	2012
MO12088	173485.4	520764.4	247.61	0	-60	299	Columbus	2012
MO12089	173586.3	520732.8	244.44	0	-60	299	Columbus	2012
MO12090	173303.8	520552.2	287.75	0	-60	409	Columbus	2012
MO12091	173220.9	520589.5	273.50	0	-60	400	Columbus	2012
MO12092	173022.7	520529.7	286.08	0	-60	374	Columbus	2012
MO12093	172924.8	520529.8	281.68	0	-60	448	Columbus	2012
MO12094	173101.5	520495.5	269.14	0	-60	464	Columbus	2012
MO12095	172845.4	520562.1	264.26	0	-60	365	Columbus	2012
MO12096	172604.5	520508.4	237.74	180	-60	119	Columbus	2012
MO12097	172603.7	520503.0	238.06	0	-60	422	Columbus	2012
MO12098	172636.2	520437.3	239.94	0	-60	389	Columbus	2012
MO12099	172423.6	520558.3	301.23	0	-60	221	Columbus	2012
MO12100	173169.6	520544.9	282.64	0	-60	381	Columbus	2012
MO12101	173261.1	520557.3	283.30	0	-50	350	Columbus	2012
MO12102	173363.8	520634.2	274.71	0	-60	344	Columbus	2012
MO12103	173394.2	520670.0	272.00	0	-60	281	Columbus	2012
MO12104	173490.1	520704.8	273.95	0	-70	346.65	Columbus	2012
MO12105	173587.3	520673.7	273.08	0	-60	413	Columbus	2012

Coordinate System: CSG 167 datum UTM Zone 22

10.3. Columbus drilling programme: 2013 to 2014

From early 2013 until June 2014 Columbus drilled a total of 56 drillholes (MO13106 to MO14160) totalling 7,185.0m. This corresponds to the Phase II of Columbus drilling, which is currently in extension through an infill drilling campaign. Drilling was done under contract by Performax Drilling of Val d'Or, Quebec, Canada. Drilling procedures were the same to those in the previous programs. All drillholes were collared using HQ equipment downsizing to NQ after intersecting solid generally un-oxidized rock. Core recovery at the drill site averages 87.5% for HQ drillholes in the saprolite zone and 99.6% in NQ drillholes in fresh material. Details of the most recent drillholes completed by Columbus in 2013 and 2014 are presented in Table 8.

A plan view showing the drillhole locations (all campaigns) is presented in Figure 16.

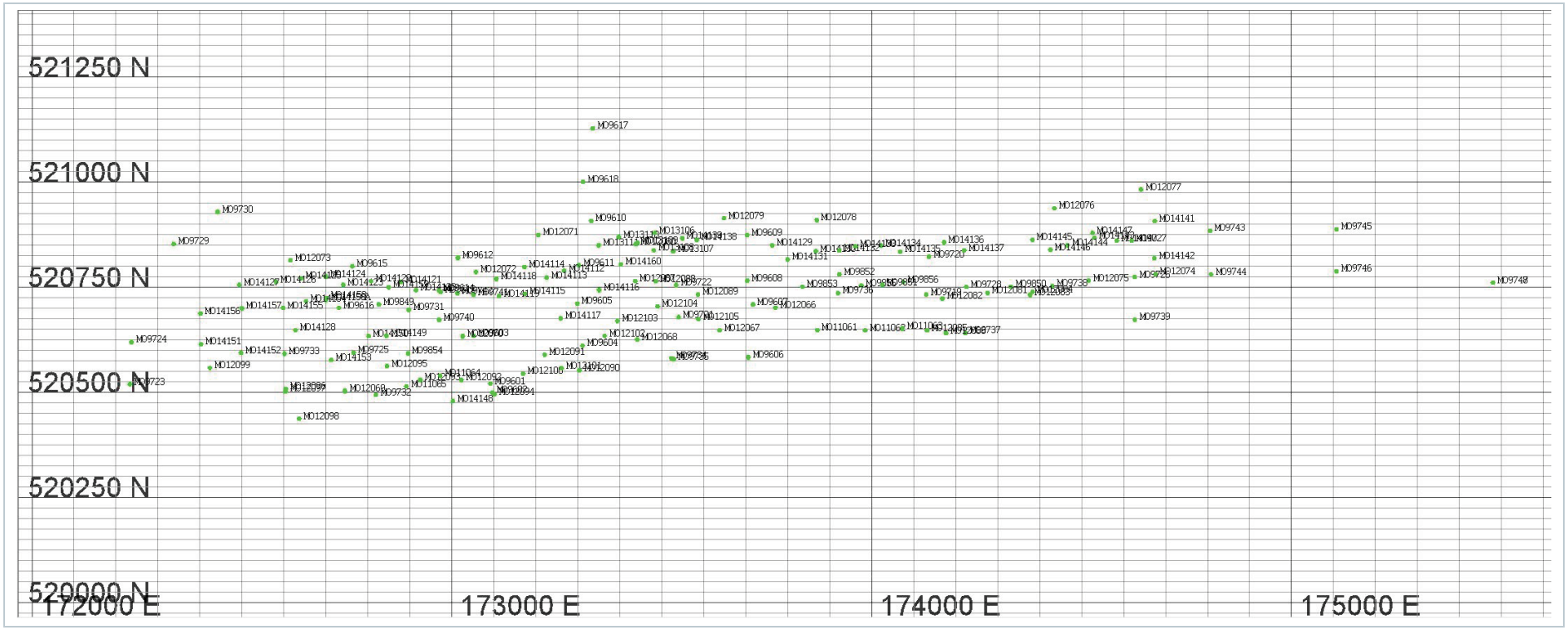
Table 8 - Drillholes (56 in total) completed by Columbus (Phase 2) in 2013 and 2014.

Drilhole	Easting	Northing	Elevation	Azimuth	Dip	Depth (m)	Operator	Year
MO13106	173483.2	520879.1	206.19	0	-53	92	Columbus	2013
MO13107	173527.2	520835.5	212.3	0	-60	152	Columbus	2013
MO13108	173481.1	520838.3	220.01	0	-60	140	Columbus	2013
MO13109	173442.3	520855.8	204.49	0	-60	122	Columbus	2013
MO13110	173397.5	520869.2	196.36	0	-60	110	Columbus	2013
MO13111	173349.6	520850	194.73	0	-60	86	Columbus	2013
MO14112	173267.4	520789.3	207.22	0	-60	108.7	Columbus	2014
MO14113	173225.5	520772.2	212.43	0	-60	118	Columbus	2014
MO14114	173173	520798.6	195.4	0	-60	88.6	Columbus	2014
MO14115	173174.1	520734.8	218.22	0	-60	167	Columbus	2014
MO14116	173350.6	520743.7	231.55	0	-60	149	Columbus	2014
MO14117	173259.3	520676.4	248.33	0	-60	161	Columbus	2014
MO14118	173106	520770.2	190.62	0	-60	74	Columbus	2014
MO14119	173112.5	520728.9	192.62	0	-60	143	Columbus	2014
MO14120	172914.5	520743.2	180.01	0	-60	122	Columbus	2014
MO14121	172879	520762.7	179.19	0	-60	110.5	Columbus	2014
MO14122	172807.3	520764.8	190.27	0	-60	111.6	Columbus	2014
MO14123	172741	520755.7	176.52	0	-60	104	Columbus	2014
MO14124	172700	520775.4	180.08	0	-60	101	Columbus	2014
MO14125	172641	520771.6	198.86	0	-60	124	Columbus	2014
MO14126	172580.9	520762.2	208.78	0	-60	122	Columbus	2014
MO14127	172493.6	520755.4	211.74	0	-60	98	Columbus	2014
MO14128	172627.5	520647.9	207.78	0	-60	123	Columbus	2014
MO14129	173763	520849.9	196.8	0	-60	122	Columbus	2014
MO14130	173866.8	520835.8	220.483	0	-60	98	Columbus	2014
MO14131	173800	520816.2	212.269	0	-60	98	Columbus	2014
MO14132	173923	520837.5	236.469	0	-60	107	Columbus	2014
MO14133	173961.5	520847.2	244.321	0	-60	121.5	Columbus	2014
MO14134	174021.7	520848.8	232.46	0	-60	111	Columbus	2014
MO14135	174067.9	520834.6	232.49	0	-60	131	Columbus	2014
MO14136	174172.3	520857.1	237.519	0	-60	101	Columbus	2014
MO14137	174220.3	520837.8	249.248	0	-60	164	Columbus	2014
MO14138	173583.5	520862.9	203.47	0	-60	116	Columbus	2014

Drilhole	Easting	Northing	Elevation	Azimuth	Dip	Depth (m)	Operator	Year
MO14139	173548.8	520866.8	194.67	0	-60	95	Columbus	2014
MO14140	174583.6	520861	181.409	0	-60	134	Columbus	2014
MO14141	174674.3	520907.6	195.605	0	-60	119	Columbus	2014
MO14142	174673.2	520818.9	208.015	0	-60	179	Columbus	2014
MO14143	174530.5	520867.2	195.634	0	-60	169	Columbus	2014
MO14144	174466.3	520850.3	214.843	0	-60	158	Columbus	2014
MO14145	174382.6	520863	226.508	0	-60	131	Columbus	2014
MO14146	174425.7	520839.1	229.992	0	-60	155	Columbus	2014
MO14147	174525.9	520878.9	193.332	0	-60	101	Columbus	2014
MO14148	173002.2	520478.8	296.2	0	-60	150.8	Columbus	2014
MO14149	172844	520634.9	243.1	0	-60	164	Columbus	2014
MO14150	172801.6	520633.7	242	0	-60	161	Columbus	2014
MO14151	172402.4	520614.7	276.8	0	-60	125	Columbus	2014
MO14152	172497.7	520593.9	274.7	0	-60	161	Columbus	2014
MO14153	172712.7	520577	222.4	0	-53	152	Columbus	2014
MO14154	172652.8	520716.9	200	0	-60	155	Columbus	2014
MO14155	172598.1	520701	213.1	0	-60	173	Columbus	2014
MO14156	172401.2	520687.5	237.2	0	-60	149	Columbus	2014
MO14157	172499.8	520700.1	229.5	0	-60	185	Columbus	2014
MO14158	172701.3	520724.5	181.1	0	-60	153	Columbus	2014
MO14158A	172700	520720	185	0	-60	22.5	Columbus	2014
MO14159	172849.4	520750.1	188.9	0	-60	130	Columbus	2014
MO14160	173402.2	520804.8	217.7	0	-60	165.8	Columbus	2014

Coordinate System: CSG 167 datum UTM Zone 22

Figure 16 - Plan view showing location of the drillholes used in the resource estimate



10.4. Interpretation of drillhole results

The drillholes have intercepted multiple wide zones of anomalous (>0.25g/t Au) gold mineralisation, mainly hosted by felsic volcanic tuffs and to a lesser degree by mafic volcanic rocks (particularly at deeper levels in the stratigraphy). The zones vary from a few meters to over 100m in true width.

Within the wider mineralised zones occur narrower intercepts of higher grade gold, including 83.36g/t Au over 1.0m in Hole MO-12-92, 63.34g/t Au over 1.0m in Hole MO-12-94 and 58.30g/t Au over 1.0m in Hole MO12-92. Of the earlier drilling, only two drillholes, MO-12-84 and MO-12-96, failed to encounter mineralisation of significance.

Drillholes generally dip towards the north to intersect the mineralised zones dipping steeply towards the south (Figure 17). However, a number of scissor holes (a total of 8 drillholes along strike) dipping towards the south were also drilled; these confirm the general southward dip of the mineralisation and provide additional information on the thickness of the zones (Figure 18).

Figure 17 - Isometric view of drillholes generally dipping toward the north to intersect the south dipping mineralised Domains

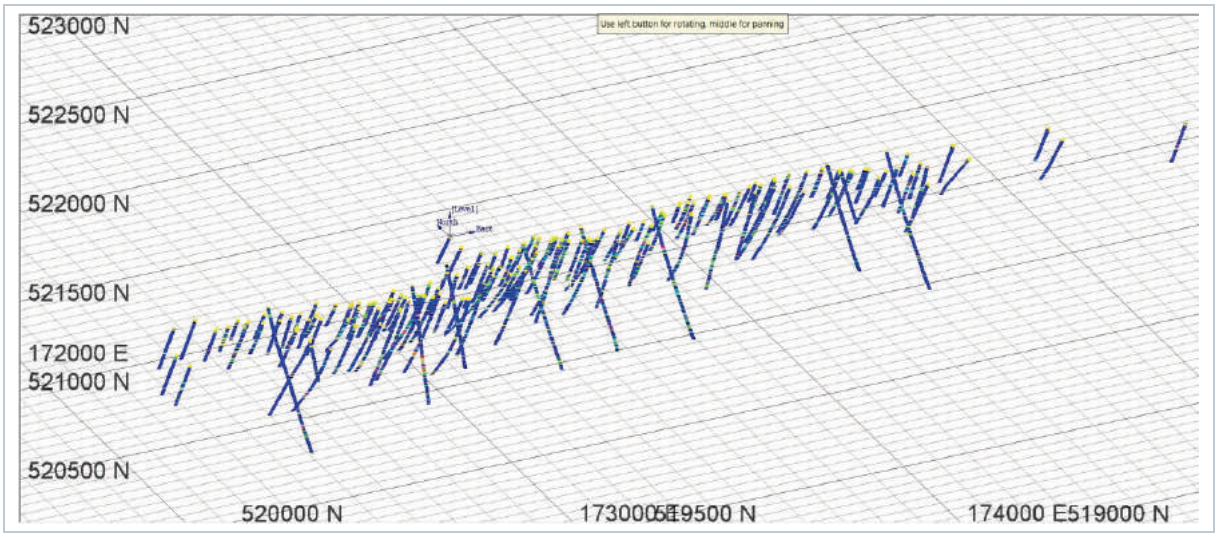
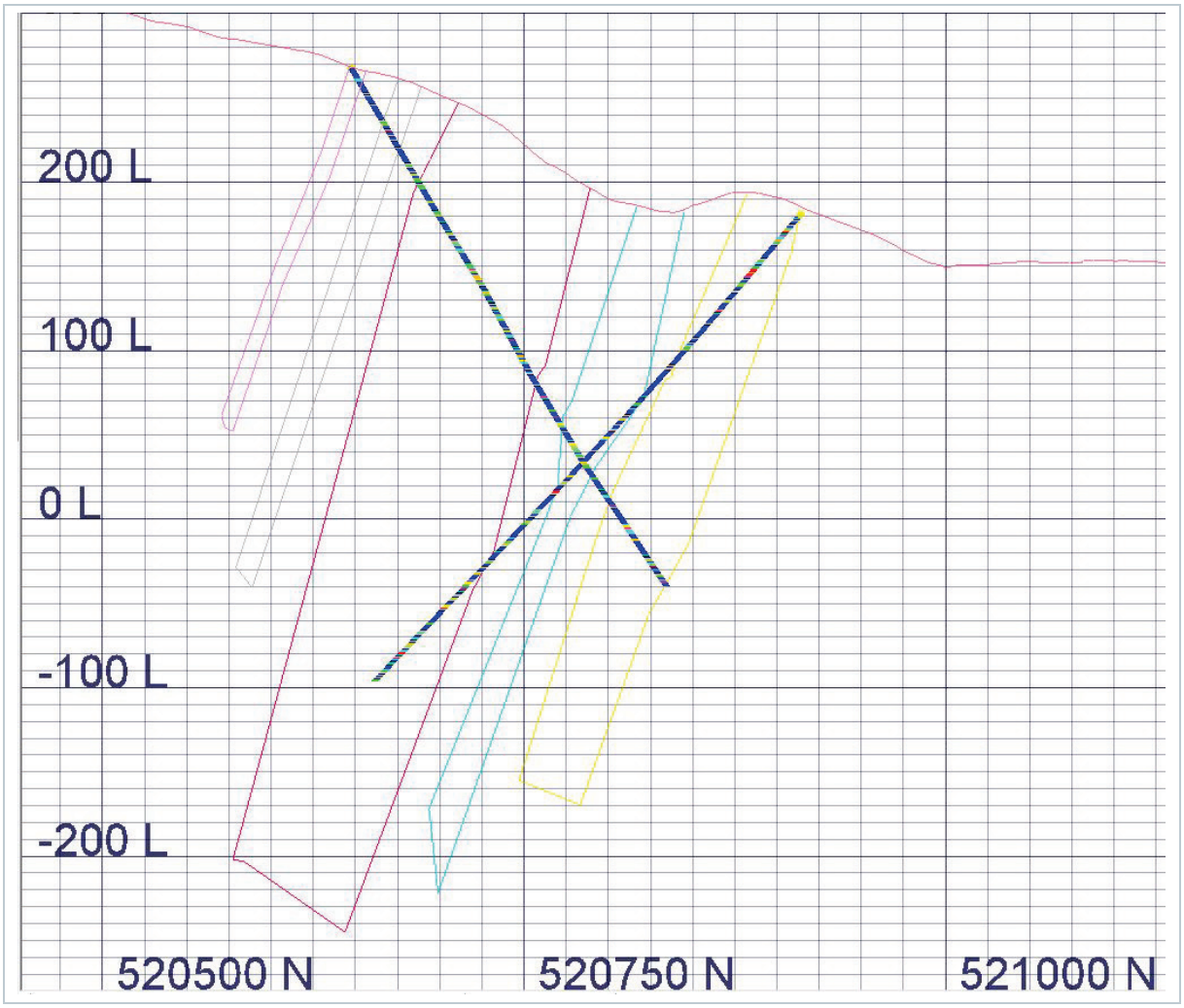


Figure 18 - Example of a Scissor Hole (MD12079) on Section 173,640mE (corridor 40m wide)



10.5. Conclusions

Columbus provided all drilling data to Coffey in digital form. The database used for the current resource estimation was finalized by Coffey on 23 June 2014. It includes a total of 159 drillholes, all available drillhole data from MO9601 up to drillhole MO14160. Drillholes MO14161 and MO14162 were excluded from the database as they did not have surveyed collar data at the time of the study. Drillhole MO9747 and drillhole MO14158A were not used as they do not have assay data. A total of 157 drillholes was thus available for use in the study.

The project database contains a total of 32,184 gold assay intervals (excluding channel samples) of which the majority has an average sample length of 1.04m and return assay values of between trace and a maximum of 163g/t Au. A total of 59 raw assay values with an average sample length of 0.99m are above 20g/t Au and 177 raw assay values with an average sample length of 1.0m are above 10g/t Au. However there are a total of 757 samples with a length of over 2m (of which 48 samples have a length of over 3m) but with an average assay value of 0.1g/t Au.

The database also includes down-hole geology (lithology code) and down-hole survey data. Coffey is of the opinion that the Columbus drilling operations were conducted in a professional manner, the core was handled, logged, and sampled by professional geologists, and the database is of sufficient quality (see data verification in Section 12.0) to be suitable ("fit for purpose") for support of a NI-43-101 compliant mineral resource estimation.

There did not appear to be any drilling, sampling, or recovery factors that could materially affect the accuracy or reliability of the results however the Guyanor drillholes have been considered in mineral resource classification.

11. Sample preparation, analyses and security

The information presented in this section concerning pre-2011 sampling and analysis has been largely based on the SRK report, Stryhas, B (2012) with additional information as specified for updated drilling data provided by Columbus Gold.

11.1. Historical methods

Limited information is available on the historical transport, sampling and analysis of the Guyanor drillholes. With regard to sampling methods and procedures employed by Guyanor during the 1996/1998 drilling campaigns, Coffey relies on the reports published by Stryhas (2012) and has carried out its own checks where possible (refer Section 11.3).

The diamond drill core was transported from the drill site to the Boeuf Mort camp where all geologic logging and sampling was conducted. Sample intervals were marked in advance by the project geologists. The saprolite core was halved with a knife, while fresh rock core was sawn with a powered diamond saw. The original assay lengths range from 0.1 m to 4.3 m with an average of 1.0m. A total of 10,693 samples were taken. The presence of dispersed zones of very narrow sulphide bands, in some cases, forced sample intervals that did not always conform to the actual lithologic breaks. The sawn half-core was bagged, labelled on site, and sent out for assaying. Sample bags were routinely placed in plastic rice bags and sealed to prevent tampering between the campsite and the laboratory. The remaining half core was returned to the core box and stored for future reference.

Rock quality description (RQD) measurements were completed on selected intervals in seven drillholes during the 1998 campaign. Magnetic susceptibility measurements were completed for 18 drillholes during this campaign (MO9601 to MO9618).

Bulk density measurements on drill core were not performed on a regular basis. The densities used for previous resource estimations utilised bulk densities taken from equivalent or nominal rock types (not described).

The diamond core and channel samples collected in the Montagne d'Or prospect area during the 1996/1998 drilling campaign were dispatched to six separate laboratories for sample size reduction, homogenization, and assay determination. Analytical methodologies utilised were typically fire assay with an atomic absorption finish. A few samples were assayed by fire assay with a gravimetric finish. These are appropriate and standard methodologies for gold analysis. There is no documentation in the project files related to the certification of any of the laboratories used to analyse the Montagne d'Or Prospect samples. It was not industry standard of the time to undergo certification procedures.

The QA/QC procedures for the Montagne d'Or Prospect analytical work prior to 1998 utilised check assays performed on quarter core, the remaining half of re-sawn split half core. Most quarter-core samples were collected from barren core (<0.05g/t Au) and used for blank material. Since the samples were not extracted from the same pulp, the samples are more correctly termed field duplicates. No data are available for assay standards included with any of the drill or channel sample analyses. Internal check assay information is provided for five of the six laboratories that were used for gold assaying.

RSG (2004) provided a review of the QA/QC results obtained during the history of the drilling and they concluded the following: the results of the RSG Global statistical assessment of the quality control data suggest that the SGS Cayenne and CanTech laboratories were producing assay results of an acceptable precision and unknown accuracy, but that the SGS France and Cone Colorado laboratories were not producing assays of an acceptable precision. The various coarse reject check assaying programs indicate that there are serious problem at all or some of the laboratories, and that precision levels from all the check assay programs are unacceptable. Correlation between assay pairs is very poor with significant bias shown in some instances. The accuracy of the data produced by each laboratory cannot be assessed without standard reference assay data, and this is a material flaw in the check assay programs completed to that date.

In 2007 Golden Star conducted a modern QAQC analysis during a re-assay program of the historical drill core at the Paul Isnard deposit. This consisted of re-sampling of the core from a wide distribution of drillholes, insertion of blanks and standards, and submitting all these to an accredited laboratory. The laboratory employed industry standard sample preparation and the techniques of analyses were appropriate for the level of gold mineralisation. The results of the QAQC verified the credibility of the 2007 re-assay results. This is discussed further in section 11.3.

11.2. Columbus Gold drill program

The following description of sample preparation and core handling protocols applies to all drilling carried out by Columbus to date on the Montagne d'Or Prospect. The next sections describe the 2011 and 2012 logging and sampling procedures, which were much upgraded for the 2013 and 2014 programme (geotechnical logging, core photography, air transport to Cayenne, use of Geotic software, assays on 50g split by FA AA, assays above 5g/t Au re-assayed by gravimetrics, refer also Section 12). Program details on the current logging, sampling and QAQC protocols were discussed in detail with Columbus staff during the site visits by Coffey and their systematic application with respect to the project was confirmed.

11.2.1. Core logging and sampling

Drill core is placed in plastic trays at the drill site by the drill crew. Drillers either transport the core to the end of the road for pickup by Columbus personnel or directly to the core shack in the Citron Camp.

Once in the camp the core boxes are opened and placed in order on logging racks within the core logging facility (Figure 19). If space is not available then the core is stored in core racks adjacent to the logging facility.

Figure 19 – Core Logging Facility at the Citron Exploration Camp

The drill core is washed to remove any dirt or grease and reconstituted. The core is measured to ensure that there are markers every meter. Geotechnical work is then undertaken, measuring recovery and RQD.

The core is descriptively logged and marked for sampling by Columbus geologists. Logging and sampling information is entered into a computer using Excel software. Selected intervals of core are photographed however the entire drillhole is not systematically photographed.

After logging the core is prepared for sampling. A line is drawn down the core and the cutter uses this as a guide. The entire drillhole is then cut. A Columbus Gold geologist does the actual sampling. The core is sampled at 1 meter intervals using the measuring blocks prepared upon initial receipt of the drill core as a guide. The entire drillhole is sampled at 1m intervals. Half of the drill core is placed in a plastic sample bag while the other half is retained din the core box for future reference. Saprolite material is cut with a knife and half placed in a textile bag for assay and the other half returned to the core box The samples and sample bags are numbered sequentially in advance allowing for the insertion standard reference samples, duplicates and blanks. The plastic sample bags are placed in larger rice bags and sealed for shipping. The sample bags are then sent by either road of air transport to Cayenne. The sample bags are then sent by truck transport to Filab in Paramaribo, Surinam for preparation and analyses.

All the core from Columbus Gold's drilling is stored in covered core racks at the Citron exploration camp (Figure 20).

Figure 20 – Core Racks at the Citron Exploration Camp

Coffey recommends that RQD be done on a routine basis prior to logging and sampling of the drill core. It is also recommended by Coffey that the core be photographed prior to splitting. This can be done either wet or dry although textures are usually more evident with wet core.

11.2.2. Density measurements

Columbus Gold measures the bulk density of representative samples of the various rocks types and not the bulk density in each drillhole. They used a conventional bulk density scale with a basket suspended below the scale to allow immersion in water. Samples are not coated in paraffin wax, however, the core was observed to be generally solid with very little pores. Saprolite was wrapped in cellophane.

The following measurement methodology was employed:

- Weigh the sample to determine the dry mass.
- Place the sample in a basket and weigh it, suspended from a balance, in (under) water. Subtract the weight of the basket in (under) water, to determine the mass of the sample in water.
- The relative dry bulk density, a unit-less ratio, is calculated as the dry mass of the sample in air divided by the difference in the mass of the sample in air and the mass of the sample in water.

The scale is zeroed out before each use and the weight of the basket holding the core is repeatedly measured. Bulk Density measurements were recorded for 11 different rock units (Table 9).

Table 9 – Listing of Montagne d'Or Prospect Dry Rock Density Measurements

Paul Isnard Project, Montagne d'Or Prospect Density Summary		
Lithological unit	**Rock Density (t/m^3)**	**Number of Samples**
Felsic tuffs (FT)	2.93	326
Felsic silicified tuffs (FTSIL)	2.81	410
Hyperchloritic facies (HYPCHL)	3.18	60
Mafic dikes (MD)	3.01	102
Mafic volcanics (MV)	3.06	121
Saprolite-Saprock (SAP)	1.90	151

Water density is assumed to be $1.0t/m^3$ with no adjustment made for changes in water temperature. Since all measurements were performed indoor in normal air temperatures, the actual water density should range between $0.999t/m^3$ at 15° C to $0.997t/m^3$ at 25°C therefore assuming a value of $1.0t/m^3$ for water density will not introduce a significant bias in the estimate and is to industry standards.

Coffey recommends that a test program be conducted to evaluate the accuracy and precision of the bulk density measurements using known reference material. As part of the test program, Columbus should experiment with different methods to seal the core, for example using paraffin wax. A standard reference material with a known bulk density should also be employed as a regular QAQC check on the density measurements.

As of November 23, 2012, Columbus had made a total of 1,170 bulk density measurements on Montagne d'Or drill core.

11.2.3. Sample preparation and analysis

Columbus staff log and sample drill core but do not carry out any form of sample preparation (crushing/pulverising) or analytical work on project samples. All project analytical work including sample preparation and analytical work is completed by FILAB at their laboratory in Paramaribo, Surinam.

FILAB established for several years a system of Quality Management and Safety to meet customer requirements (standards ISO17025 and ISO9001). FILAB is accredited by the DKD (now the DAkkS) and the SAFRAN Group and approved by DF control PMUC. The following description is sourced from documentation provided by FILAB.

After samples are received at the laboratory, then weighed and dried in furnaces at a temperature <130°C. They are then crushed and ground to a 70% <2.5mm. From this grind a 300g to 400g split is pulverized to 90% <100µm. All equipment is cleaned by air after the processing of each sample.

Gold concentrations for the Columbus program are analysed by FILAB using a 30g sample split and fire assay pre-concentration methods followed by an Atomic Absorption Spectroscopy finish (FA-AAS). The detection limit for this method is 0.01ppm Au.

Gravimetric analysis was conducted on samples above a 5g/t Au value for the 2013 and 2014 drilling programme (the threshold is not reported for the earlier drilling and cannot be verified as personnel involved is no longer on site) and results from the gravimetric analysis were prioritised over FA in the database.

ICP analysis for up to 40 elements but routinely only for Ag and Cu are done using Aqua Regia digestion on a 0.25g subsample.

FILAB routinely inserts blanks and certified reference materials (standards) into each batch of samples as an internal check.

11.3. QAQC

11.3.1. Guyanor QAQC

The QA/QC procedures for the Montagne d'Or Prospect analytical work prior to 1998 utilised check assays performed on quarter core, the remaining half of re-sawn split half core. Most quarter-core samples were collected from barren core (<0.05g/t Au) and used for blank material. Since the samples were not extracted from the same pulp, the samples are more correctly termed field duplicates. The assay data provided by Columbus for the Guyanor drilling contains QAQC data from 1999 and 2001. This contains submitted standards, blanks, coarse reject checks, pulp duplicates, and field duplicates. However, the majority of this data applies to soil sampling and rock chips from various prospects, with only nine standards used in assaying of the first three drill holes in Paul Isnard.

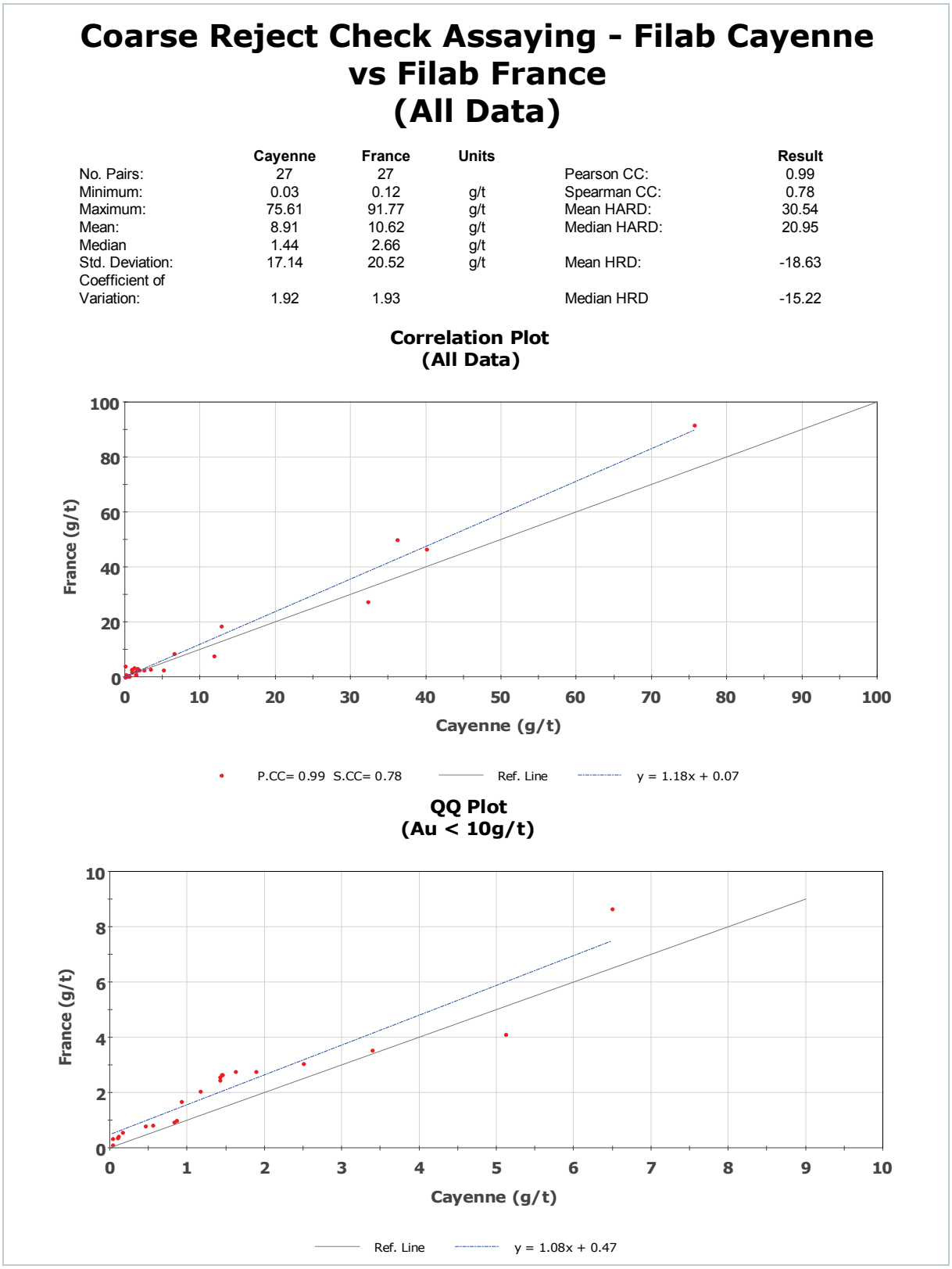
The standards used were derived from Carlin type gold ore prepared by Chemex Labs. The expected values and standard deviations were obtained from Rio Tinto. All standards returned satisfactory results. It appears that industry standard QAQC procedures were used by Guyanor in 1999-2001. However, no data are available for assay standards included with the remaining earlier Guyanor drill or channel sample analyses (note: it appears no standards, nor blanks, were inserted into the sample sequence). Internal check assay information is provided for five of the six laboratories that were used for gold analysis.

RSG (2004) provided a review of the QA/QC results obtained during the history of the drilling and they concluded the following:

The results of the RSG Global statistical assessment of the quality control data of the Guyanor drillholes suggest that there are serious problem at all or some of the historic laboratories and that precision levels from all check assay programs were not acceptable. Correlation between assay pairs was very poor with significant bias shown in some instances. Coffey has reviewed coarse reject check assay data between Filab Cayenne and Filab Chenôve, France (Figure 21). Both laboratories assayed by fire assay with an AAS finish. The Chenôve laboratory used a 30g charge whilst the Cayenne laboratory used a 50g charge. Despite having a high Pearson correlation coefficient (0.99) the statistics for each data set show that assays from the French laboratory have a much higher average grade than those from Cayenne. This is highlighted in the Q-Q plot in Figure 21. Using a 30% precision limit, as is typical for field duplicate data, 40.74% of the data pairs fall outside of the acceptable precision limits set.

Coffey agrees with the RSG comment that "The accuracy of the data produced by each laboratory cannot be assessed without standard reference assay data, and this is a flaw in the check assay programs completed to date."

Figure 21 - Guyanor Coarse Reject check assaying, Filab Cayenne vs Filab France



In 2007, Golden Star conducted a modern QA/QC analysis during a re-assay program of the historical drillcore at the Paul Isnard deposit. This consisted of re-sampling a wide distributing of the core, insertion of blanks and standards, and submitting all these to an accredited laboratory. The laboratory employed industry standard sample preparation and the techniques of analyses were appropriate for the level of gold mineralisation. The results of the QA/QC verified the credibility of the 2007 re-assay results.

Coffey has reanalysed the 2007 re-sampling data. Initial comparison of the original and re-sampled assays used the average of primary and repeat assays for the re-sampled data. Coffey has not be able to ascertain if the same method was applied to the original data. Comparison of averages is not considered a legitimate technique in this case. Also, the MDA audit of the historic data noted many transcription errors in the assay data.

Both the original and re-sampling samples are recorded as having been assayed by fire assay with AAS finish, with some samples having a gravimetric finish. Coffey has not been successful in assigning an assay method to every sample. The Au_final field from the MDA audited database prioritises gravimetric finish over FA/AAS. This value has been used to inform the “Original Au” field, and the same technique applied to the 2007 re-sampled results in an attempt to provide equivalent data. There is still a possible influence from differing sample support with the original samples being from half core and the resamples being quarter core.

Comparison of the re-sampled assays with the original assays shows a very low Pearson Correlation Coefficient of 0.42. Even allowing a 30% precision tolerance, as is appropriate for field duplicates, only 53.59% of data pairs are within precision limits (Figure 22). The mean grade of the original samples is 0.88g/t Au compared with a mean grade of 1.37g/t Au for the resampled data. This is clearly seen in the QQ-plot where the resampled grades are biased high above approximately 2g/t Au. The correlation plot shows a wide scatter, which is typical for gold. There are many data pairs in which one sample has significant gold values and the other doesn’t, which is typical of nuggety or non-disseminated gold ores. However there are many high grade resampled assays which have an original assay <0.5g/t (and often much less than this value), suggesting there might have been some bias in the re-sampling i.e. that visibly high grade sections of core might have been preferentially selected over less mineralised sections, particularly if the mineralisation occurs in narrow zones.

A log/log correlation plot (Figure 23) shows scatter but not overall bias. Coffey consider the Guyanor assay data to be “fit for purpose” for an Inferred Resource.

SRK have repeatedly recommended all Guyanor drilling be re-sampled. However, a combination of core being mixed up upon return to core trays during the 2007 re-sampling programme, and oxidation caused by exposure to high humidity, has resulted in the remnant Guyanor core no longer being fit for re-sampling.

Coffey recommends that Columbus aim to replace all Guyanor drill holes with new drill holes sampled with modern QAQC protocols to allow confidence in the project to be increased. Continued use of the Guyanor assay data in future resource estimates will keep the classification category as Inferred Mineral Resources.

Figure 22 - Analysis of original vs. re-sampled Guyanor assays

Summary (All Data)

	Au_final_original	Au_final	Units		Result
No. Pairs:	724	724		Pearson CC:	0.419
Minimum:	0.001	0.000	g/t	Spearman CC:	0.763
Maximum:	61.000	50.134	g/t	Mean HARD:	35.125
Mean:	0.878	1.366	g/t	Median HARD:	25.835
Median	0.096	0.116	g/t		
Std. Deviation:	3.434	4.623	g/t	Mean HRD:	-7.298
Coefficient of Variation:	3.909	3.384		Median HRD	-6.769

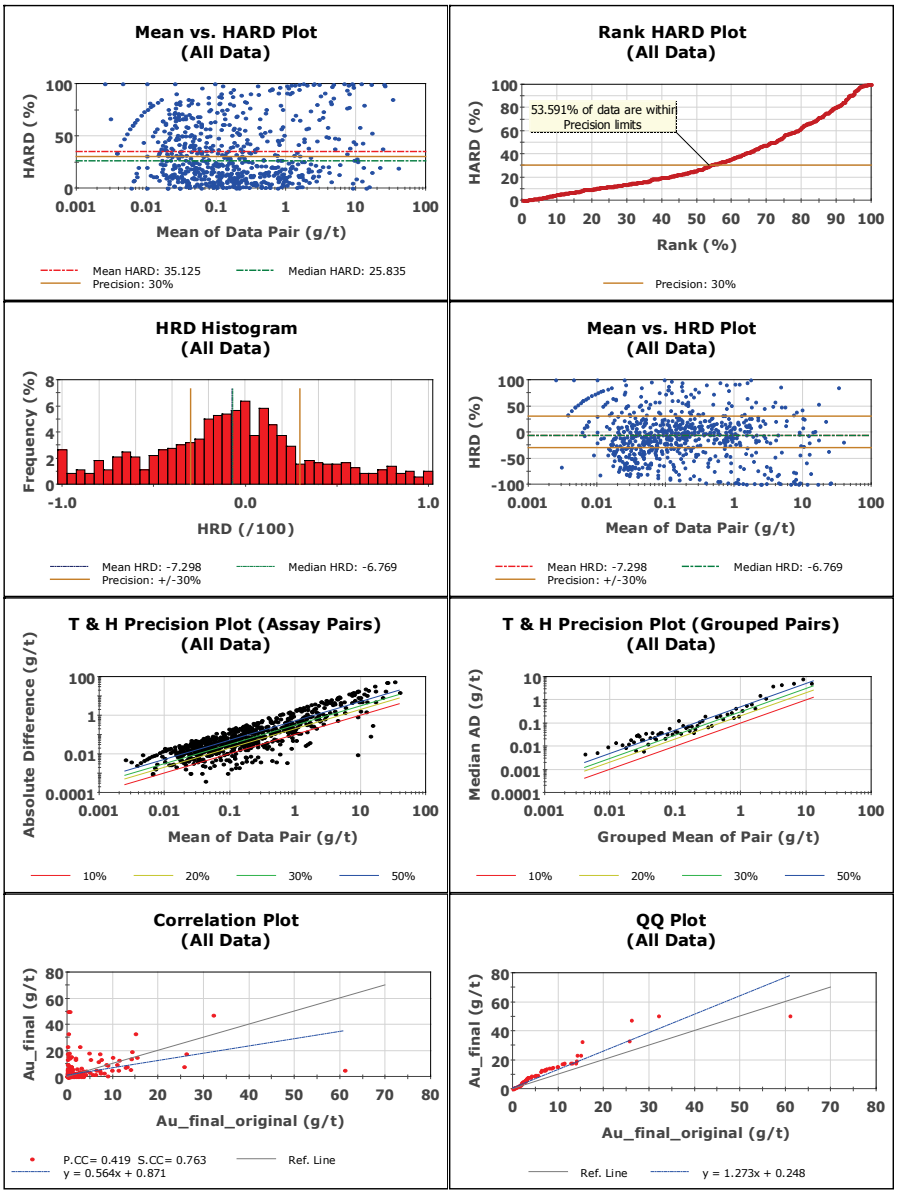


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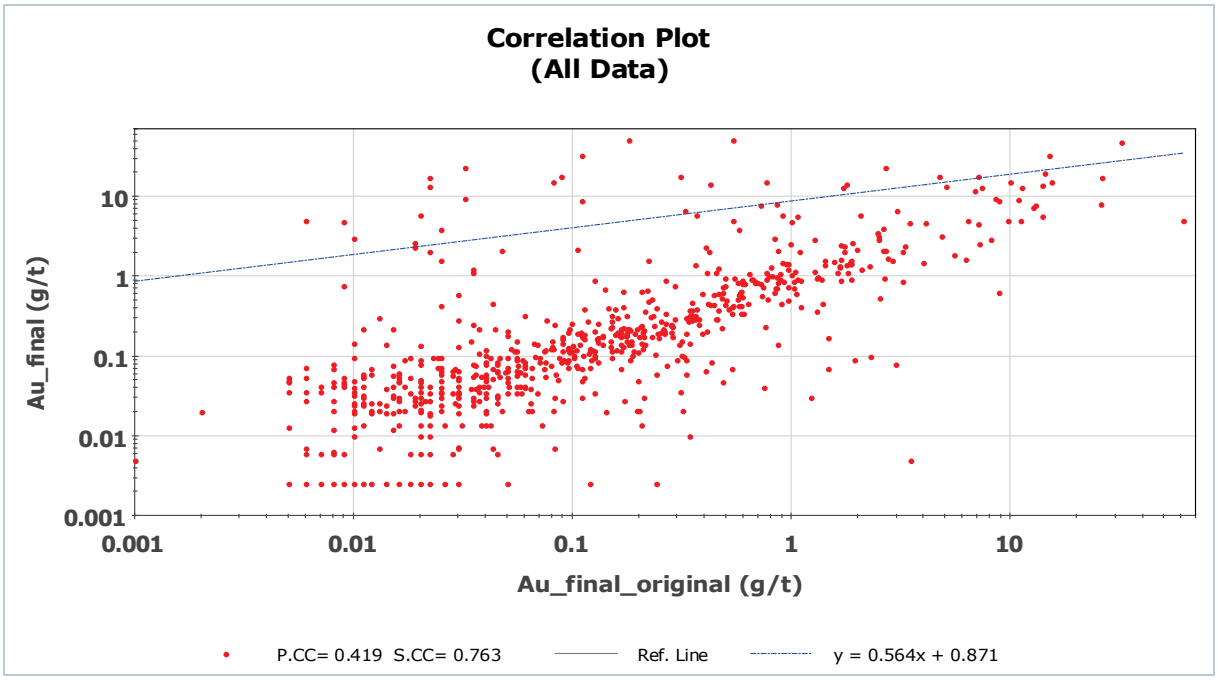
Figure 23 – Log/Log correlation plot of original vs. re-sampled Guyanor assays



11.3.2. Columbus Phases 1 and 2 QAQC

Drill core sampling carried out by Columbus Gold during the Phase 1 and Phase 2 drilling programs on the Montagne d'Or Prospect were subject to a QA-QC program administered by the company. This included submissions of blank samples, use of certified reference materials, core duplicates and analysis of pulp reject and check sample splits at a third party commercial laboratory. Results of both the in-house and laboratory quality control and assurance analyses were monitored by Columbus Gold on an on-going basis during the course of the project.

The composition of the QAQC database is given in Table 10. The rate of insertion of standards has improved from 1 in 49 in Phase 1 to a much more acceptable 1 in 19.

Table 10 - Composition of Columbus Phase 1 and Phase 2 QAQC database

Columbus drill programme	# assays	Standards		Blanks		Field Duplicates		Pulp Duplicates		Umpire checks	
		No.	Rate	No.	Rate	No.	Rate	No.	Rate	No.	Rate
Phase 1	15,706	322	1:49	398	1:40	200	1:79	1,323	1:12	258	1:61
Phase 2	6,965	363	1:19	201	1:35	145	1:48	n/a	n/a	n/a	n/a

Various statistical techniques are available for the investigation of data accuracy and precision with each technique having strengths and weaknesses. It is recommended that a combination of techniques be implemented in order to determine the accuracy and precision of the analytical data and bias. Determination of data accuracy and precision can be facilitated with the following statistical tools:

- Thompson & Howarth (T&H) plots.
- Cumulative precision graphs (Rank Absolute Difference [RAD] Plots).

- Relative error frequency histograms.
- Correlation plots.
- Quantile-quantile (Q-Q) plots.
- Time series analysis (standards/precision control graphs).

The Thompson and Howarth (T&H) plot and Rank Absolute Difference (RAD) plot enable the magnitude of sampling and analytical precision to be determined. The T&H plot is more resistant relative to the RAD plot to distortion from spurious high grade outliers and allows the determination of precision across the entire grade range. The RAD plot, in contrast, enables determination of the level of precision at any cut-off of interest.

T&H and RAD plots, however, do not display the level of grade bias or trends where, for example, the repeat assay is consistently higher than the original assay. The investigation of trends or bias is accomplished through a combination of correlation analysis (correlation plots), relative error frequency histograms and quantile-quantile plots. The correlation plots allow the determination of correlation coefficients, which rates the similarity of one variable against the other. It is also possible to identify trends and biases that are inherent in the data set. The disadvantage of correlation plots is that the degree of correlation is significantly affected by outlier samples and is dependent on the grade range investigated.

The use of quantile-quantile (Q-Q) plots reduces the noise associated with the assay error (data precision and sampling error) and allows comparison of the distribution of variable one relative to the distribution of a second variable. Detailed investigation of apparent trends is completed with the use of relative error frequency histograms, which display the data error (variable2 subtracted from variable1). If there is no trend or bias in the data, the relative errors will display a normal distributed around a mean of zero (i.e. no skew). The presence of skew indicates a bias or trend. Plotting of normalised errors against the mean assay grade of each pair of analyses allows investigation of bias within selected grade ranges.

Standards

The use of check standards provides the only true measure of assay accuracy and thus check standards play a critical role in identifying any short or long-term assay biases. Standards have a ‘certified’ mean value and an associated confidence interval and it is through the monitoring of the value of the standard, when assayed with the unknown samples, that the accuracy of the assay process is monitored. Such monitoring is best achieved via the use of control charts.

Individual assays for each standard are plotted on a time sequential basis onto separate charts. Short-term problems are identified by any assay lying outside of the two standard deviation limits. Experience shows that a large proportion of these problems can be rectified without re-assaying as they relate to calculation or transcription errors. Longer term problems can be identified in a variety of ways, the most common of which are significant numbers of points that congregate either above or below the mean. A change in instrument calibration is a problem that can be detected in this manner.

The precision of laboratory results during the drilling/sampling program can be monitored with the use of reliable standards (including blanks), of the same or similar matrix to the normal samples. The plotting of standards on time series or control charts highlights problem periods at the laboratory and samples submitted during these times may be inspected closely for possible error. A range of standards should be used to test the upper and lower precision of the assay laboratory.

Standard results from both phases of the Columbus drilling have been analysed using the sample number as the time reference. Columbus has used 11 standards over the course of the two drilling programmes, though only five were used in Phase 1. All have been used in Phase 2. Both oxide and sulphide gold and gold/silver standards have been used. The range of grades of the standards is entirely appropriate for this deposit. All standards have been obtained from Rocklabs, New Zealand.

Certified expected values (EVs) and standard deviations (StDev) for the standards used are given in Table 11.

Table 11 - Certified Standards Used by Columbus

Standard Name	EV	std dev	EV-2sd	EV+2sd	EV-3sd	EV+3sd
STD 1000 (HiSilK2)	3.474	0.087	3.3	3.648	3.213	3.735
STD 1001 (OxG84)	0.922	0.033	0.856	0.988	0.823	1.021
STD 1002 (Oxi81)	1.807	0.033	1.741	1.873	1.708	1.906
STD 1003 (SE58)	0.607	0.019	0.569	0.645	0.55	0.664
STD 1004 (SJ53)	2.637	0.048	2.541	2.733	2.493	2.781
STD 1005 (SL77)	5.181	0.156	4.869	5.493	4.713	5.649
STD 1006 (SN74)	8.981	0.222	8.537	9.425	8.315	9.647
STD 1007 (SE68)	0.599	0.013	0.573	0.625	0.56	0.638
STD1008 (OxG104)	0.925	0.021	0.883	0.967	0.862	0.988
STD 1009 (Oxi121)	1.834	0.05	1.734	1.934	1.684	1.984
STD 1010 (SJ80)	2.656	0.057	2.542	2.77	2.485	2.827

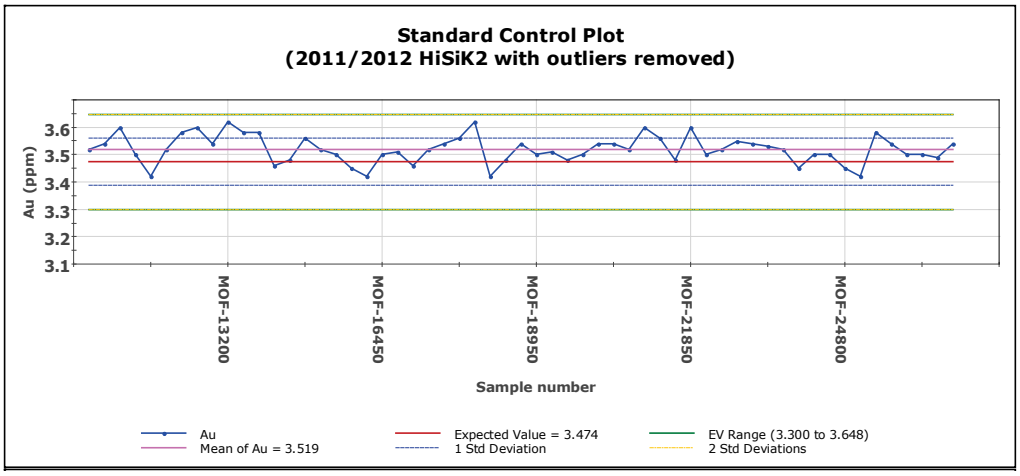
There are a few obvious sample swaps/mislabelled samples in the Phase 1 data, but not enough to affect confidence in the data. The results are reasonably consistent for each standard, and very few samples fall outside of EV ± 2StDev (refer Figure 24 to Figure 28). Because the results from Columbus Phase 1 fall mainly between the limits of two standard deviations, they are considered acceptable.

The results from Phase 2 (Figure 29 to Figure 34) show less variability than those for Phase 1 and there was only one sample swap evident (probably a swap with a blank).

Figure 24 – Standard HiSik2 Results for Columbus Phase 1 and Phase 2 Drilling Programs

(2011/2012 HiSiK2 with outliers removed)

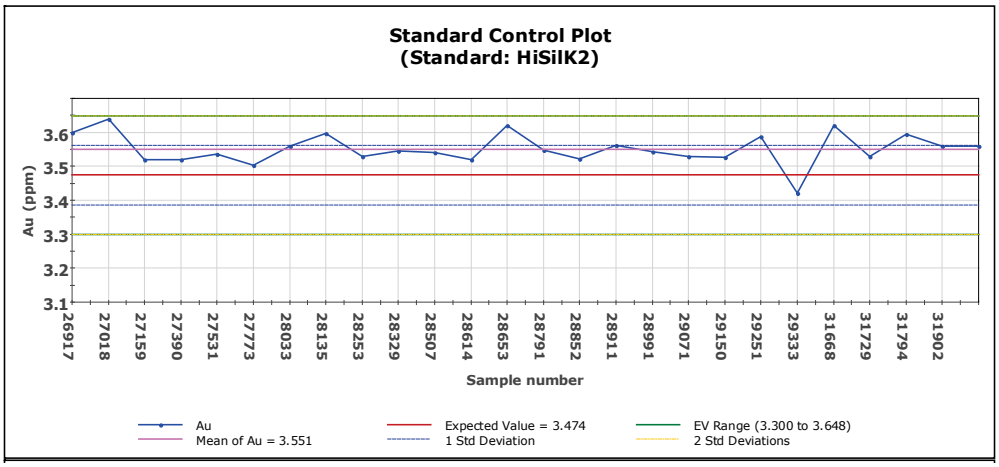
Standard:	STD HISILK2	No of Analyses:	57
Element:	Au	Minimum:	3.420
Units:	ppm	Maximum:	3.620
Detection Limit:	0.01	Mean:	3.519
Expected Value (EV):	3.474	Std Deviation:	0.050
E.V. Range:	3.300 to 3.648	% in Tolerance	100.000 %
		% Bias	1.304 %
		% RSD	1.422 %



Phase 1 HiSiK2 with obvious outliers removed

Summary
(Standard: HiSilK2)

Standard:	HiSilK2	No of Analyses:	26
Element:	Au	Minimum:	3.420
Units:	ppm	Maximum:	3.640
Detection Limit:	0.01	Mean:	3.551
Expected Value (EV):	3.474	Std Deviation:	0.044
E.V. Range:	3.300 to 3.648	% in Tolerance	100.000 %
		% Bias	2.221 %
		% RSD	1.252 %

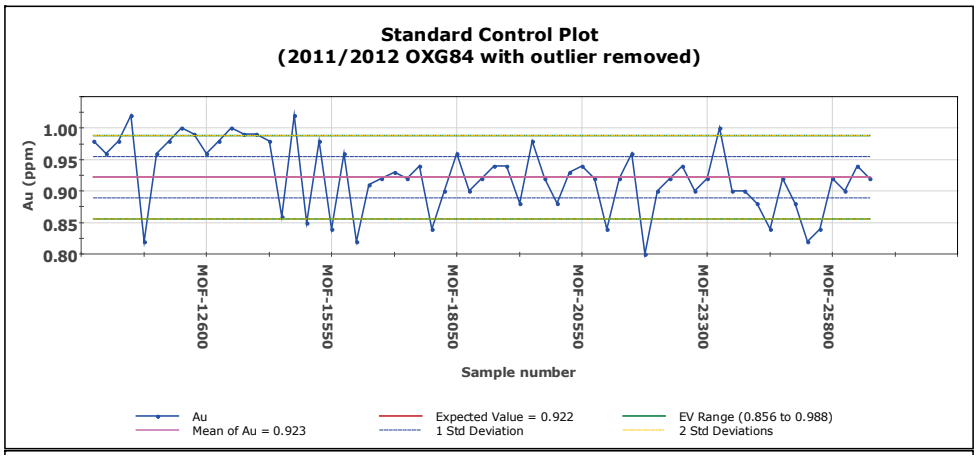


Phase 2 HiSik2

Figure 25 – Standard OXG84results for Columbus Phase 1 and Phase 2 Drilling Programs

Summary
(2011/2012 OXG84 with outlier removed)

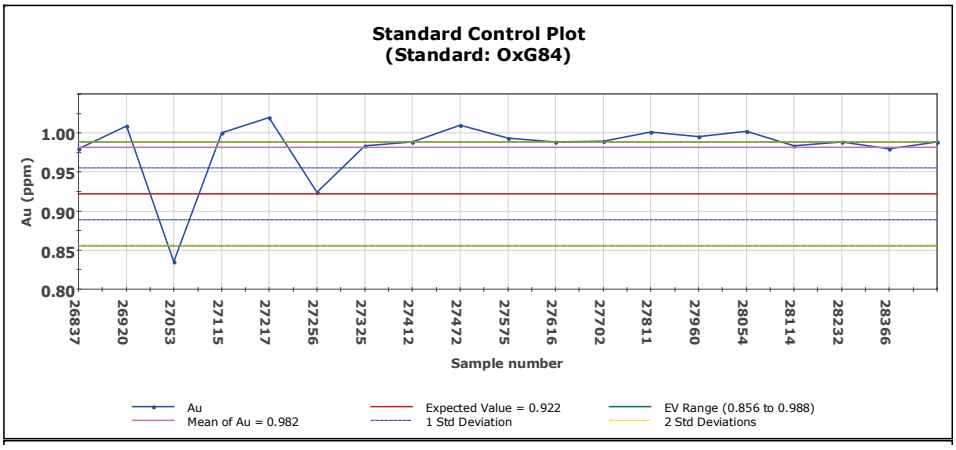
Standard:	STD OXG84	No of Analyses:	63
Element:	Au	Minimum:	0.800
Units:	ppm	Maximum:	1.020
Detection Limit:	0.01	Mean:	0.923
Expected Value (EV):	0.922	Std Deviation:	0.054
E.V. Range:	0.856 to 0.988	% in Tolerance	71.429 %
		% Bias	0.110 %
		% RSD	5.870 %



Phase 1 OXG84 with obvious outlier removed

Summary
(Standard: OxG84)

Standard:	OxG84	No of Analyses:	19
Element:	Au	Minimum:	0.835
Units:	ppm	Maximum:	1.020
Detection Limit:	0.01	Mean:	0.982
Expected Value (EV):	0.922	Std Deviation:	0.039
E.V. Range:	0.856 to 0.988	% in Tolerance	26.316 %
		% Bias	6.508 %
		% RSD	4.014 %

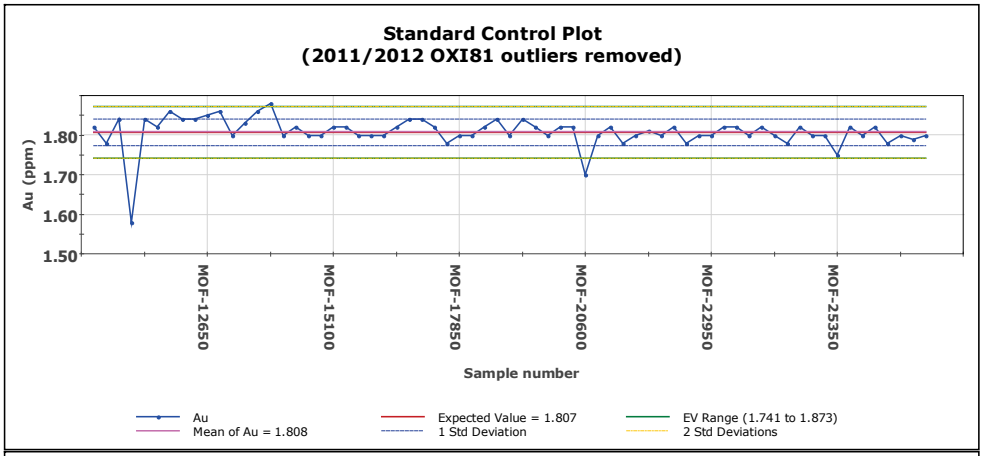


Phase 2 OXG84

Figure 26 – Standard OXI81results for Columbus Phase 1 and Phase 2 Drilling Programs

Summary
(2011/2012 OXI81 outliers removed)

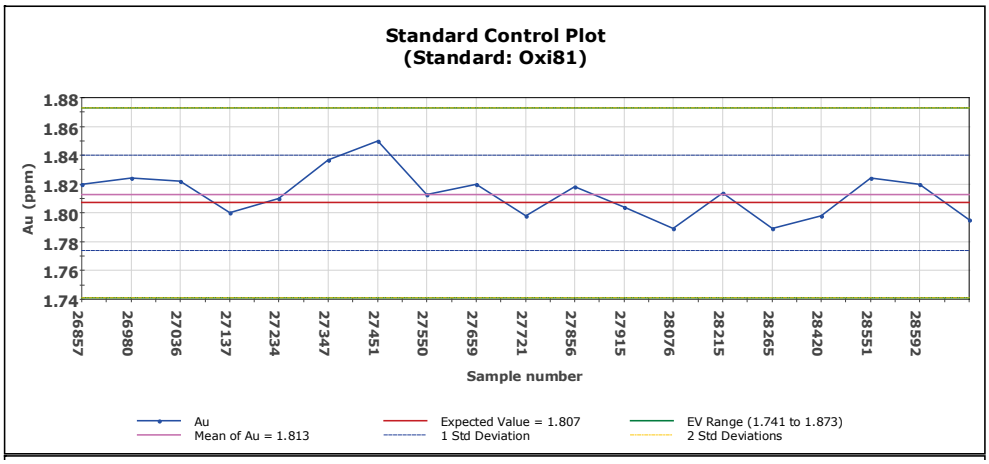
Standard:	STD OXI81	No of Analyses:	67
Element:	Au	Minimum:	1.580
Units:	ppm	Maximum:	1.880
Detection Limit:	0.01	Mean:	1.808
Expected Value (EV):	1.807	Std Deviation:	0.039
E.V. Range:	1.741 to 1.873	% in Tolerance	95.522 %
		% Bias	0.067 %
		% RSD	2.136 %



Phase 1 OXI81 with obvious outliers removed

Summary
(Standard: Oxi81)

Standard:	Oxi81	No of Analyses:	19
Element:	Au	Minimum:	1.789
Units:	ppm	Maximum:	1.850
Detection Limit:	0.01	Mean:	1.813
Expected Value (EV):	1.807	Std Deviation:	0.016
E.V. Range:	1.741 to 1.873	% in Tolerance	100.000 %
		% Bias	0.326 %
		% RSD	0.861 %

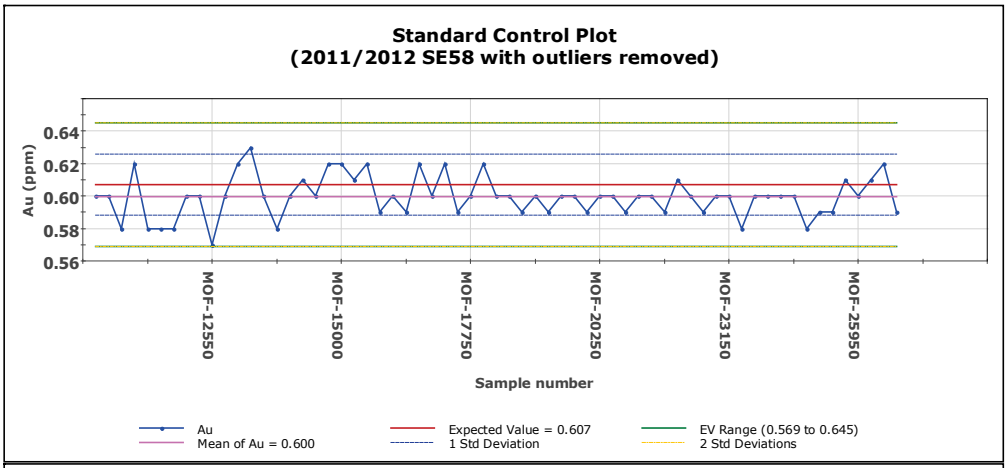


Phase 2 OXI81

Figure 27 – Standard SE58results for Columbus Phase 1 and Phase 2 Drilling Programs

Summary
(2011/2012 SE58 with outliers removed)

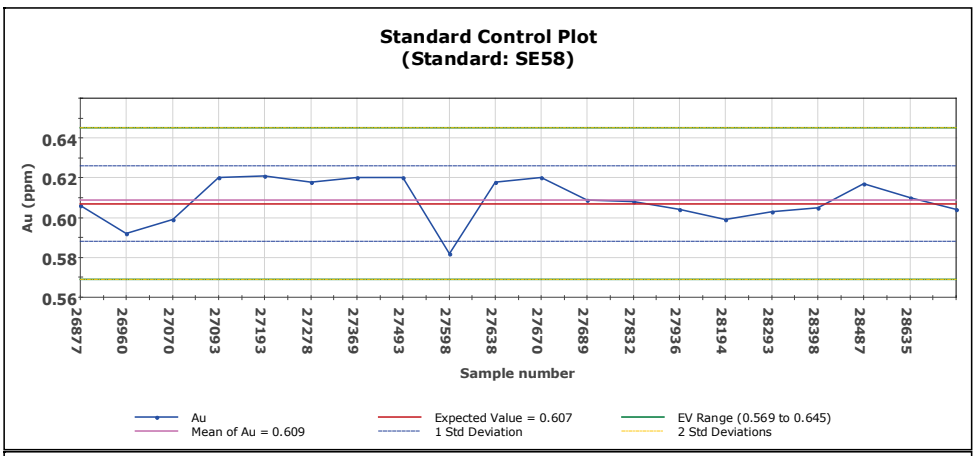
Standard:	STD SE58	No of Analyses:	63
Element:	Au	Minimum:	0.570
Units:	ppm	Maximum:	0.630
Detection Limit:	0.01	Mean:	0.600
Expected Value (EV):	0.607	Std Deviation:	0.013
E.V. Range:	0.569 to 0.645	% in Tolerance	100.000 %
		% Bias	-1.232 %
		% RSD	2.089 %



Phase 1 SE58 with obvious outliers removed

Summary
(Standard: SE58)

Standard:	SE58	No of Analyses:	20
Element:	Au	Minimum:	0.582
Units:	ppm	Maximum:	0.621
Detection Limit:	0.01	Mean:	0.609
Expected Value (EV):	0.607	Std Deviation:	0.010
E.V. Range:	0.569 to 0.645	% in Tolerance	100.000 %
		% Bias	0.288 %
		% RSD	1.717 %

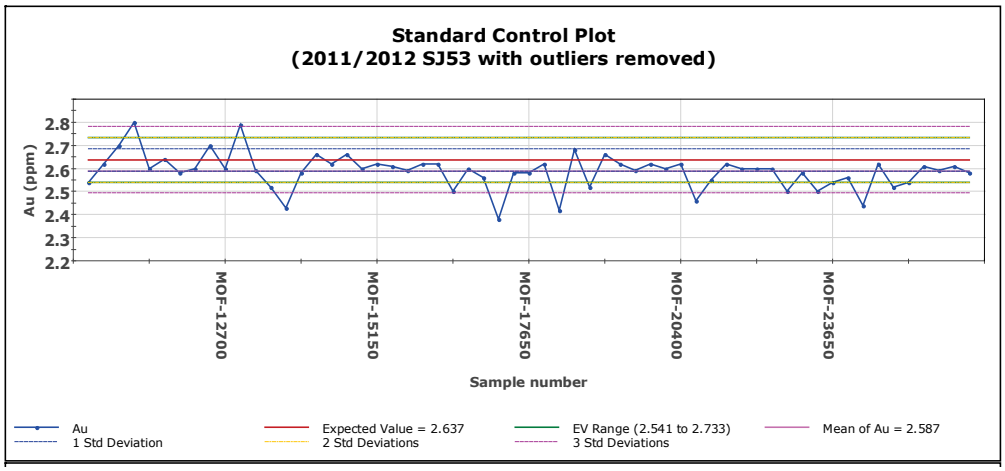


Phase 2 SE58

Figure 28 Standard SJ53 results for Columbus Phase 1 and Phase 2 Drilling Programs

Summary
(2011/2012 SJ53 with outliers removed)

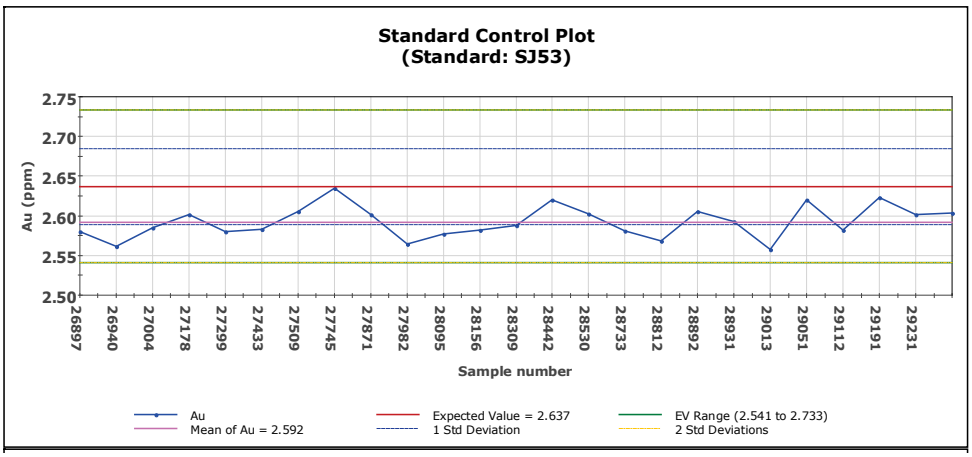
Standard:	STD SJ53	No of Analyses:	59
Element:	Au	Minimum:	2.380
Units:	ppm	Maximum:	2.800
Detection Limit:	0.01	Mean:	2.587
Expected Value (EV):	2.637	Std Deviation:	0.075
E.V. Range:	2.541 to 2.733	% in Tolerance	72.881 %
		% Bias	-1.879 %
		% RSD	2.907 %



Phase 1 SJ53 with obvious outliers removed

Summary
(Standard: SJ53)

Standard:	SJ53	No of Analyses:	25
Element:	Au	Minimum:	2.558
Units:	ppm	Maximum:	2.635
Detection Limit:	0.01	Mean:	2.592
Expected Value (EV):	2.637	Std Deviation:	0.020
E.V. Range:	2.541 to 2.733	% in Tolerance	100.000 %
		% Bias	-1.700 %
		% RSD	0.759 %

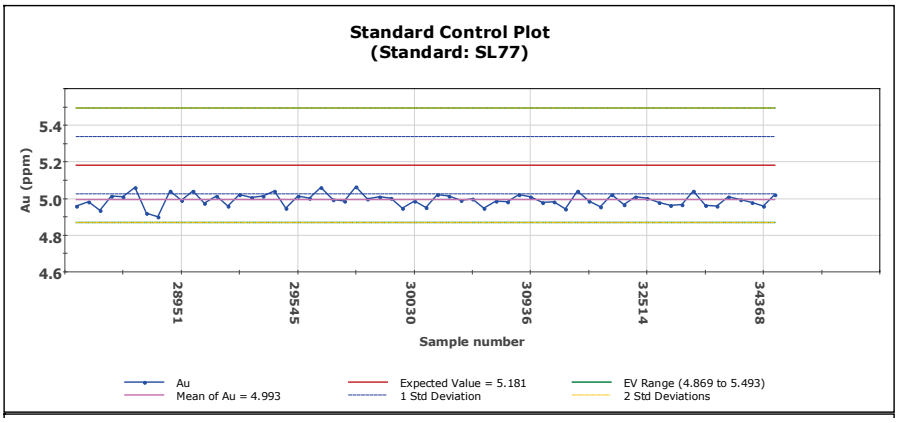


Phase 2 SJ53

Figure 29 – Standard SL77 results for Columbus 2014 Phase 2 Drilling Program

Summary (Standard: SL77)

Standard:	SL77	No of Analyses:	61
Element:	Au	Minimum:	4.902
Units:	ppm	Maximum:	5.063
Detection Limit:	0.01	Mean:	4.993
Expected Value (EV):	5.181	Std Deviation:	0.034
E.V. Range:	4.869 to 5.493	% in Tolerance	100.000 %
		% Bias	-3.634 %
		% RSD	0.684 %

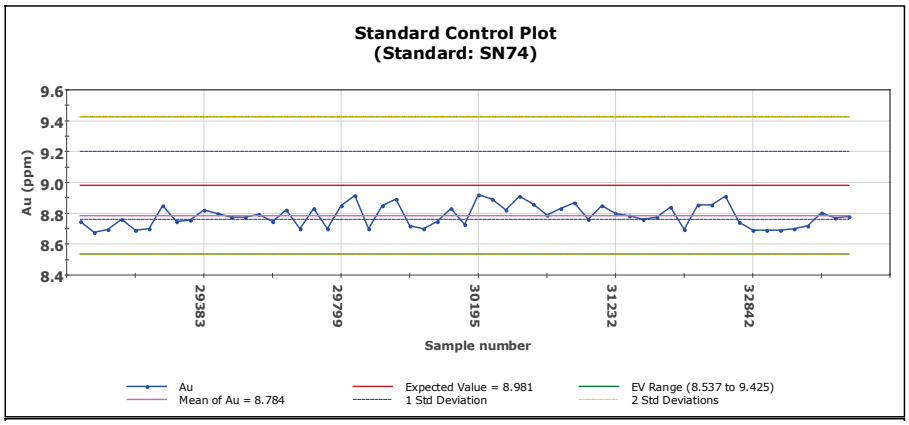


Phase 2 2014 SL77

Figure 30 Standard SN74 results for Columbus 2014 Phase 2 Drilling Program

Summary (Standard: SN74)

Standard:	SN74	No of Analyses:	57
Element:	Au	Minimum:	8.678
Units:	ppm	Maximum:	8.920
Detection Limit:	0.01	Mean:	8.784
Expected Value (EV):	8.981	Std Deviation:	0.069
E.V. Range:	8.537 to 9.425	% in Tolerance	100.000 %
		% Bias	-2.196 %
		% RSD	0.791 %

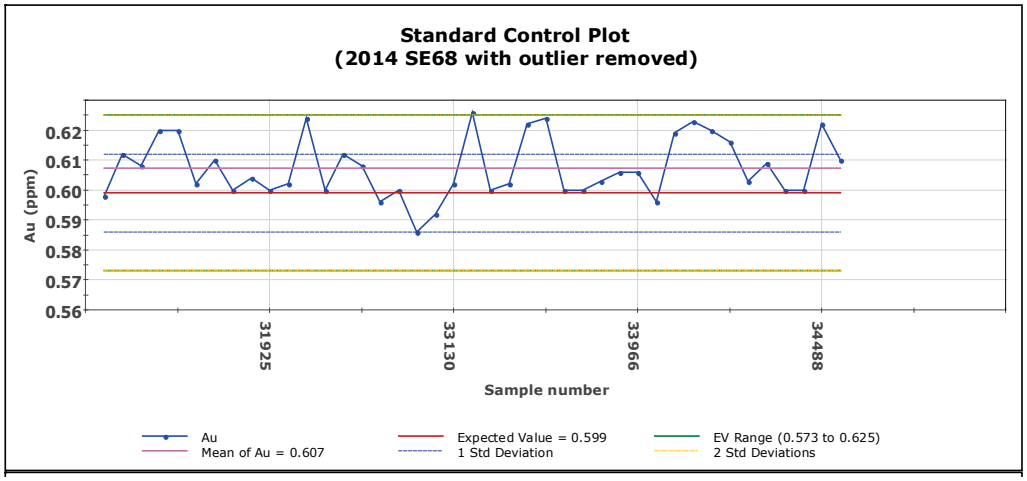


Phase 2 2014 SN74

Figure 31 Standard SE68 results for Columbus 2014 Phase 2 Drilling Program

Summary
(2014 SE68 with outlier removed)

Standard:	SE68	No of Analyses:	41
Element:	Au	Minimum:	0.586
Units:	ppm	Maximum:	0.626
Detection Limit:	0.01	Mean:	0.607
Expected Value (EV):	0.599	Std Deviation:	0.010
E.V. Range:	0.573 to 0.625	% in Tolerance	97.561 %
		% Bias	1.401 %
		% RSD	1.630 %



Phase 2 2014 SE68

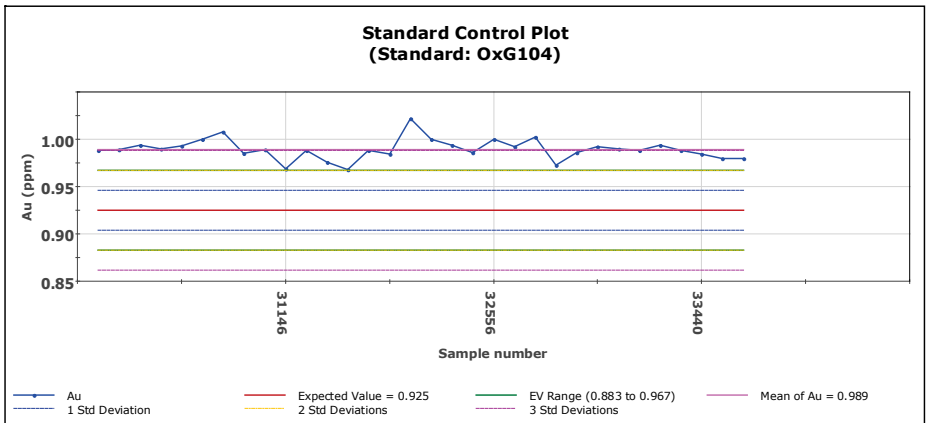
Hole	Sample ID	Type	Reference	Comment
MO14142	31335	Standard	1007	Blank?

Details of outlier SE68 sample

Figure 32 Standard OXG104 results for Columbus 2014 Phase 2 Drilling Program

Summary (Standard: OxG104)

Standard:	OxG104	No of Analyses:	32
Element:	Au	Minimum:	0.968
Units:	ppm	Maximum:	1.022
Detection Limit:	0.01	Mean:	0.989
Expected Value (EV):	0.925	Std Deviation:	0.011
E.V. Range:	0.883 to 0.967	% in Tolerance	0.000 %
		% Bias	6.959 %
		% RSD	1.073 %

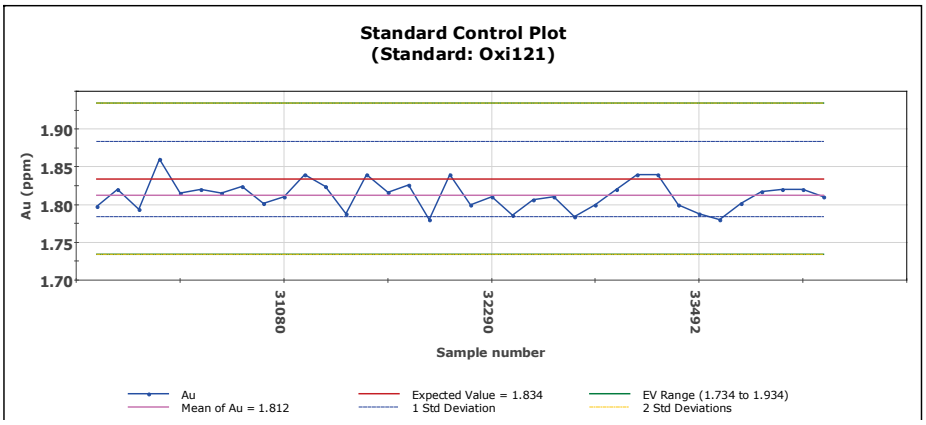


Phase 2 2014 OXG104

Figure 33 Standard OXi121 results for Columbus 2014 Phase 2 Drilling Program

Summary (Standard: Oxi121)

Standard:	Oxi121	No of Analyses:	36
Element:	Au	Minimum:	1.780
Units:	ppm	Maximum:	1.860
Detection Limit:	0.01	Mean:	1.812
Expected Value (EV):	1.834	Std Deviation:	0.019
E.V. Range:	1.734 to 1.934	% in Tolerance	100.000 %
		% Bias	-1.180 %
		% RSD	1.046 %

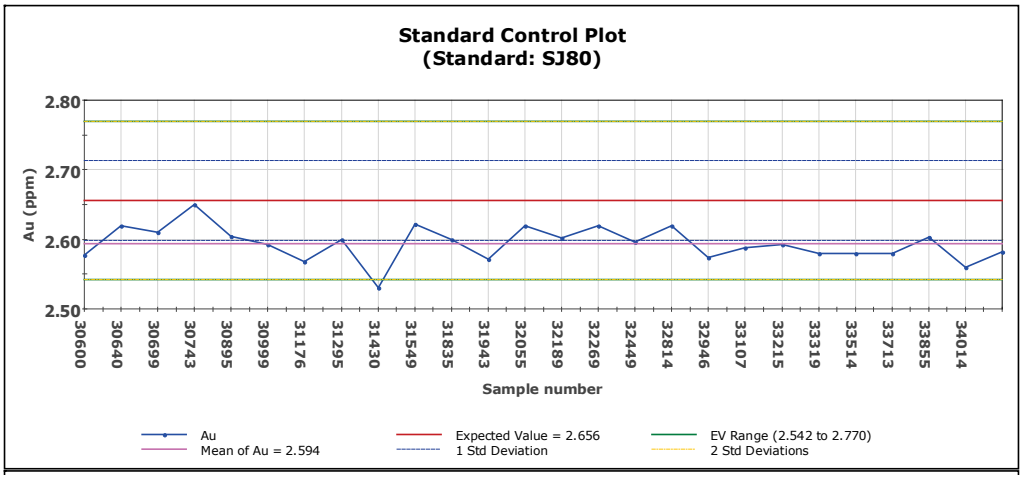


Phase 2 2014 OXi121

Figure 34 Standard SJ80 results for Columbus 2014 Phase 2 Drilling Program

Summary (Standard: SJ80)

Standard:	SJ80	No of Analyses:	26
Element:	Au	Minimum:	2.530
Units:	ppm	Maximum:	2.650
Detection Limit:	0.01	Mean:	2.594
Expected Value (EV):	2.656	Std Deviation:	0.024
E.V. Range:	2.542 to 2.770	% in Tolerance	96.154 %
		% Bias	-2.336 %
		% RSD	0.928 %



Phase 2 2014 SJ80

The results for many of the standards show a bias compared to the EV. This is generally around ±1StDev from the EV, but in the case of OXGI04, the bias is 3*StDev above the EV. There is no relationship between the bias (+ or -) and the gold grade. Study of the standard certificates obtained from the Rocklabs website shows that this is not of concern. Rocklabs suggest that the variation of the standard results from a particular laboratory is to be monitored as opposed to using the certified EV and SD. Taking this into account, the results of the standard analyses do not indicate any systematic or ongoing problems with the assay laboratory used.

Blanks

Blanks should be introduced at the start of each batch submitted to the assay laboratory to provide evidence for contamination in the crushing process prior to fine pulverisation and also in the pulverisation stage. 2-3 blanks should be inserted at the start of the run of samples in each batch sent to the laboratory. Additionally blanks should be inserted immediately following nominated high-grade intervals and intermittently throughout the batch of samples (as a standard).

The laboratory should also be instructed to run a quartz flush at specified intervals (including up to after every sample) and retain the pulps results as part of their own internal QAQC.

A total of 398 blanks were inserted into the Phase 1 drilling samples. Only four samples returned assays greater than 0.1g/t Au. It is not possible to determine retrospectively if these are due to contamination during sample preparation or are swapped or misnamed samples. Given that several of the standards from this programme appear to have been swapped with blanks, the latter cannot be ruled out. The results from the blanks (Figure 35) suggest there is little or no contamination between samples during sample preparation.

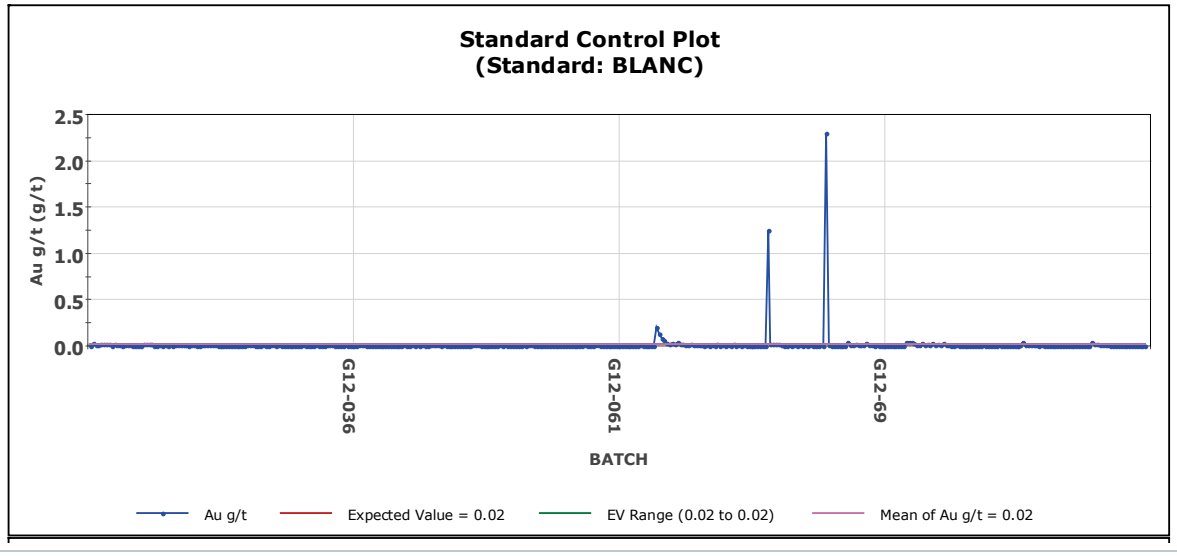
A total of 203 blanks were inserted into the Phase 2 drilling samples. Of the 203 samples, only three are outliers, and two of these are the 2012 samples. This indicates the laboratory used for sample preparation in the 2013/2014 drilling programme has been working at a high standard of cleanliness and there is no indication of contamination during sample preparation.

The rate of insertion of blanks has increased only slightly from 1 in 40 to 1 in 35 between Phase 1 and Phase 2. However, as there is no indication of contamination during sample preparation, Coffey considers this rate to be acceptable whilst still using the FILAB Suriname laboratory. However, Coffey recommends continued monitoring of results and an increase in the rate of blanks used to a similar rate to the standards if the quality of the laboratory should deteriorate or another laboratory is used in future.

Figure 35 – Phase 1 Blanks

Summary
(Standard: BLANC)

Standard:	BLANC	No of Analyses:	398
Element:	Au g/t	Minimum:	0.01
Units:		Maximum:	2.30
Detection Limit:	-	Mean:	0.02
Expected Value (EV):	0.02	Std Deviation:	0.13
E.V. Range:	0.02 to 0.02	% in Tolerance	6.28 %
		% Bias	-7.66 %
		% RSD	709.31 %



Field duplicates

Duplicate samples are submitted to monitor the precision of the entire sampling and assaying process. The average precision measured includes any variability introduced because of the method of sampling, the sample preparation procedures used, the assay methods adopted and the inherent variability present in any sample.

Field duplicates were taken for the 2011/2012 drilling programme (Columbus Phase 1). There are 100 informed pairs for these samples. These have a moderate correlation with a Pearson correlation coefficient of 0.70. There is a large difference in the mean and variance of the two datasets which is caused by one extreme value (Figure 36). Once this is removed (Figure 37), the Pearson correlation coefficient increases to 0.81 and the mean and variance for the two data sets are very similar.

Coffey consider the results of the field duplicates to reflect the nuggety nature of the gold mineralisation and do not indicate any problems with the sample collection and preparation.

Figure 36 - Phase 1 Field Duplicates

Columbus Phase 1 Field Duplicates (All Data)

	Au g/t orig	Au g/t	Units		Result
No. Pairs:	100	100		Pearson CC:	0.70
Minimum:	0.00	0.01	g/t	Spearman CC:	0.83
Maximum:	7.20	63.34	g/t	Mean HARD:	32.66
Mean:	0.41	0.97	g/t	Median HARD:	31.30
Median	0.06	0.09	g/t		
Std. Deviation:	1.11	6.33	g/t	Mean HRD:	-6.45
Coefficient of Variation:	2.69	6.50		Median HRD	0.00

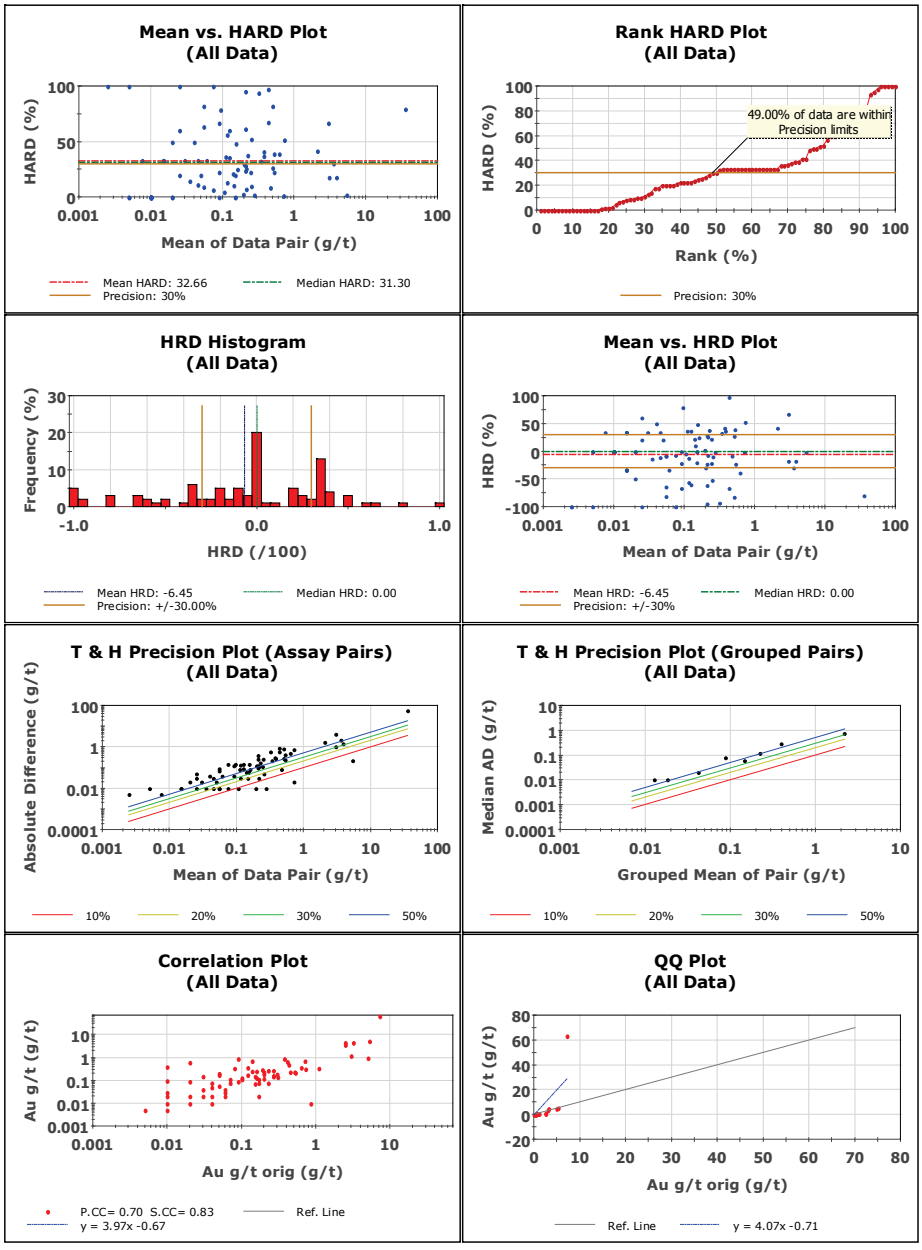


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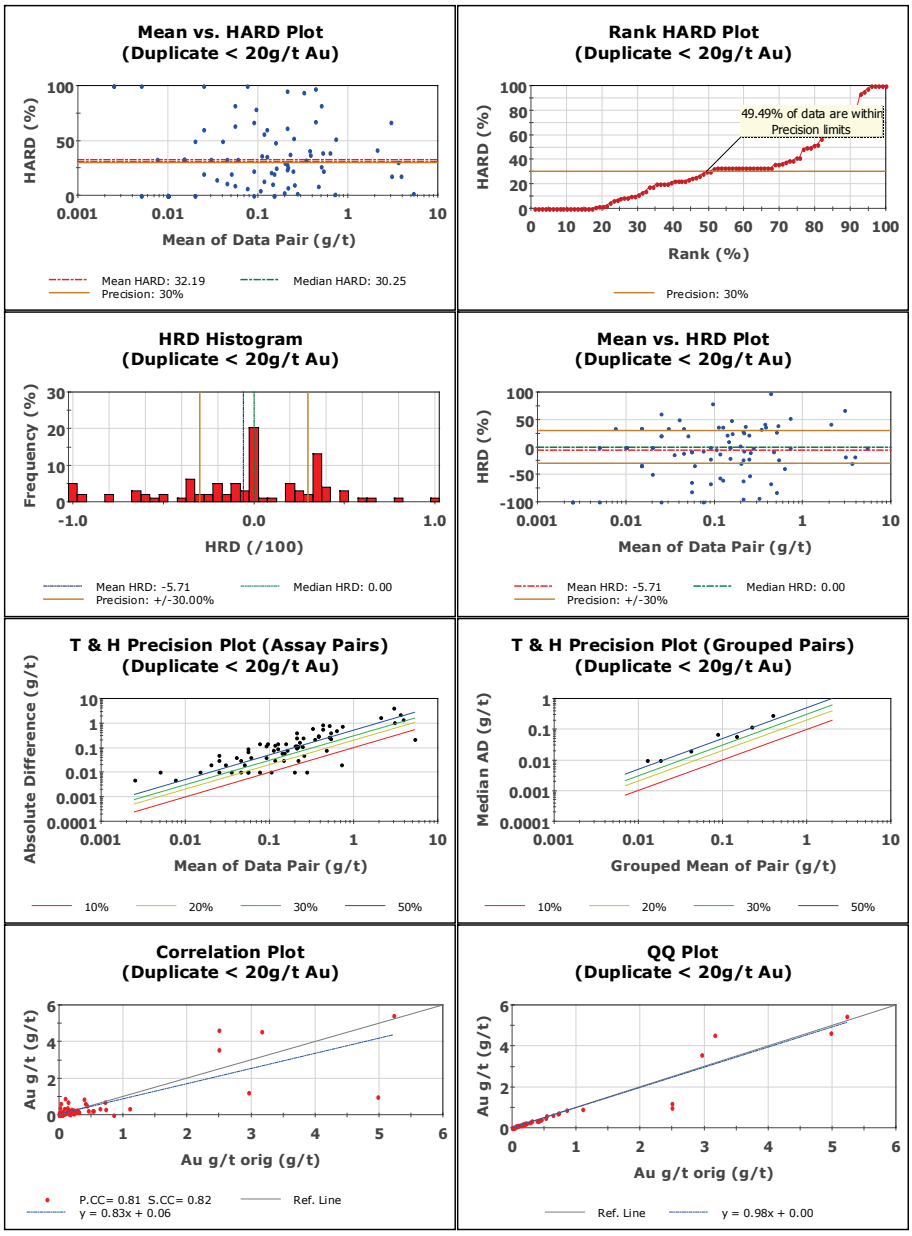
Figure 37 - Phase 1 Field Duplicates with Extreme Value Removed

Columbus Phase 1 Field Duplicates (Duplicate < 20g/t Au)

	Au g/t orig	Au g/t	Units		Result
No. Pairs:	99	99		Pearson CC:	0.81
Minimum:	0.00	0.01	g/t	Spearman CC:	0.82
Maximum:	5.23	5.45	g/t	Mean HARD:	32.19
Mean:	0.35	0.34	g/t	Median HARD:	30.25
Median	0.06	0.08	g/t		
Std. Deviation:	0.88	0.91	g/t	Mean HRD:	-5.71
Coefficient of Variation:	2.55	2.63		Median HRD	0.00



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Field duplicates were taken for the 2013/2014 drilling programme (Columbus Phase 2). There are 145 pairs, of which 130 pairs were informed (i.e. had assays for both samples) as at the time of writing. These show moderate correlation with a Pearson correlation coefficient of 0.7 and a Spearman correlation coefficient of 0.89. Using a precision limit of 30% (typical for field duplicates), 65.52% of data are within precision limits. The mean grade and variance of the duplicate data is higher than that of the original samples. However the log/log correlation plot (refer Figure 38) shows scatter but no bias. If extremely high grades (>100g/t Au) are removed from the dataset, the remaining 119 pairs have a higher Pearson correlation coefficient of 0.83 and the means of the two data sets are much closer (original samples have a mean of 2.60g/t Au while duplicates have a mean grade of 2.65g/t Au), reflecting the influence of nuggetty gold.

Figure 38 – Phase 2 Field Duplicates

Summary (All Data)

	orig Au	dup Au	Units		Result
No. Pairs:	145	145		Pearson CC:	0.70
Minimum:	0.00	0.00	g/t	Spearman CC:	0.89
Maximum:	45.58	102.00	g/t	Mean HARD:	28.80
Mean:	2.36	2.88	g/t	Median HARD:	18.12
Median	0.29	0.21	g/t		
Std. Deviation:	5.95	9.50	g/t	Mean HRD:	4.45
Coefficient of Variation:	2.52	3.30		Median HRD	0.00

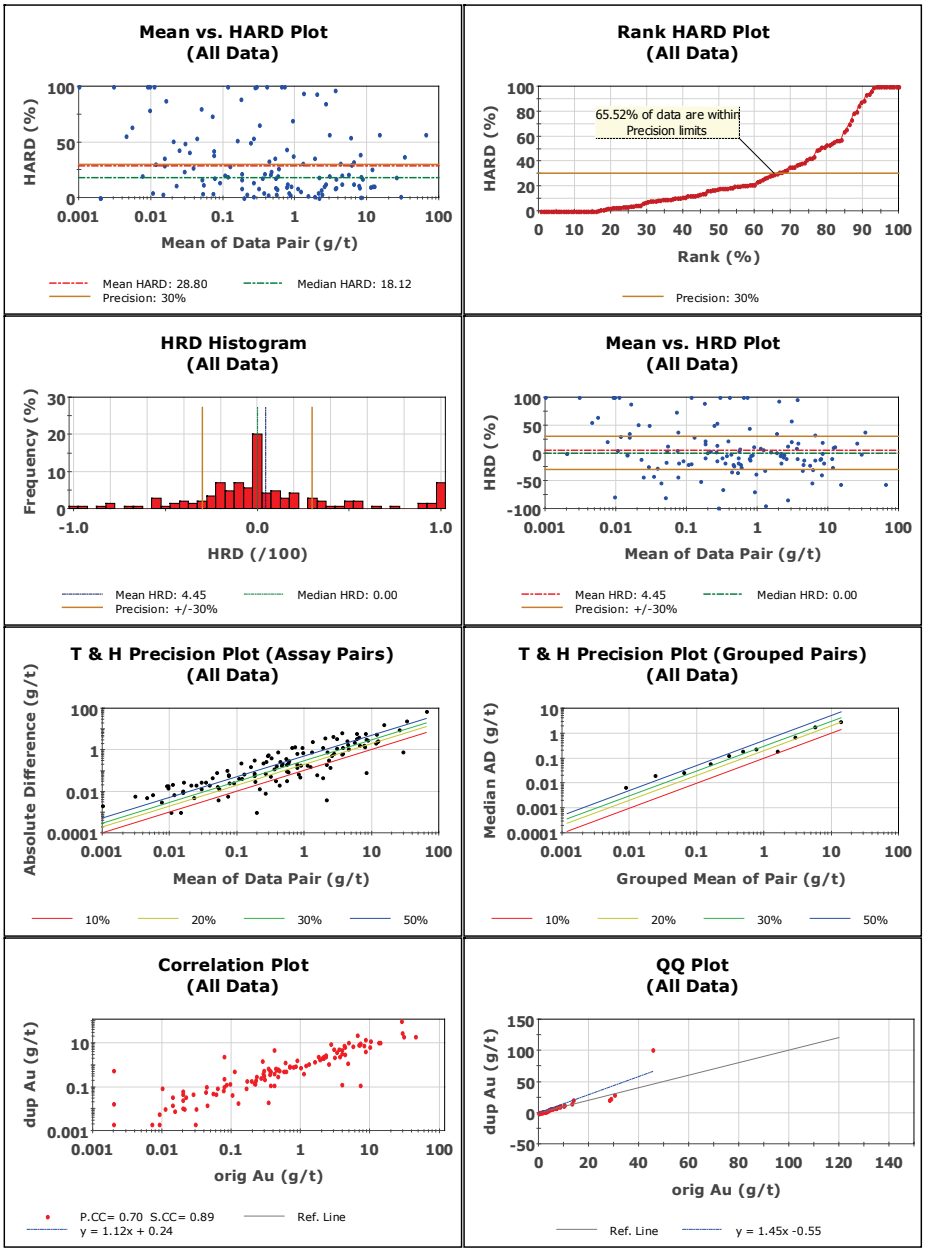

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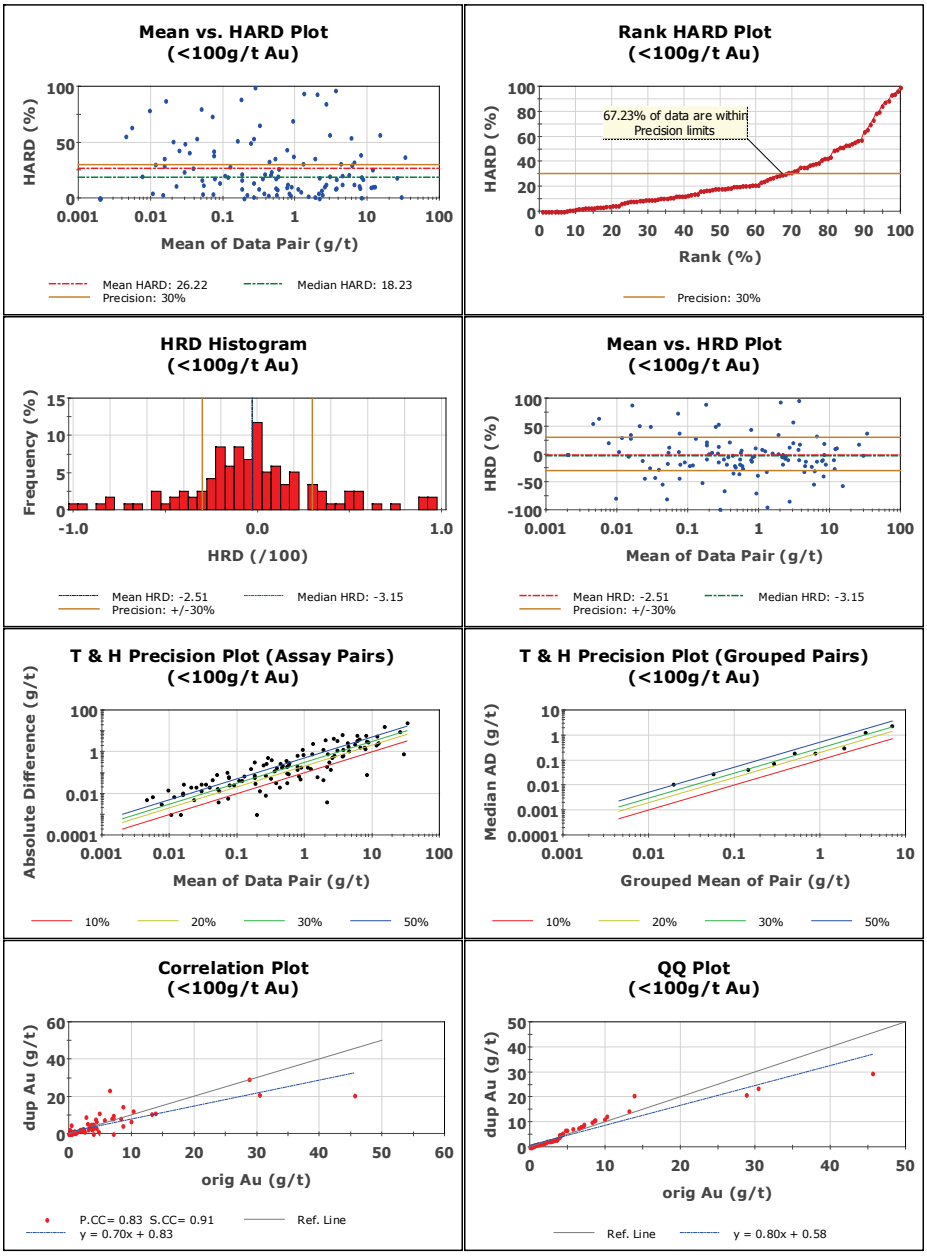
Figure 39 - Phase 2 Field Duplicates Au <100g/t

Summary (<100g/t Au)

	orig Au	dup Au	Units		Result
No. Pairs:	119	119		Pearson CC:	0.83
Minimum:	0.00	0.00	g/t	Spearman CC:	0.91
Maximum:	45.58	29.57	g/t	Mean HARD:	26.22
Mean:	2.60	2.65	g/t	Median HARD:	18.23
Median	0.36	0.53	g/t		
Std. Deviation:	6.04	5.06	g/t	Mean HRD:	-2.51
Coefficient of Variation:	2.32	1.91		Median HRD	-3.15



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Pulp duplicates

Pulp duplicates are normally submitted to the original laboratory and to a secondary laboratory to assess the analytical accuracy and identify laboratory bias.

In 2012, 1,323 pulps were resubmitted to Filab (Suriname). Upon return to Columbus Gold of the rejects and pulps from the first analysis a selection of pulps covering many of the mineralised zones and wall rock are resubmitted to the original laboratory (Filab) for analyses using. Gold is analysed by fire assay and Atomic Absorption finish, the same as for the original analysis.

The pulp duplicates included 15 blanks. As these are pulp duplicates and therefore involve no sample preparation, the blanks are only providing another test of assay accuracy at low grades. The results of the duplicated Blanks are very similar to those of the original assay.

The pulp duplicates have an excellent Pearson correlation coefficient of 0.99. Using a 20% precision limit, as is appropriate for pulp duplicates, 88.21% of data are within precision limits. The correlation plot (Figure 40) shows very little scatter.

A total of 258 pulps were sent to an Umpire laboratory in OMAC, Ireland.

Nine standards were included in the duplicates. All but one returned acceptable values. This is the same rate of "failure" as for the original assays from the FILAB Suriname results (Table 12). Coffey concludes from this that both laboratories are working at an acceptable level of accuracy.

Table 12 - Results of standards from Umpire pulp duplicates

Standard	Samp ID	Au g/t Original	Au g/t OMAC	EV	St Dev (sd)	EV-2sd	EV+2sd	EV-3sd	EV+3sd
HiSilK2	MOF-11750	3.42	2.02	3.474	0.087	3.3	3.648	3.213	3.735
HiSilK2	MOF-14200	3.58	3.44	3.474	0.087	3.3	3.648	3.213	3.735
OxG84	MOF-14800	0.85	0.91	0.922	0.033	0.856	0.988	0.823	1.021
Oxi81	MOF-12650	1.85	1.74	1.807	0.033	1.741	1.873	1.708	1.906
Oxi81	MOF-15350	1.82	1.74	1.807	0.033	1.741	1.873	1.708	1.906
Se58	MOF-13000	0.62	0.56	0.607	0.019	0.569	0.645	0.55	0.664
SE58	MOF-15750	0.62	0.57	0.607	0.019	0.569	0.645	0.55	0.664

These show an acceptable level of correlation with a Pearson correlation coefficient of 0.94. Using a 20% precision limit, 76.74% of data are within precision limits. The correlation plot (Figure 41) shows more scatter than the FILAB/FILAB pulp duplicates (Figure 40). The Q-Q plot shows no bias until 10g/t. Above 10g/t, the OMAC assays are consistently higher than the FILAB assays. Some of the FILAB assays are finished by gravimetric methods as well as by AAS. In these cases, the gravimetric assay is used in preference to the AAS assay.

Coffey received the OMAC assay certificates from Columbus to determine the assay technique used. As it is usual to repeat analysis with a gravimetric finish for higher grade samples, the slight bias seen in the QQ plot could possibly be the result of differing assay techniques. When the correlation plot is constructed on log/log basis (Figure 42), scatter but no bias is seen.

As at the time of the study, Coffey had not received any pulp duplicate results from the Phase 2 drilling programme.

Figure 40 – Phase 1 Pulp Duplicates – FILAB Suriname

FILAB Suriname Pulp Duplicates 2011/2012 (All Data)

	Au_calc_original	Pulp Duplicate	Units		Result
No. Pairs:	1,323	1,323		Pearson CC:	0.99
Minimum:	0.01	0.01	g/t	Spearman CC:	0.98
Maximum:	78.40	85.00	g/t	Mean HARD:	8.54
Mean:	1.38	1.47	g/t	Median HARD:	3.23
Median	0.30	0.33	g/t		
Std. Deviation:	4.83	5.05	g/t	Mean HRD:	-5.22
Coefficient of Variation:	3.52	3.43		Median HRD	0.00

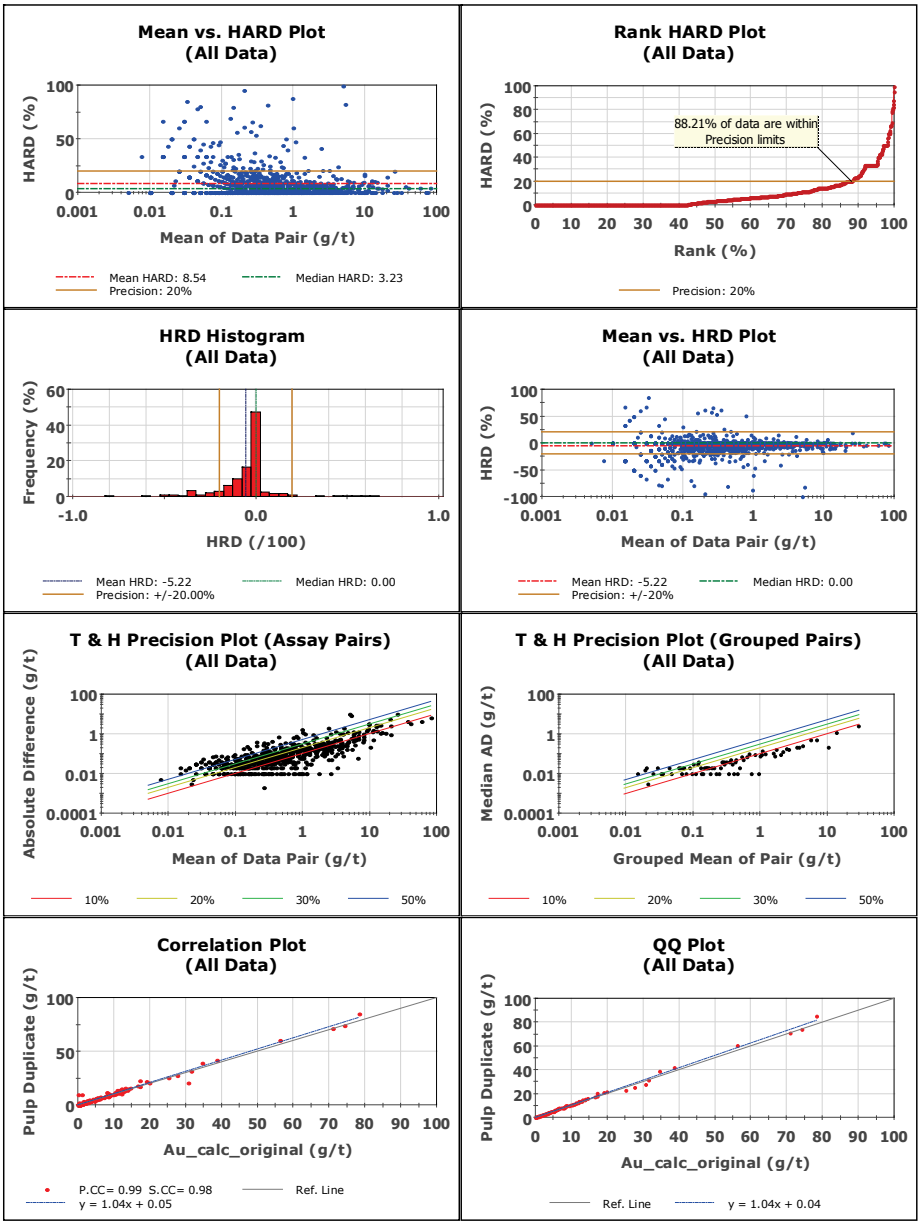

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Figure 41 – Phase 1 Pulp Duplicates – FILAB OMAC

FILAB Suriname Pulp Duplicates 2011/2012 (All Data)

	Au_calc_original	Pulp Duplicate	Units		Result
No. Pairs:	1,323	1,323		Pearson CC:	0.99
Minimum:	0.01	0.01	g/t	Spearman CC:	0.98
Maximum:	78.40	85.00	g/t	Mean HARD:	8.54
Mean:	1.38	1.47	g/t	Median HARD:	3.23
Median	0.30	0.33	g/t		
Std. Deviation:	4.83	5.05	g/t	Mean HRD:	-5.22
Coefficient of Variation:	3.52	3.43		Median HRD	0.00

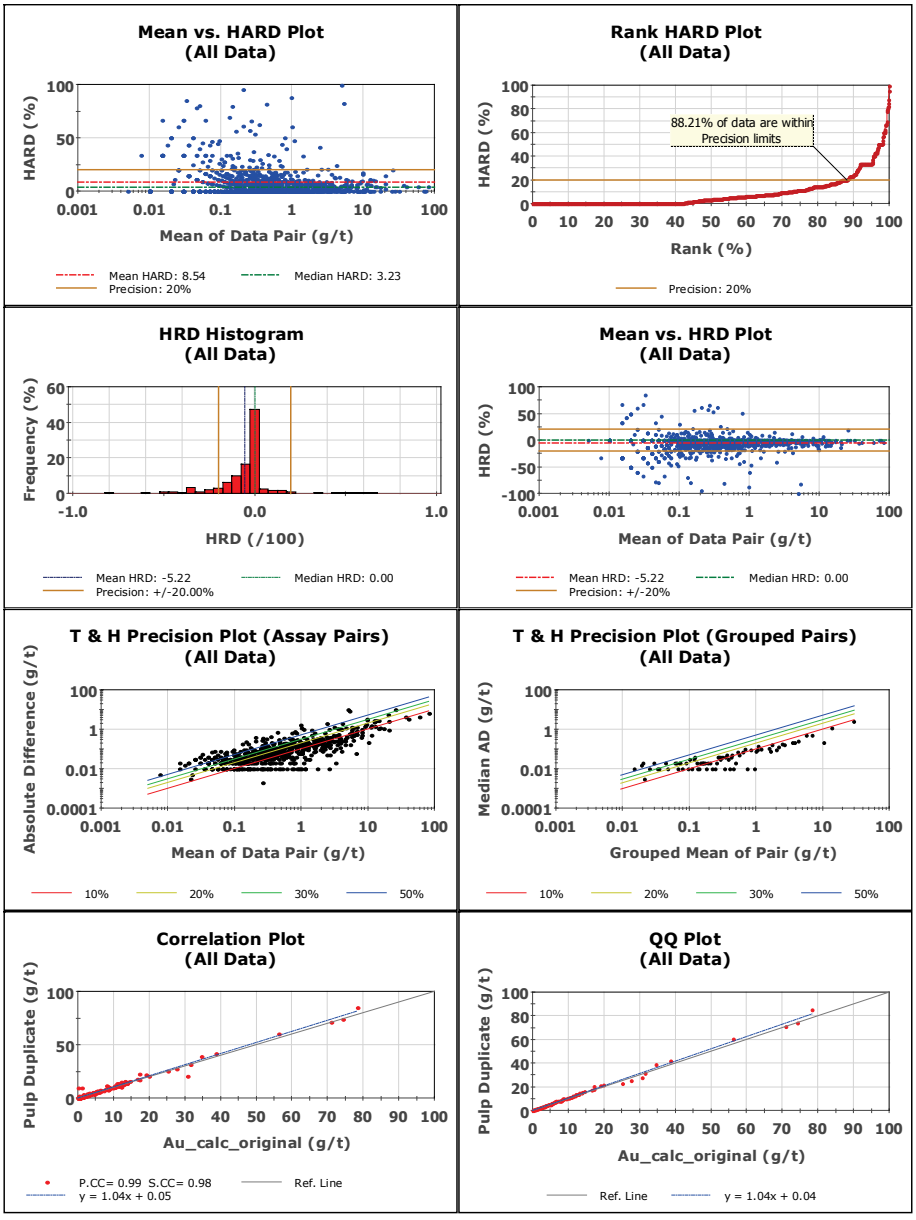

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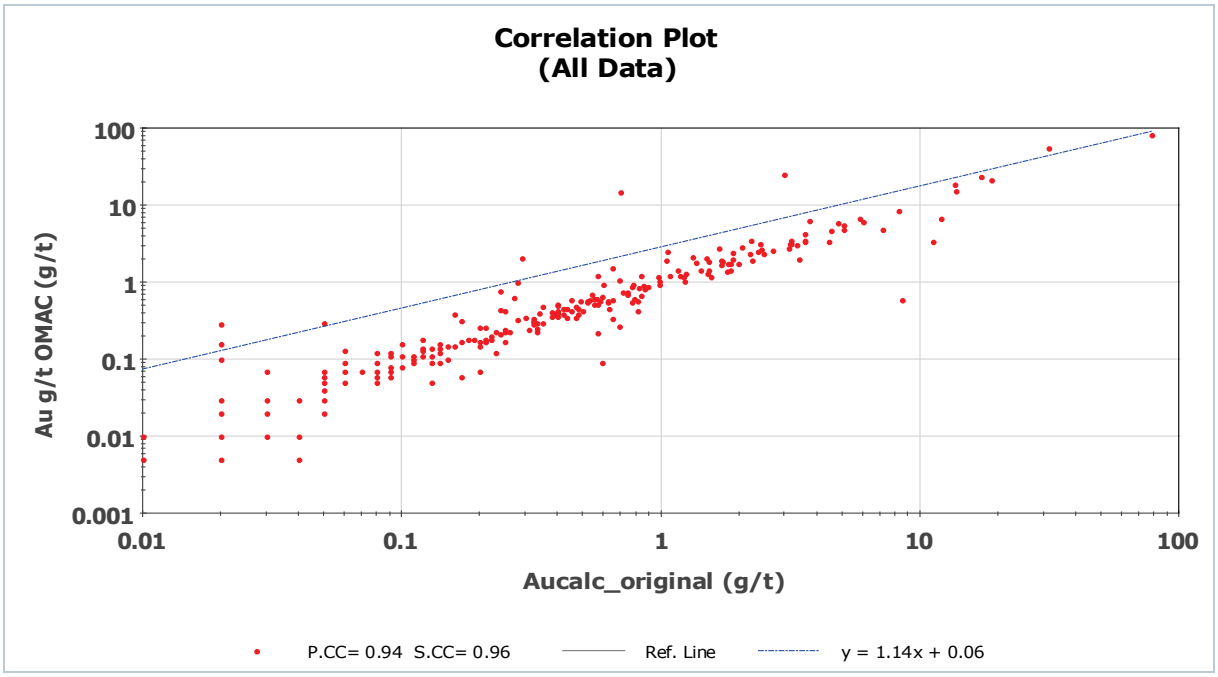
Figure 42 – Phase 1 Pulp Duplicates – FILAB OMAC – log correlation plot



11.3.3. Conclusions

Coffey recommends that Columbus aim to replace all Guyanor drill holes with new drill holes sampled with modern QAQC protocols to allow confidence in the project to be increased. Continued use of the Guyanor assay data in future resource estimates will keep the classification category at best as Inferred Mineral Resources.

Coffey is of the opinion that the Columbus' sample preparation, logging and security methodologies employed at the Montagne d'Or Prospect are acceptable and sufficient for a project of this size and that suitable precautions are being taken to identify and address irregularities in these activities.

Coffey is of the opinion that the QAQC methodologies employed by Columbus at the Montagne d'Or Prospect are acceptable and sufficient for a project of this size and that the results of the assays of standards, blanks and duplicates support the use of the assay database in a resource estimation.

12. Data verification

12.1. Site visit

A site visit was conducted by Mr Roger Stangler, Principal Resource Geologist with Coffey based on Perth, Western Australia, from 17 to 20 June 2014 (Figure 43), with additional time spent at the Columbus Office in Cayenne on 21 June 2013. This section covers the main findings of the site visit and related discussions with project geologists and management.

Figure 43 – Picture of the Paul Isnard Camp Site at Citron.

The area covered to date by drilling lies closer to the boundary of the Dékou Dékou portion of the biological reserve that is located approximately 0.8km to the south of the deposit. There is, however, no buffer zone to the north of the Dékou Dékou area and the field inspection has confirmed that the deposit lies at a sufficient distance from the biological reserve to cause any interference of the protected area.

Core sample records, lithology logs, laboratory reports and associated drillhole information for all drill programs completed by Guyanor, Golden Star and Columbus were digitally compiled by Columbus staff. Information pertaining to the exploration history in the property area had already been compiled by Columbus and was reviewed in conjunction with newly generated Columbus data to assess completeness, consistency and validity of compiled results. Figure 44 is a picture of the storage of the earlier drillholes completed by Guyanor during 1998 and 1999.

Figure 44 – Picture of Core Storage of Older Guyanor Drillholes.

From 29 November 2011 to 2 August 2012, a total of 45 diamond drillholes for 15,824.15m were drilled at Paul Isnard by “SOTRAPMAG SAS”. All drilling was executed by Performax, a company based in Val d’Or, Québec, Canada. This drilling campaign is also referred to as Columbus Phase 1 drilling. Diamond drilling started with HQ diameter drillholes in the saprolite zone and changed to NQ diameter when fresh rock was encountered. Drillholes were logged using standard lithology coding and hydrothermal alteration (sericitisation, silification, epidotisation, albitisation, chloritisation) was also recorded in a standard fashion. Survey control was managed by a local surveying company called Defos du Rau and results were registered to the international CSG67 coordinate system.

For density measurements, drill core was cut into half using a diamond saw and a total of 1,170 density measurements were completed on site using the Archimedes Immersion method. Density measurements were done using a balance with a precision (read-out) to 1 decimal. Density measurements were done on half core except for 5 drillholes completed in 2012 (MO1293 to MO1297) which were measured on full core samples.

Results from the 2011 and 2012 drilling campaign were gathered in ArcGIS and Gemcom software and the analytical data were stored in an Access database. The most recent Columbus drilling campaign (2013 and 2014, also known as Columbus Phase 2 drilling), concentrated on the northernmost and shallowest portions of the deposit has not significantly changed the interpretation and understanding of the gold mineralisation.

The collars of the diamond drillholes of the different drilling campaigns are well preserved in field but are not encased in cement blocks due to environmental restrictions (Figure 45). The drillhole locations were confirmed with the use of hand-held GPS, as well as in relation to the location of the surroundings, access roads and the exploration camp.

Figure 45 – Example of Core Collar Location in the Field

During the site visit it was verified that the most recent drilling by Columbus has followed the same procedures as applied to all the Columbus drilling phases and that the same drilling company, Pro Forage Guyane (formerly Performax Drilling), was used throughout. The diamond drill core diameter at the start of the drillhole was always established at HQ for the saprolite intercepts, changing to NQ when fresh rock was encountered.

Figure 46 – Core storage at the Paul Isnard Campsite

The core storage facilities at the Paul Isnard Project site is shown in Figure 46. No drilling was going on during the site visit and actual sampling and sample preparation was not observed, except for sampling of the metallurgy twin drillholes which follows a different sampling procedure. Sampling Procedure documents are in preparation and were reviewed in draft format by Coffey. Standard sampling procedures were verified by Coffey and appear to have been applied consistently throughout all Columbus drilling campaigns since 2011.

The core logging and sampling procedure is as follows: The drill core is placed into the core trays usually in standard 1m length intervals respecting the lithological boundaries while care is taken not to break core except at length of tray, and then is logged geologically in the core trays at the exploration camp. Core recovery is recorded together with RQD. The original sample lengths are related to lithological boundaries (minimum length 0.5m, maximum length 1.2m) and are recorded in the logs. The core is marked and sawed in half using a diamond saw, before being sampled according to the original geological intervals and sent to Cayenne by either plane or helicopter.

Samples in lots of 25kg, usually from standard 1m length intervals which comprise 9 intervals for fresh rock core or 6 intervals for saprolite samples, are sent by plane or helicopter to Cayenne. From Cayenne, samples are sent on a weekly basis by road to FILAB analytical laboratory in Paramaribo, Surinam, at a distance of approximately 350km.

Core logging is done by the geologists directly in GEOTIC format onto a laptop computer and transferred into an Access database. All information recorded is backed-up weekly onto disc and sent to the Cayenne office. There is no local or Cayenne computer server.

Figure 47 and Figure 48 show the verification of a sulphide intersection in Columbus drillhole MO1164 at around 220m and the corresponding logging sheet and analytical details.

Figure 47 – Sulphide Mineralisation Intersection in One of Columbus Drillholes (MO1164)

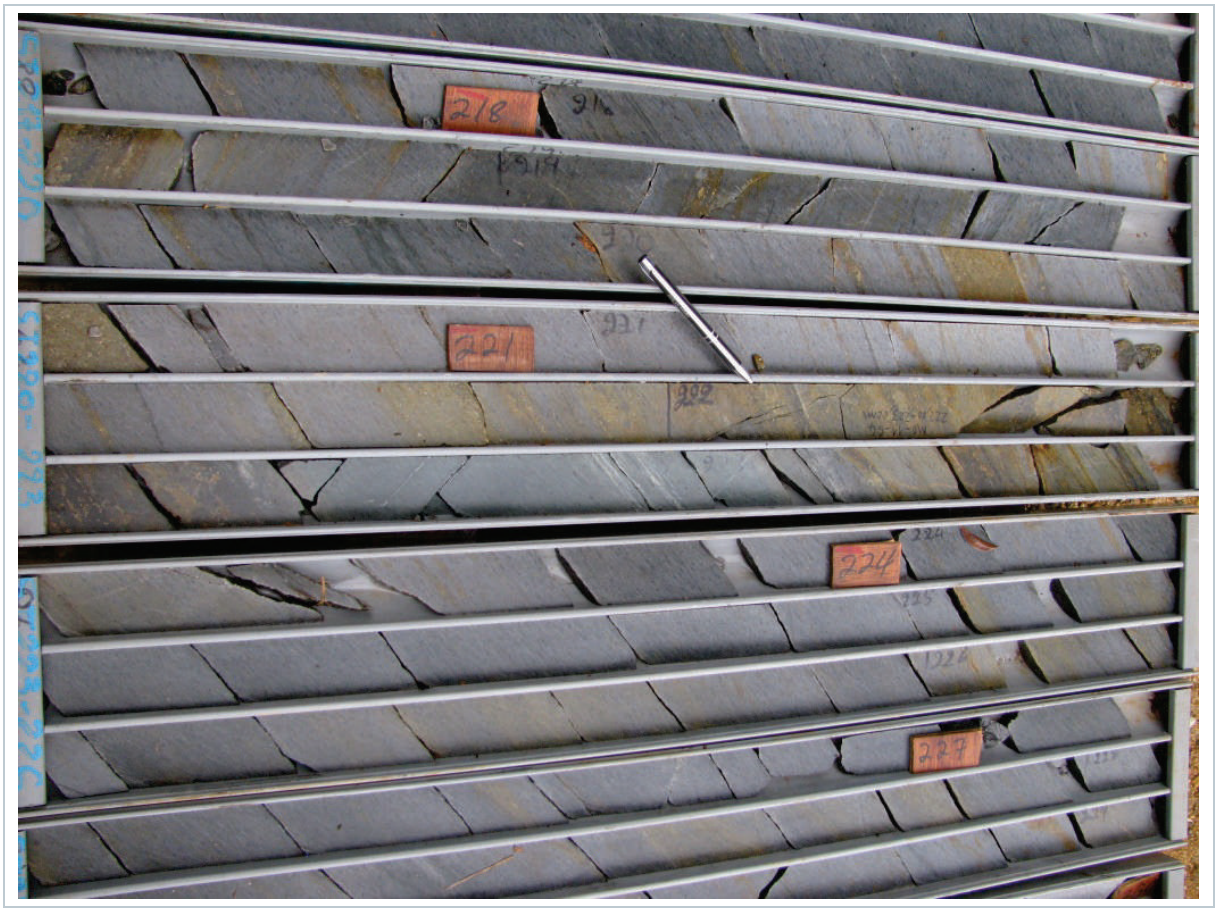
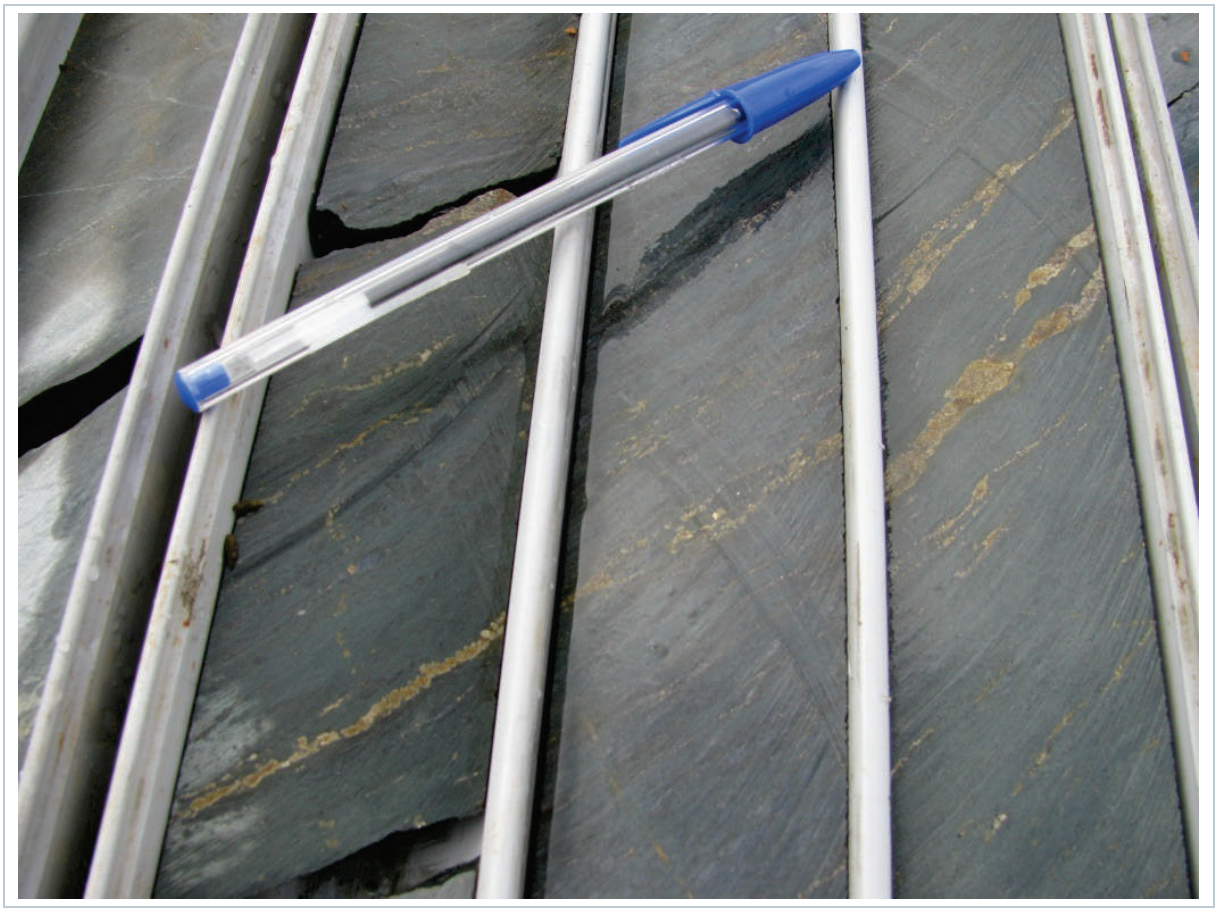


Figure 48 – Example of Sulphide Mineralisation in Drillhole MO14129 at Approximately 81m.



There is a written Standard QAQC Protocol for the insertion of standards and blank samples into the sampling stream to measure and monitor sampling and assaying quality. The use of standards (certified reference samples) and blank samples with a pre-defined proportion of insertion was verified during the site visit: for the Columbus Phase 2 drilling this is 1 standard in 20 samples, and 1 blank sample or 1 duplicate sample per batch of 30 to 40 samples. Standards and blanks are preferentially inserted in sample batches derived from mineralised zones. The logging geologist selects the standard with the most likely corresponding grade to the mineralisation observed in the drillhole.

Bulk density determinations were not completed on site during the latest drilling campaign as an oven for drying the samples before carrying out the measurement was not available. Currently, a Weighing Room has been prepared with a new balance installed (G-122-SP-4001 electronic balance, Ohaus Corporation, New Jersey USA) for carrying out systematic bulk density determinations in mineralised and waste zones (one sample every 10m in mineralisation and one sample every 20m in non-mineralised zones) during the execution of the additional infill drilling programme.

During the site visit, an informal written Sample Bulk Density Determination Procedure (used for Columbus Phase 1) was studied. From at least every 3m of drillcore length, a sample is selected on the basis of lithology and mineralisation. If the observed mineralisation is especially strong, samples are selected from before, within and after the mineralised zone. The sample length is measured as precisely as possible. A balance with a read-out to 2 decimals is used to first measure the sample weight under dry conditions, then the sample is put in a wire net and the weight of the sample plus the wire net is measured with the sample fully immersed in water. The weight of the wire net without sample is then subtracted from the second reading to obtain the weight of the immersed sample only. Saprolite and saprock samples are wrapped in a plastic film before being immersed in water. The dry bulk density is calculated as the ratio of the dry sample weight divided by the difference of the dry and the wet sample weights. This measurement procedure is considered by Coffey as industry standard.

Coffey observed that the original Guyanor core samples contain missing sample intervals and sample mixing as result of re-logging of the core. The criteria used by Guyanor for core logging were different from the Columbus criteria. Re-logging or re-validation of the core to the current Columbus logging standards has not been completed. Due to the observed issues of drillcore integrity the Guyanor drilling is considered of a lower quality than the Columbus managed drilling.

Coffey discussed the status of the Guyanor drillholes during the site visit and studied the quality data available for the original Guyanor drillholes (refer Section 11.3). Coffey concludes that the Guyanor drillholes are of sufficient quality to be used in the current study. However, Coffey believes that the lower quality of the Guyanor drillholes must be taken into account during the resource classification process, and that at some stage in the future re-drilling of the Guyanor drillholes will be required as re-sampling of the available drill core is no longer an option.

Follow-up drilling due to commence in July 2014is expected to consist of the completion of the 89 authorised infill drillholes, without any depth restrictions, distributed along strike throughout the mineralisation. This programme will enable an improved geological interpretation of geology and mineralisation on closer spaced north-south cross sections, the definition of a detailed lithological, geological, weathering/alteration model and a redefinition of the spatial distribution of mineralised domains for low grade and high grade zones that will improve the estimation of block grades.

12.2. Validation of drilling parameters and data

A selection of eight diamond drillholes were reviewed in detail for the current estimation purpose. Digital records of drilling were checked against original source documents provided by Columbus and both consistency and accuracy of such records were assessed. Similar checks were carried out against this and the Columbus drilling dataset after completion of internal validation by Columbus. Parameters reviewed in detail include collar coordinates, down-hole survey values, hole depths, sample intervals, assay values and lithology codes.

After completion of checking the details of recording procedures, drillhole logging and sampling procedures, and verifying the system for the database records, and taking into account what is the reported in Section 11.3, Coffey considers the drillhole database to be acceptable for supporting the resource estimation programme described in this report.

12.3. Independent assay of drill core and laboratory visit

Coffey did not carry out an independent analysis of drillcore samples during the site visit in 2014. Visual inspection of the core during the site visit verified that higher grades of eight drillholes selected were clearly identifiable displaying alteration and mineralisation macroscopically in the core.

Coffey did not visit the analytical laboratory in Paramaribo in 2014. The FILAB analytical laboratory in Paramaribo is used for all core assays and is affiliated to ALS; FILAB is acting as the agent for ALS in Surinam. The laboratory possesses an ISO9001 certificate and an ISO/IEC17025 issued on 31 January 2014.

13. Mineral Processing and Metallurgical Testing

Columbus has not undertaken any metallurgical test work since they acquired the property in November 2010. However, they have already completed a total of six twin drill holes specifically for metallurgical studies as discussed in Section 12.1. Results are expected during 2014.

The following is adapted from Stryhas (2012) describing the historical metallurgical work that has been undertaken on the Montagne d'Or mineralisation. Coffey has not relied on any of the assumptions or conclusions in this historic work, and has provided this commentary for descriptive purposes only.

13.1. Testing and Procedures

There have been three metallurgical test programs conducted on Paul Isnard Project samples between 1998 and 2008. In these test programs, various metallurgical variables were examined to determine the optimum design parameters for the processing plant including:

- Gravity separation;
- Flotation;
- Cyanidation of whole ore and concentrates;
- Grinding size for liberation;
- Bottle roll testing; and
- Bond ball mill work index.

The samples selected were representative of the type of mineralisation and grade present on the property.

13.1.1. Historic Testwork (June 1998)

Resource Development Inc (RDI), located in Wheatridge, Colorado, conducted bottle roll testing on two samples designated as semi-massive and disseminated. The objective of the test program was to determine the refractory nature of the two samples. The test results indicated that the contained gold could be extracted by cyanide from both samples and the ores were not refractory. The tests were undertaken at particle size passing 100% of 270 mesh (53 microns), 40% solids, pH of 11 and NaCN addition rate of 10g/L. The results for the 48hr leach products for the two samples gave high average gold recoveries of 85% and 90% for the semi-massive and disseminated samples, respectively.

13.1.2. Historic testwork (July 1998)

RDi conducted a second metallurgical test program in July 1998 on the samples from the June 1998 tests to examine:

- gravity recovery for both semi-massive and disseminated samples;
- bottle roll leaching of the disseminated sample to determine its amenability to heap leaching; and
- intensive leaching of the feeds and residues from the June 1998 tests to examine the extraction of zinc and copper.

The composite samples were ground to a particle size passing 100% of 48 mesh (300 microns). Free gold was noted in both samples and tests were conducted using both Gemini and Diester tables. The Gemini table recovered 17.8% and 35.5% of the gold from semi-massive and disseminated samples respectively. The Diester table recovered 73.1% and 61.6% of the gold from semi-massive and disseminated samples respectively.

Bottle roll kinetic leach tests were conducted on a disseminated sample to determine its amenability to heap leaching. The test conditions were done on the receipted sample as is (particle size) at 40% solids, pH >10.5, and 1g/L NaCN. The gold and silver extractions were 57.7% and 29.1%, respectively, after 100hrs of leaching; however, very little additional extraction (1.7%) occurred during the last 48 hours. The bottle roll test results indicated that a gold recovery of 60% to 70% could be achieved by heap leaching.

Intensive leaching conditions of the feed and residue samples from the June 1998 testwork program were done to examine the extraction efficiencies of zinc and copper. There was negligible zinc recovered in either sample and low copper recoveries were observed in both semi-massive and disseminated samples, 10% and 22% respectively.

13.1.3. Historic testwork (February 2008)

An additional metallurgical test program was completed by RDi in 2008. The program was comprised of:

- Bonds ball mill work index;
- Grind establishment tests;
- Gravity tests;
- Flotation tests; and
- Leach tests.

The tests were conducted on three composites, which were categorised according to the parameters shown in Table 13.

Table 13 – Parameters Obtained from a Metallurgical Study Conducted by RDi in 2008

Categorisation Parameters and Assays for Three Composites in the RDi February 2008 Metallurgical Test Program						
Composite No	Composite Classification	ppm Au	ppm Ag	% S (Total)	ppm Hg	ppm Cu
1	Au > 0.5ppm; Cu < 400ppm	1.42	1.31	0.67	0.06	244
2	Cu > 500ppm	2.95	14.53	2.41	0.07	3995
3	Au < 0.5ppm	0.18	14.35	0.99	<0.05	177

The Bond ball mill work index was determined for Composite No. 3 at 100 mesh (150 microns) grind was 11.25kWh/t. The Bond ball mill work indices for Composites 1 and 2 were determined using an indirect method of grind time-grind size data. The results were estimated to be 8.88kWh/t and 9.88kWh/t for Composites 1 and 2 respectively. Bond ball mill indices of 9 to 14 are considered a as medium rock hardness.

Gravity tests were conducted to determine if the contained free gold could be recovered from the ore into a concentrate. The gravity tests were conducted on all three composites with a 1kg charge ground to P_{80} 65 mesh (212 microns) and 100 mesh (150 microns) in a 3.5 inch diameter KC-MD3 Knelson concentrator. The test results indicate that that majority of the gold is free and amenable to gravity concentration with gold recoveries between 68.5% and 89.0%.

Additional large-scale gravity tests were undertaken using Gemini table and Diester table in a gravity cleaning stepto examine the potential to produce a high-grade concentrate for direct smelting. The results indicated this is possible with 35% to 53% of the contained gold reporting to the concentrate from Composite 1 and Composite 2 respectively.

Flotation tests were done on the gravity concentration tails for the three composites at a primary grind of P_{80} 65 mesh (212 microns) using AeroPromoter 404, potassium amyl xanthate (PAX) and MIBC frothing agent. The test results indicate gold recoveries of 76% and 81% for Composites 1 and 2.

Whole ore flotation tests were conducted on the three composites at a P_{80} grind of 150 mesh (106 microns) using the same reagents as the gravity concentration tails flotation tests. Gold recoveries of 79%, 85% and 92% were obtained for Composites 1, 2 and 3 respectively.

The lower gold recoveries noted for Composite 3 for both the gravity tails and whole ore flotation tests are due to the lower head grades of 0.08 Au g/t and 0.23 Au g/t.

Leach tests were conducted on:

- gravity tailings;
- flotation tailings; and
- whole ore.

The gravity tailings leach tests were done at P_{80} 100 mesh (150 microns) for 48 hrs at 40% solids and pH 11. The test results indicate that a majority (over 90%) of the gold is extracted within the first 24 hrs of leaching.

Cyanide leach tests were also done on rougher and cleaner gravity tailings from the large-scale gravity tests for Composites 1 and 2 at a P_{80} 100 mesh (150 microns). The gold recovery from the gravity rougher tailing samples was about 83%; with gold recovery from the gravity cleaner tailings for Composites 1 and 2 were 91% and 61% respectively. The lower recovery in Composite 2 was due to its higher copper content. Thus, the overall gravity plus leach recoveries for Composites 1 and 2 are 90.6% and 88.6% respectively.

The leach result of the flotation tailings was significantly lower for Composite 1 at 61% after 48 hrs, whereas for Composites 2 and 3 they were 93.0% and 98.2% respectively after 24 hrs. Whole ore leaching tests were done on all three composites at P_{80} 100 and 150 mesh (150 and 106 microns), 40% solids, pH 11 and 1g/L NaCN. The results indicate that a majority of the gold is extracted in 24 hrs leach time with low NaCN consumption rates.

The results of RDi's metallurgical testwork indicate that the gold is predominantly free. However, gravity concentrating methods alone will not recover a sufficient amount of the gold into a product that can be directly smelted. A satisfactory gold recovery of greater than 85% can be achieved by direct cyanidation or a combination of gravity and cyanidation of gravity tailings or flotation and cyanidation of flotation tailings.

RDi's recommendation for the scoping level (conceptual) flowsheet is a combination of gravity and carbon-in-leach (CIL) of the gravity tailings for recovery of the gold into a doré. Due to the low copper grade, no copper recovery is included in this flowsheet or recovery circuit design.

13.2. Mineral processing

A proposed processing flowsheet for the Paul Isnard Project based on the scoping level metallurgical test results would be as follows utilising conventional technologies for the production of gold doré:

- Primary crushing using a jaw crusher;
- Grinding using a SAG – ball mill configuration;
- Gravity concentrating using Gemini and Diester tables for production of a gravity concentrate for direct smelting;
- Cyanide leaching and CIP;
- Carbon stripping; and
- Induction furnace for production of a gold doré.

Additional metallurgical testwork will be carried out on a total of 975.7m of core sampled with 6 recently drilled twin holes of HQ diameter in fresh rock. Figure 49 shows an example of recent metallurgical core of HQ size. The total material consists of approximately 2.5 tonnes of mineralised intercepts which are currently being shipped to Vancouver, Canada, (Figure 50) where they will be investigated by Inspectorate Company. The results are expected to be available at the end of 2014.

Figure 49 – Example of a metallurgical drillcore at HQ size

Figure 50 – Storage of Metallurgical Samples before Shipment To Canada for Metallurgical Testing

14. Mineral resource estimates

14.1. Introduction

A total of eight distinct, parallel, closely spaced sub-vertical mineralised domains were modelled. A statistical assessment of raw sample lengths indicates that most samples are taken at a nominal core length of approximately 1m (average length 1.04m) but that there are a number of samples with larger support. Only 24 assays with an average value of 0.04g/t Au derive from sample lengths greater than 3m and 3m composites were selected for the resource estimation. Grade interpolation for gold was completed using Ordinary (Block) Kriging.

Coffey completed this Mineral Resource Estimate in June 2014 using drillhole details provided by Columbus. Initial mineralisation wireframes were also provided by Columbus but were reviewed by Coffey and adjusted to the latest drilling formation and in view of the geological model for the mineralisation that emphasises the occurrence of thin higher grade mineralised zones. The drillhole spacing at this stage is not favourable for adequately defining mineralised envelopes of higher grade domains inside the lower grade domains. The wireframes have been digitised and snapped to drillholes and accommodate internal waste (defined by raw assay values lower than 0.25g/t Au) in current domains defining a mixture of low grade and high grade mineralisation and continuity that is reasonable for the current drilling spacing.

The Mineral Resource Estimation presented in this study is based upon a total of 157 drillholes (155 of which have assay values) consisting of the drilling completed by Guyanor from 1996 to 1998 and all drillholes completed by Columbus from 2011 to 2014 as discussed in Section 10. This database therefore includes the historic diamond drillholes completed by Guyanor that was part of the previous resource estimates.

RSG Global completed a Canadian National Instrument 43-101 compliant estimation of an Inferred Mineral Resource Estimate for a previous property owner in January, 2004. The subsequent change of property ownership and the amendment to NI 43-101 in 2011 determine that estimate to be a “historical estimate”. A subsequent NI 43-101 compliant Independent Mineral Resource Estimates were completed for Golden Star and Columbus by SRK Consulting in 2008 and 2012 and the latest estimate was completed by Coffey Mining Canada in 2012.

Drilling sections are spaced from 50m to 200m along strike with intercepts on each section varying from 50m to over 100m separation down dip. The resource remains open in several directions. Mineral Resources were classified entirely as Inferred Resources based on confidence in the data, current drillhole spacing, and the apparent continuity of mineralisation.

This estimate represents the fourth Mineral Resource Estimate completed for the Montagne d'Or Prospect in the Paul Isnard Project. The estimate has been prepared in compliance with CIM Definition Standards (2010) and NI 43-101 by Mr Louis Voortman, with an Effective Date of 27 June 2012.

Mr Voortman is a professional resource geologist with over 30 years of experience in mineral exploration and mineral resource estimation. His experience is with base metals and precious metals. Mr. Voortman is a Chartered Professional Geologist registered as a Fellow with the Australasian Institute of Mining and Metallurgy in Melbourne, Australia. Mr Voortman is independent of Columbus as that term is defined in Section 1.5 of the Instrument.

The current mineral resources are deemed to be mineable in principle using standard large scale open pit mining methods. At this stage there are no environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other relevant factors known that could materially affect the mineral resource estimates.

14.2. Resource estimation

14.2.1. Estimation procedures

The Montagne d'Or Prospect is an “exploration stage property” as defined in the NI 43-101 as no PFS has yet been conducted and no reserves have been estimated. The historical exploration information has now been supplemented by recent drilling and sampling that justify the preparation of a new resource estimate.

Drilling during 2013 and 2014 focused on in-fill drilling throughout the deposit but was concentrated on the northern most portion of the mineralisation. Despite this progress, additional drilling will be required to fully delimit and define the mineralisation, especially for adequately defining the higher grade domains that occur within the current low grade domains and extensions of the deposit to depth.

The estimate of Mineral Resources presented here was prepared from a geostatistical block modelling method based on drillcore-derived data. The mineral resource model is constrained by an interpreted geological/structural boundary of gold mineralisation constructed as a 3D wireframe interpreted from sectional drilling and all available assay data.

The evaluation of mineral resources followed a number of steps as follows:

- Validation of database and review/update wireframes received from Columbus;
- Perusal of geology publications provided by Columbus;
- Database compilation and QAQC verification;
- Import of 3D wireframes, adjustment of wireframes to additional drillhole information, generation of new wireframes minimising internal waste, wireframe verification;
- Modelling of mineralisation boundaries using Maptek Vulcan version 9.0.1 64-bit build date 2 March 2014;
- Drillhole data processing (compositing, top-cutting, domain flagging, allocation of average density values to lithology types), statistical analysis and variography;
- Selection of block estimation strategy and estimation parameters;
- Block modelling and grade estimation;
- Sensitivity analysis of a series of plausible block model sizes and search strategies for controlling and minimising high grade smearing;
- Validation and resource classification;
- Assessment of “reasonable prospects” and selection of reporting cut-off grades;
- Preparation of Mineral Resource Statement and sensitivity analysis; and
- Reconciliation against previous estimates.

14.2.2. Drillhole database

Data was delivered in the form of an Access database and additional Excel spreadsheets containing collar locations, down-hole survey data, lithology codes, sampling intervals and 32,181 gold assay results and a total of 1,211 rock density measurements. Analytical Quality Control data was also received, including assays for blanks, duplicates and standards inserted into the sample stream as described and discussed in Section 11.

Coffey received the drilling database from Columbus at the beginning of June 2014 with supplementary data received on 20 June and 25 June respectively. The supplementary data comprised all available density measurements (derived from Columbus Phase 1 drilling) and the results of additional surveyed collar coordinates (14 drillholes) of the 2014 drilling campaign.

The Access database provided was originally constructed, at Columbus' request, by Mine Development Associates (MDA) in May 2014. MDA were requested to "produce a database of sufficient quality to support publically reportable, Canadian Instrument NI 43-101- compliant resource estimations, subject to evaluation of the available quality assurance/quality control data (a task that was not undertaken by MDA)" (MDA, 2014). MDA validated all the then existing data for the Paul Isnard project, inputting data from the original laboratory assay reports where necessary. A field of "Au_ppm_USE" was created, prioritising the primary gravimetric assay over the primary AAS assay. The constructed Access database was checked for validity by both automated and manual checks. New drilling data, from the 2014 Phase 2 drill programme, has recently been added to this database by Columbus.

On receipt of the data Coffey conducted the following basic validation steps:

- Check of minimum and maximum assay values and confirmation or editing of those outside the expected ranges, and
- Check for gaps, overlaps and out-of-sequence intervals for assay and lithology tables.

This latest validation process found only a very few data issues which were corrected in consultation with Columbus (a total of 14 re-surveyed drillhole collar coordinates mentioned above, refer Table 14) and one suspicious down-hole survey value in drillhole MO1164 which was removed.

Coffey is of the opinion that the updated database is suitable "(fit for purpose") as the basis for the mineral resource estimate.

Table 14 – Listing of Drillholes with Collar Coordinates Corrected in Consultation with Columbus

DHID	Easting (m)	Northing (m)	RL (m)	Depth (m)
MO14129	173763.0	520849.9	196.8	122.0
MO14148	173002.2	520478.8	296.2	150.8
MO14149	172844.0	520634.9	243.1	164.0
MO14150	172801.6	520633.7	242.0	161.0
MO14151	172402.4	520614.7	276.8	125.0
MO14152	172497.7	520593.9	274.7	161.0
MO14153	172712.7	520577.0	222.4	152.0
MO14154	172652.8	520716.9	200.0	155.0
MO14155	172598.1	520701.0	213.1	173.0
MO14156	172401.2	520687.5	237.2	149.0
MO14157	172499.8	520700.1	229.5	185.0
MO14158	172701.3	520724.5	181.1	153.0
MO14159	172849.4	520750.1	188.9	130.0
MO14160	173402.2	520804.8	217.7	165.8

Coordinate System: CSG 167 datum UTM Zone 22

14.2.3. Geological model

Coffey has defined a total of eight detailed mineral wireframes using a nominal 0.25g/t Au mineralisation cut-off which is identical to the mineralisation cut-off used in the most recent previous resource estimate (2012). The mineralisation occurs scattered through all the drillholes from start to end of the hole, and care was taken achieve a trade-off between enclosing as much as possible of the gold mineralisation above the mineralisation cut-off, and minimise the amount of internal waste (assay values below 0.25g/t Au) within the wireframes.

The main geological control for the direction of the mineralised wireframes (Domains) was taken as the S1 shear zone at a strike of 080° east and dipping 70° sub-vertically towards the south. This direction follows the major east-west structural trend; the overall strike and dip directions of all mineralised domains closely follows this orientation. The full database of rock density measurements was investigated and results are reported in Section 14.2.5.

From south to north the Domains are numbered sequentially (from 110 to 170) and a listing of the domain colours and numbers is provided in Table 15. The main portion of the mineralisation is captured within Domains 130 (Red), 140 (Blue) and 150 (Yellow). A separate Domain with limited extent (named Yellow-NW and numbered 160) was defined in the westernmost portion of the area to capture mineralisation intersected in two drillholes. A separate Domain (named Orange with number 180) was included in the western margin between the Grey and Red Domains. The domains were cut to topography and the triangulation volumes are also reported in the table.

Table 15 – Listing of Mineralisation Domain Numbers, Allocated Colours and Volumes

Domain	Triangulation
110	e_pink_0614.00t
120	e_Grey_0614.00t
130	e_red_0614.00t
140	e_blue_0614.00t
150	e_yellow_0614.00t
160	e_green_0614.00t
170	e_yellow_NW_0614.00t
180	e_orange_0614.00t

All wireframes enclosing mineralised domains were incorporated in the block model; a sub-blocking process was used to fill the domains adequately. Figure 51 shows an overview of the wireframes in plan view and the overall cover of the deposit by drillholes along strike. Figure 52 provides an oblique view looking towards the east and shows the orientation of the mineralised Domains dipping steeply to sub-vertical towards the south, and the general direction of the diamond drillhole towards the north.

Along strike of the deposit, the Domains bifurcate and amalgamate to capture most of the mineralisation and avoid the unnecessary inclusion of internal waste. The Domains are cut by topography. Where possible the domains are made as thin as possible to capture mineralised intervals above 0.25g/t Au, however locally some mineralisation remains in the waste area between the Domains. This waste area is coded as Domain number zero in the block model.

Figure 51 - Plan View of Mineral Domains Steeply Dipping towards the South (Bottom) and Drillhole Distribution along Strike

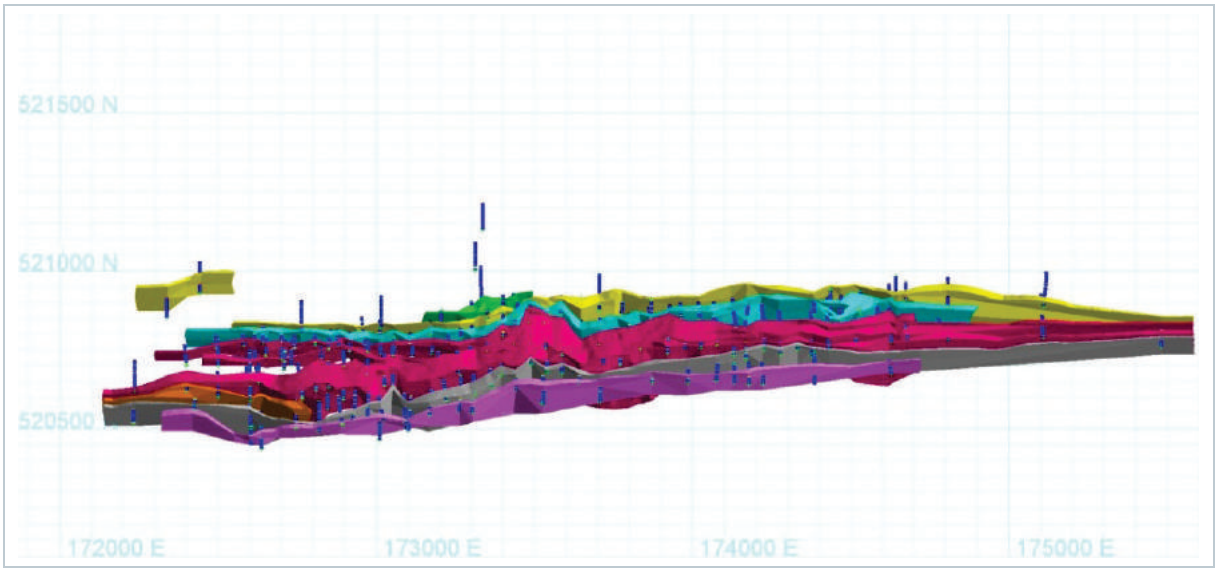
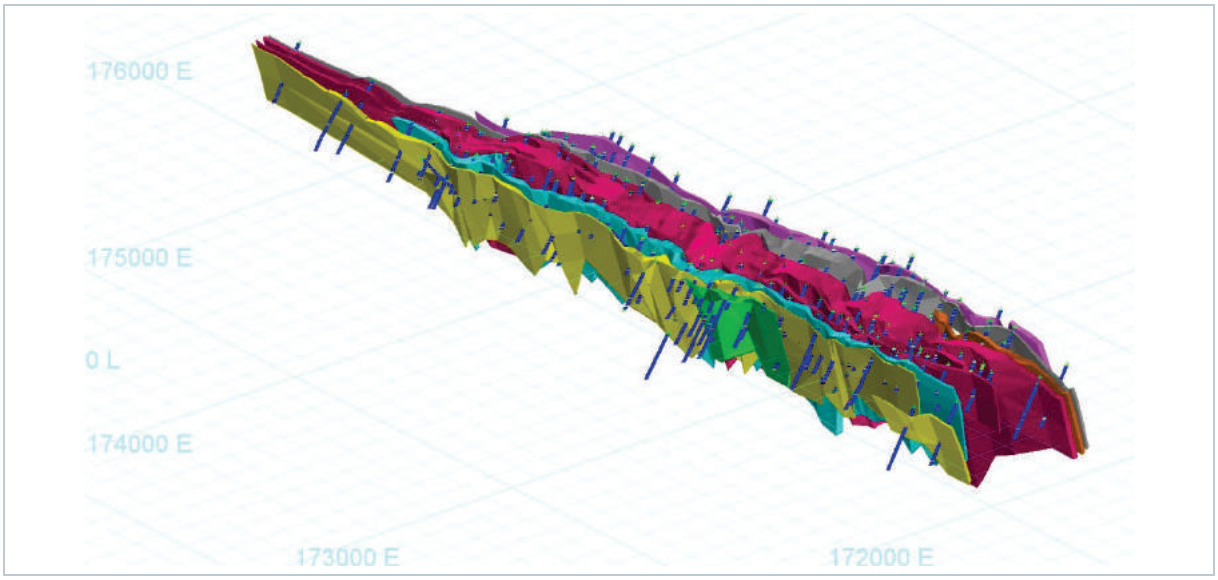


Figure 52 - Oblique View of the Mineralised Domains, Steeply Dipping towards the South (Right)

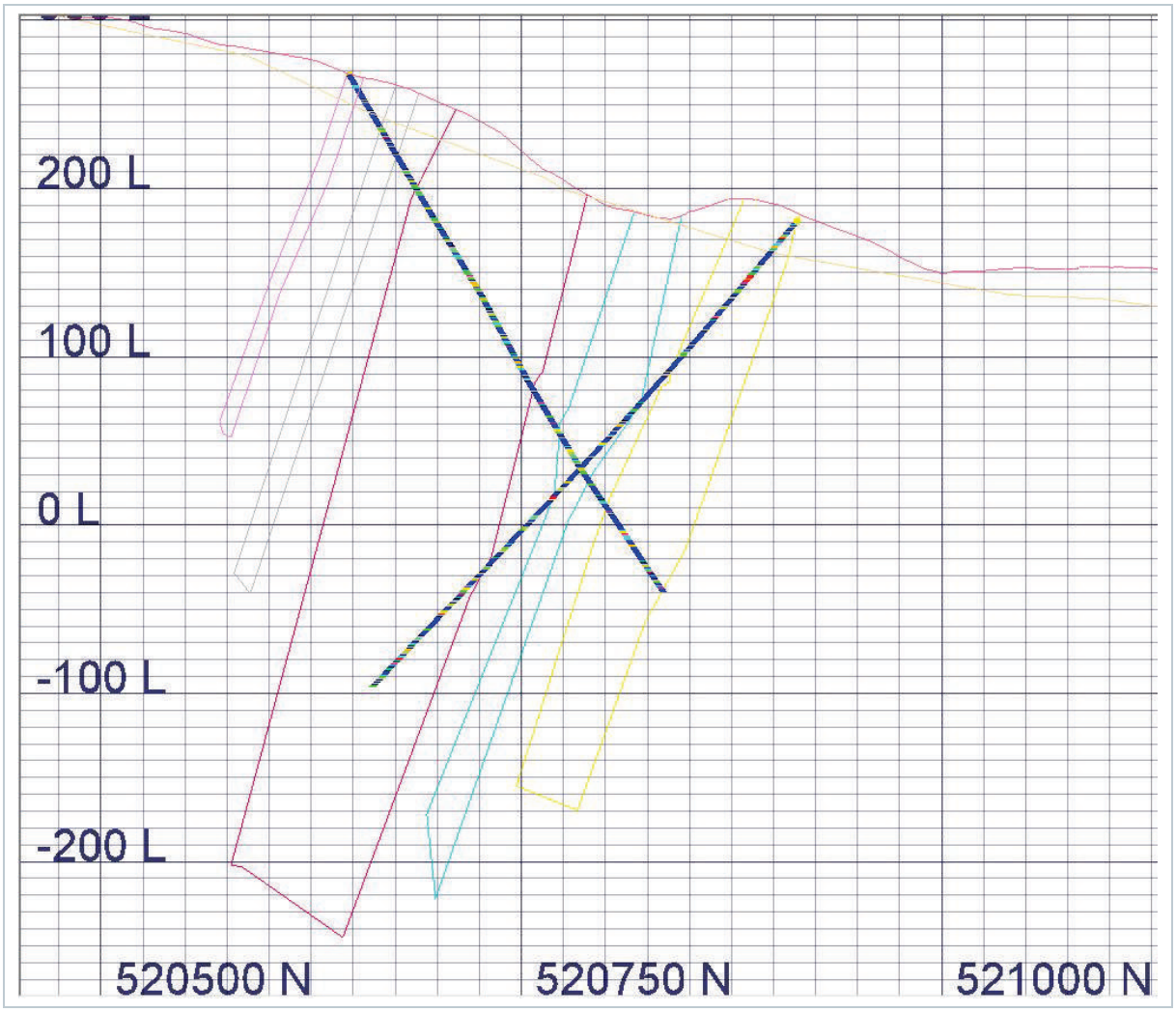


The greatest volume of the mineralised Domains is made up of Domains 130, 140 and 150. Domain 130 is the largest Domain and varies in thickness from around 20m in the far western portion of the deposit to a thick unit or to one or more bifurcating units in the centre with a maximum thickness of up to approximately 130m, and decreasing towards the eastern portion of the deposit to a combined thickness (within the classification envelope) of around 35m.

A separate surface was created for saprolite as a hard boundary between fresh and oxidized mineralisation. Figure 53 shows a typical cross section through the wireframes defining the mineralised Domains at 173,640mE with the red line showing the topography surface and the orange line the top of fresh. Insufficient drilling data for the upper saprolite region exists at this stage. Until such time that sufficient drillhole data for the saprolitic zone is available to treat this as a separate mineralised Domain, Coffey decided to model the extensions of the mineralised Domains into the saprolitic zone with the fresh variogram model based on all data. The waste Domains in between the mineralised Domains, both within fresh and the saprolite zone, are modelled separately using the waste variograms.

All domains were extended as far as possible to depth and results from the three-pass kriging interpolation were used to decide to how far the mineralisation may be validly extrapolated down depth. All mineral wireframes were used during the resource estimation.

Figure 53 - Typical Cross Section through the Mineralised Domains at 173,640mE



14.2.4. Statistical analysis and compositing

The drillhole data available for the resource estimation consist of a total of 157 diamond drillholes, comprising a total of 32,181 samples. Two most recent drillholes were not yet allocated reliable collar coordinates at the time of the study (drillholes MO14161 and MOP14162) and have not been considered in the study. A total of 14 drillholes of the latest drilling campaign was re-surveyed after an issue was found with the original survey instrumentation and the collar locations were corrected in the database. A total of 157 drillholes was used for modelling comprising 56 drillholes from earlier Guyanor drilling and 101 drillholes completed by Columbus since 2011); 155 drillholes are available for resource estimation as there are no assay values for two drillholes (MO9747 and MO14158A). A listing of drillhole numbers is provided in Table 16. Table 17 provides a listing of drillholes with recently re-surveyed and corrected collar locations.

Table 16 - List of drillholes available for the study

	From drillhole	To drillhole	Number
Guyanor	MO9601	MO9618	18
	MO9719	MO9748	30
	MO9849	MO9856	8
Columbus Phase 1	MO1161	MO1165	5
	MO12066	MO12105	40
Columbus Phase 2	MO13106	MO13111	6
	MO14112	MO14162	52
Total			159

Table 17 - List of drillholes with re-surveyed collar locations

DHID	Easting (m)	Northing (m)	RL (m)
MO14129	173763.0	520849.9	196.8
MO14148	173002.2	520478.8	296.2
MO14149	172844.0	520634.9	243.1
MO14150	172801.6	520633.7	242.0
MO14151	172402.4	520614.7	276.8
MO14152	172497.7	520593.9	274.7
MO14153	172712.7	520577.0	222.4
MO14154	172652.8	520716.9	200.0
MO14155	172598.1	520701.0	213.1
MO14156	172401.2	520687.5	237.2
MO14157	172499.8	520700.1	229.5
MO14158	172701.3	520724.5	181.1
MO14159	172849.4	520750.1	188.9
MO14160	173402.2	520804.8	217.7

Coordinate System: CSG 167 datum UTM Zone 22

No channel samples have been included in the database or used in the interpretation because of the differences in sample support.

The raw drillhole data was flagged with the wireframes for each mineralised domain and assessed through histograms, cumulative frequencies and probability plots to verify the data distributions and assess the need for using a top-cut. Listings of statistics of sample length and Au value per individual Domain (Domain 0 is allocated to the area between the mineralised zones) are provided in Table 18 and Table 19. A listing of cumulative frequency plots for the domains is provided in Appendix A.

Table 18 - Statistics of sample lengths of raw assay data within the Domains

Sample length (m) – Raw data									
Domain	0	110	120	130	140	150	160	170	180
Number	19,756	302	760	7,383	2,733	1,057	56	15	122
Minimum	0.15	0.50	0.60	0.10	0.30	0.50	0.25	1.00	0.85
Maximum	4.70	1.60	3.00	4.00	3.10	2.30	3.00	2.00	1.50
Mean	1.06	1.01	1.03	1.03	1.00	1.01	1.05	1.10	1.03
Median	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Std Dev	0.25	0.11	0.14	0.20	0.15	0.16	0.32	0.28	0.11
Variance	0.06	0.01	0.02	0.04	0.02	0.02	0.10	0.08	0.01
Std Error	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00
Coeff Var	0.24	0.10	0.13	0.19	0.16	0.15	0.30	0.26	0.11
10th perc	1.00	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00
20th perc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30th perc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40th perc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50th perc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60th perc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70th perc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80th perc	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00
90th perc	1.20	1.00	1.00	1.00	1.00	1.00	1.17	1.25	1.00
95th perc	1.50	1.17	1.40	1.50	1.20	1.20	1.31	1.63	1.18
97.5th perc	2.00	1.45	1.50	1.50	1.30	1.50	1.44	1.81	1.50
99th perc	2.00	1.50	1.50	2.00	1.60	1.87	2.16	1.93	1.50

Table 19 – Statistics of Au values of raw assay data within the Domains

Au (g/t) – Raw Data									
Domain	0	110	120	130	140	150	160	170	180
Number	19,753	302	760	7,383	2,733	1,057	56	15	122
Minimum	0.001	0.010	0.010	0.002	0.002	0.002	0.002	0.003	0.002
Maximum	70.990	3.980	17.080	163.000	59.800	62.500	7.160	40.100	5.960
Mean	0.081	0.369	0.484	0.904	0.929	0.769	0.767	5.454	0.345
Median	0.025	0.100	0.220	0.160	0.135	0.110	0.320	0.091	0.120
Std Dev	0.712	0.650	1.162	3.963	2.933	3.046	1.316	11.514	0.690
Variance	0.508	0.423	1.349	15.704	8.603	9.278	1.731	132.579	0.477
Std Error	0.000	0.002	0.002	0.001	0.001	0.003	0.023	0.768	0.006
Coeff Var	8.755	1.762	2.402	4.385	3.156	3.959	1.716	2.111	2.000
10th perc	0.007	0.020	0.030	0.020	0.010	0.010	0.031	0.005	0.010
20th perc	0.010	0.030	0.070	0.030	0.020	0.020	0.068	0.009	0.029
30th perc	0.010	0.050	0.100	0.060	0.032	0.040	0.110	0.016	0.060
40th perc	0.020	0.070	0.160	0.100	0.070	0.060	0.172	0.018	0.080
50th perc	0.025	0.100	0.220	0.160	0.135	0.110	0.320	0.091	0.120
60th perc	0.030	0.170	0.290	0.263	0.270	0.250	0.450	0.930	0.210
70th perc	0.050	0.290	0.390	0.422	0.480	0.440	0.614	1.205	0.300
80th perc	0.080	0.556	0.563	0.740	0.891	0.690	0.718	6.170	0.456
90th perc	0.150	1.010	0.910	1.620	1.914	1.354	2.016	15.975	0.726
95th perc	0.230	1.588	1.620	3.190	4.346	2.902	3.122	28.325	1.078
97.5th perc	0.354	2.798	2.390	6.463	7.589	5.657	4.496	34.213	1.996
99th perc	0.730	3.348	4.432	13.168	13.403	10.790	5.984	37.745	2.915

A statistical assessment of the raw sample lengths indicates that most samples are taken at a nominal core length of approximately 1m. Figure 54 shows the histogram of the sample lengths for all domains combined (on the left). The figure indicates that the average sample length is around 1.04m but that there are a number of samples with larger support (up to a maximum sample length of 4.7m, however this maximum sample length relates to a barren intersection). The histogram of all samples located within the major mineralised Domains (130, 140 and 150) is also provided in Figure 54 (on the right). The maximum sample length within the major domains is 4m. Only 24 assays (at an average value of 0.04g/t Au) derive from a sample length greater than 3m and 3m composites were selected for the resource estimation.

Figure 54 - Histogram of raw sample lengths in all drillcore samples (left) and within the major mineralised Domains (right)

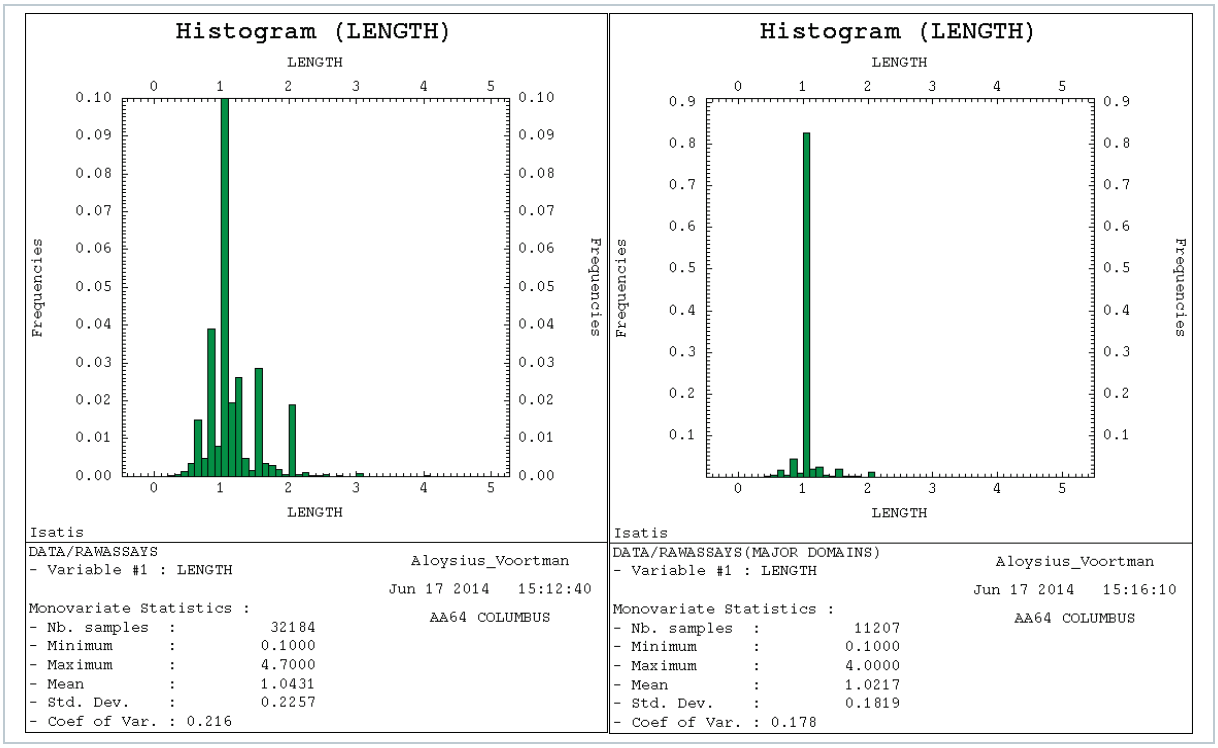
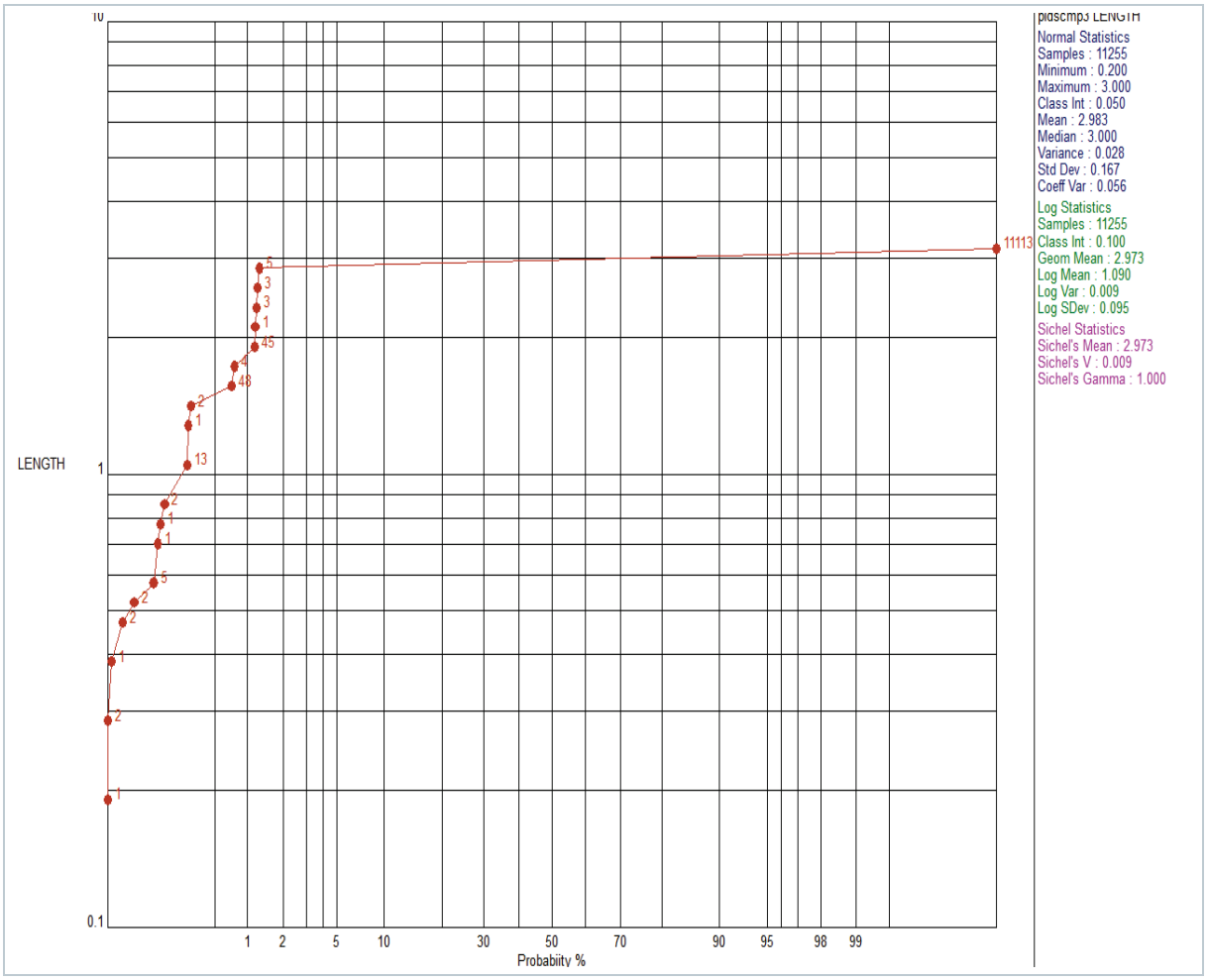


Figure 55 shows the lengths after compositing to 3m composite intervals within the mineralised domains. Out of 11,255 composites, a total of 11,113 (98.7%) have a length of 3m; 142 remainder lengths occur, of which only 17 lengths are below 1m. The composites are therefore accepted as being “at equal sample support”, however the maximum composited assay value of 67.6g/t Au value indicates that the gold distribution in the 3m composites is still highly skewed.

Figure 55 - Results of lengths after compositing into 3m within mineralised domains



The composite data set was flagged with the mineralised domains and a listing of statistics of the composite lengths is provided in Table 20. Domain Number 0 defines the space between the mineralised domains and any sample falling within this domain will be used for the creation of a waste model to ensure that all available gold assay values will be used in the final model. A listing of statistics of the composite Au values within the individual domains and the waste domain is provided in Table 21.

Table 20 - Statistics of 3m composite lengths within the mineralised domains

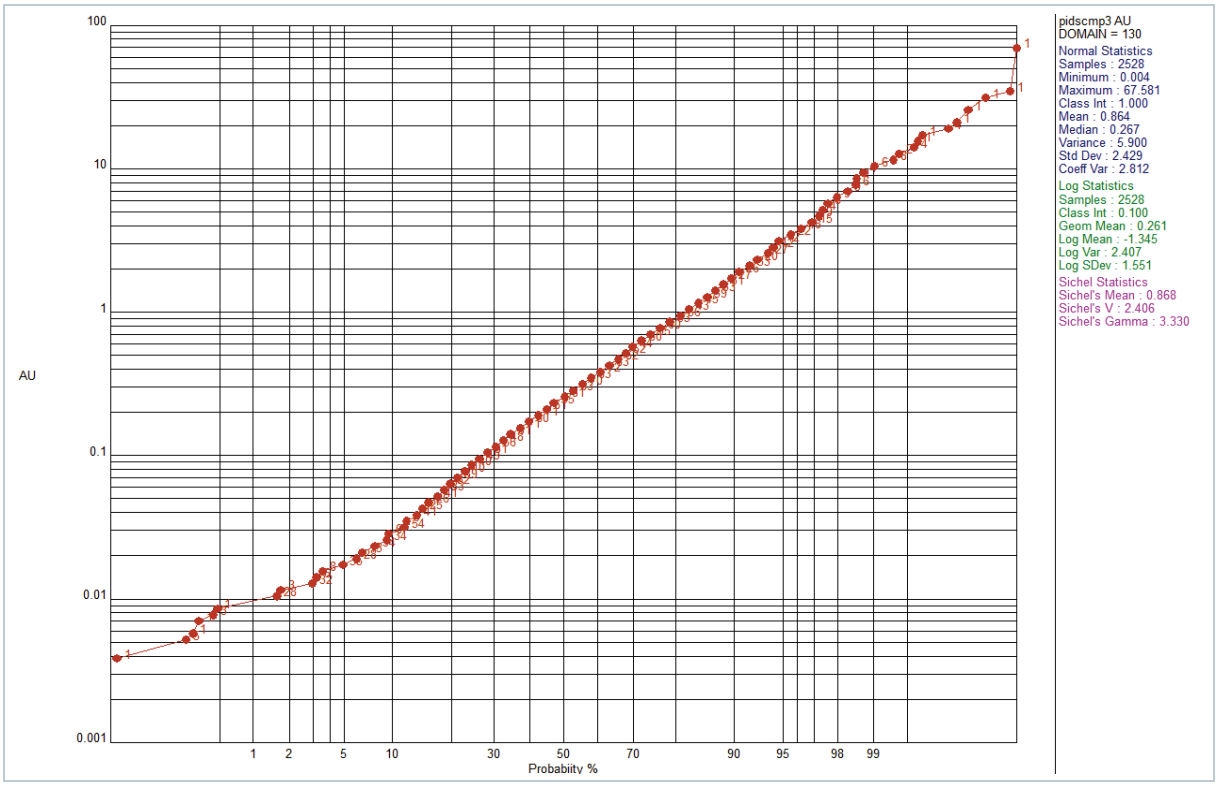
Composite lengths (m) – 3m Composites									
Domain	0	110	120	130	140	150	160	170	180
Number	7,039	100	256	2,528	915	354	18	5	40
Minimum	0.20	1.50	3.00	1.60	3.00	1.40	3.00	3.00	3.00
Maximum	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Mean	2.97	2.99	3.00	3.00	3.00	2.98	3.00	3.00	3.00
Median	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Std Dev	0.21	0.15		0.04		0.15			
Variance	0.04	0.02		0.00		0.02			
Std Error	0.00	0.00		0.00		0.00			
Coeff Var	0.07	0.05		0.02		0.05			
10th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
20th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
30th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
40th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
50th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
60th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
70th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
80th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
90th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
95th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
97.5th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
99th perc	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Table 21 - Statistics of Au in 3m composite data within the mineralised domains

Au (g/t) – 3m Composites									
Domain	0	110	120	130	140	150	160	170	180
Number	7,039	100	256	2,528	915	354	18	5	40
Minimum	0.001	0.010	0.010	0.004	0.002	0.002	0.026	0.012	0.009
Maximum	23.873	2.473	6.397	67.581	17.242	27.017	2.593	6.085	2.073
Mean	0.100	0.319	0.449	0.864	0.863	0.721	0.630	3.249	0.331
Median	0.033	0.152	0.279	0.267	0.281	0.237	0.319	2.544	0.211
Std Dev	0.488	0.406	0.693	2.429	1.699	1.982	0.730	2.927	0.447
Variance	0.238	0.165	0.480	5.900	2.886	3.928	0.532	8.568	0.200
Std Error	0.000	0.004	0.003	0.001	0.002	0.006	0.041	0.585	0.011
Coeff Var	4.860	1.271	1.544	2.812	1.967	2.747	1.159	0.901	1.351
10th perc	0.010	0.023	0.063	0.030	0.020	0.020	0.030	0.012	0.047
20th perc	0.013	0.047	0.117	0.067	0.043	0.037	0.057	0.012	0.067
30th perc	0.019	0.070	0.162	0.118	0.096	0.079	0.147	0.080	0.091
40th perc	0.025	0.111	0.217	0.183	0.180	0.154	0.295	0.148	0.165
50th perc	0.033	0.152	0.279	0.267	0.281	0.237	0.319	2.544	0.211
60th perc	0.048	0.237	0.340	0.389	0.410	0.335	0.393	4.940	0.240
70th perc	0.067	0.360	0.411	0.610	0.624	0.489	0.516	5.000	0.303
80th perc	0.100	0.502	0.549	0.951	1.057	0.752	1.046	5.059	0.367
90th perc	0.179	0.653	0.842	1.868	2.366	1.458	1.588	5.572	0.563
95th perc	0.285	1.157	1.353	3.437	3.937	3.027	2.030	5.829	1.567
97.5th perc	0.485	1.457	1.791	5.611	5.752	4.592	2.311	5.957	1.700
99th perc	0.991	1.573	3.995	10.394	8.342	6.856	2.480	6.034	1.924

The mineralisation in Domains 110 to 180 is well-described by the composite distributions. As an example the cumulative histogram plot of the composite values within Domain 130 is shown in Figure 56. The plot indicates that the distribution of gold values within this mineralised domain is, for practical purposes, close to a 2-parameter lognormal distribution. The figure also indicates that higher gold values are part of the same distribution and should, without further evidence, not be regarded as outlier values, for example belonging to a different mineralisation event.

Figure 56 – Example of the composite distribution in Domain 130



Domains 130, 140 and 150 evidently are the main mineralised domains with average values of around 0.86g/t Au for 130 and 140, and 0.72g/t Au for 150. These Domains are reasonably well informed by the drilling along strike, and to a lesser extent to depth. The average values in Domains 160, 170 and 180, towards the footwall of the mineralised assemblage, show lower mean values. However, the number of composites that are at this stage available for Domains 160, 170 and 180 are low. The number of composites available in Domains 100 and 120 (100 and 256 respectively) is also not high. Nevertheless, the resource likely to occur within these domain may be estimated using a spatial model defined from all data combined as the geology of all domains is interpreted as based on the same geology, the same structures and the same pattern of mineralisation. There is no geological reason, and also no evident statistical reason, for not combining all the available data with the aim to define a useful and workable variogram model.

The mineralisation in the saprolite domain also display a clean distribution that for practical purposes is close to a 2-parameter lognormal distribution. This implies that when in future more drilling is available from the saprolite horizon, it may be expected that a valid resource model for the saprolite on its own can be generated. At the current stage, where saprolite samples are not extensive, it is decided to define the variogram model for all mineralisation from all available data although from a geological point of view it will be better to treat the saprolite zone as a distinct unit. Material in the saprolite waste zone has therefore been estimated using a different variogram model.

The coefficient of variation (CoV) is the ratio of the standard deviation to the mean. It is a relative measurement of sample variability and, if the ratio is much higher than 1, care should be taken during estimation using a linear Kriging algorithm. CoV ratios that are significantly higher than 1 indicate that the underlying statistical distributions are skewed and that the influence of high grades during Kriging interpolation should be controlled to avoid unrealistic smearing of high assay values.

The composite statistics in Table 22 shows that the CoV ratios for the major mineralised Domains 130, 140 and 150 are 2.8, 2.0 and 1.7. This means that the influence of high grades during estimation needs to be carefully controlled.

The composite values were de-clustered to determine the influence of de-clustering on overall statistics. The current drilling pattern is such that spatial de-clustering of the drillhole data does not significantly influence drillhole statistics of the 3m composite data. Table 22 provides a listing of statistics for a range of de-clustering cell sizes.

Table 22 - Statistics for a number of de-clustering cell sizes on 3m composites

X dim (m)	Y dim (m)	Z dim (m)	Average (g/t)	StDev (g/t)
25	10	25	0.3679	1.4264
50	15	50	0.3701	1.4064
75	20	75	0.3651	1.4173
100	25	100	0.3593	1.4586
125	30	125	0.3340	1.3884
150	35	150	0.3187	1.3186

The statistics of the 3m composite data provided in Table 21 indicated that the data distribution is highly skewed: in the mineralised domains 130, 140 and 150 which contain the majority of the mineralisation, the value of the 97.5th percentile is around 5g/t to 6g/t Au. This implies that top-cutting is required to control the influence of a small number of high composite gold values during block estimation.

The investigation of the by cumulative frequency histograms of the gold distributions within the different domains also indicates that they are for practical purposes close to 2-parameter log-normal distributions. A cumulative frequency plot for Au of the 3m composites within all mineralised Domains is provided in Figure 57, and for the major mineralised Domains 130, 140 and 150 in Figure 58.

Figure 57 - Cumulative frequency plot for Au of 3m composites within all mineralised domains

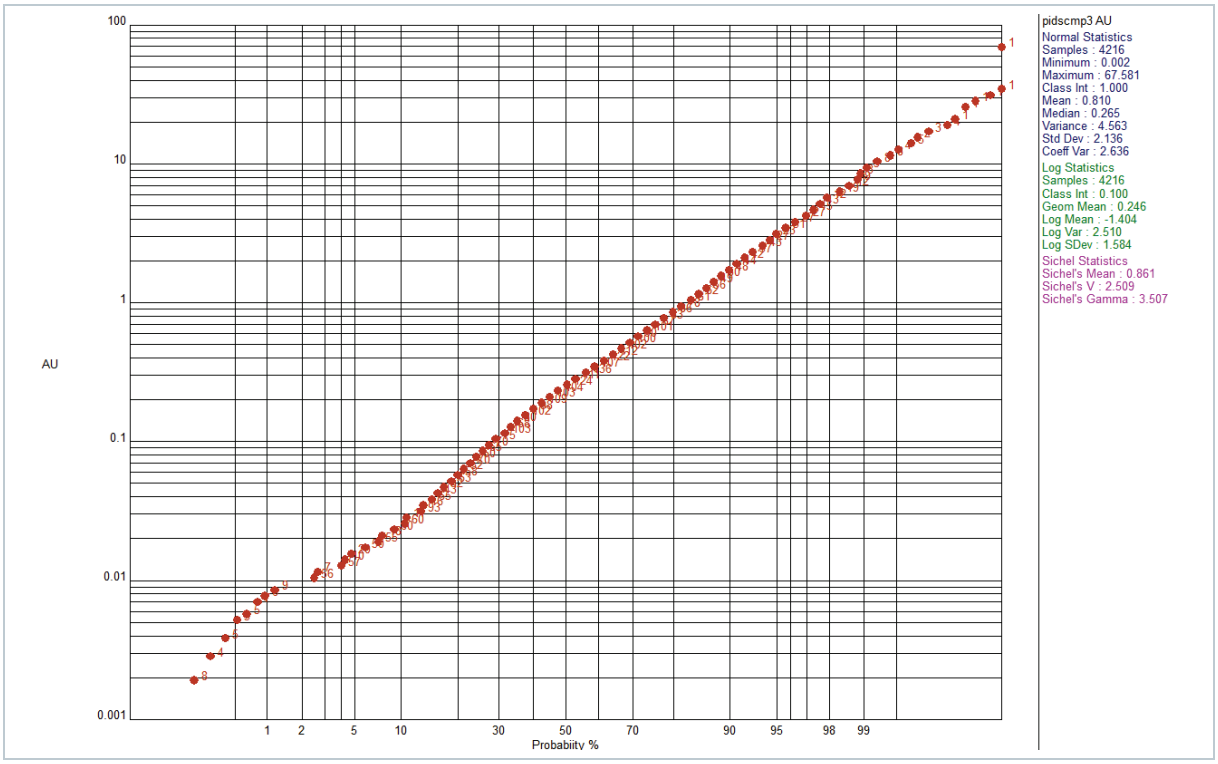
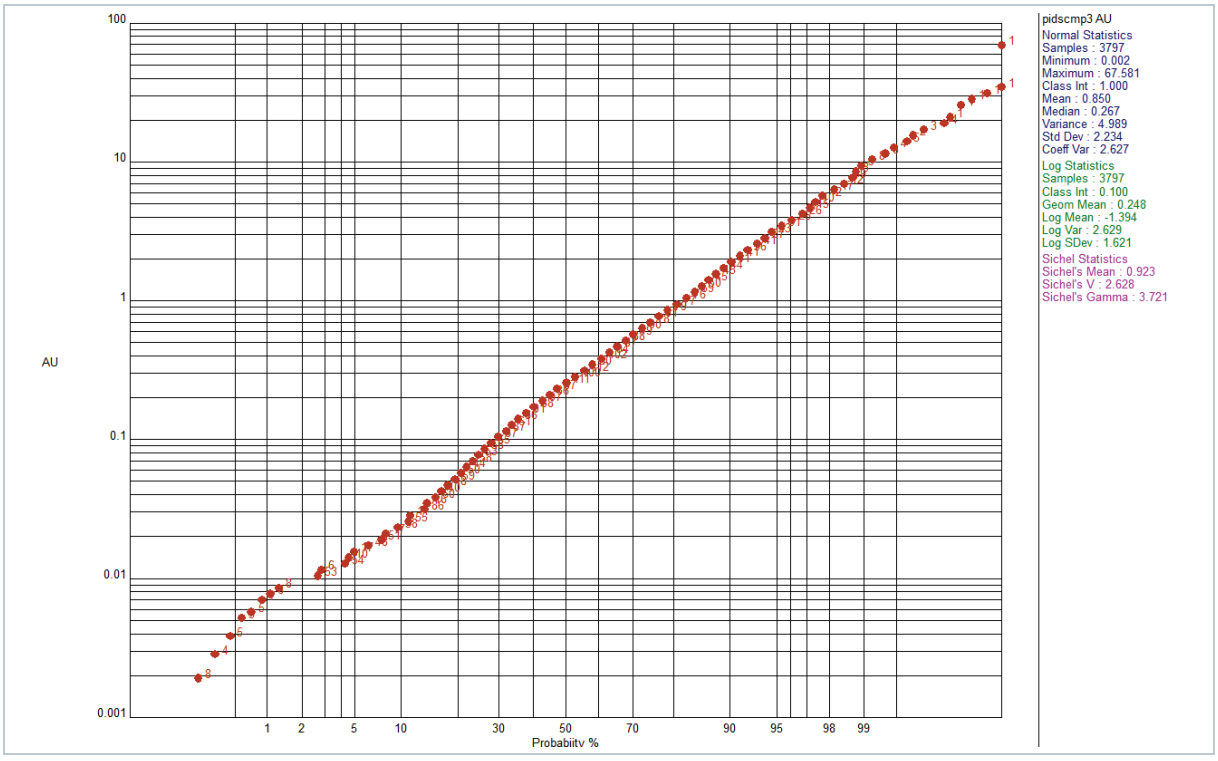


Figure 58 - Cumulative frequency plot for Au of 3m composites within mineralised Domains 130, 140 and 150



The cumulative frequency histograms show that the distributions are well-behaved and that there is no obvious inflection point that would indicate a “natural” top-cut value. Statistics for all 3m composites within all mineralised domains (Domain 110 to 180) is provided in Table 23. The 97.5th percentile of all 3m composites is approximately 5g/t Au and the 99th percentile approximately 9g/t. Therefore, the influence was studied of (a number of different) top-cuts and statistics for all Domains combined are included in Table 23, and for separate Domains in Table 24.

Table 23 - 3m composite statistics and the influence of different top-cuts for all mineralised domains combined

Mineralised Domains 110 to 180	Au (g/t) no topcut	Au (g/t) topcut 5g/t	Au (g/t) topcut 10g/t	Au (g/t) topcut 16g/t
Number	4,216	4,216	4,216	4,216
Minimum	0.002	0.002	0.002	0.002
Maximum	67.581	5.000	10.000	16.000
Mean	0.810	0.675	0.749	0.780
Median	0.265	0.265	0.265	0.265
Std Dev	2.136	1.069	1.442	1.679
Variance	4.563	1.143	2.080	2.818
Std Error	0.001	0.000	0.000	0.000
Coeff Var	2.636	1.584	1.926	2.151
10th perc	0.027	0.027	0.027	0.027
20th perc	0.060	0.060	0.060	0.060
30th perc	0.113	0.113	0.113	0.113
40th perc	0.181	0.181	0.181	0.181
50th perc	0.265	0.265	0.265	0.265
60th perc	0.380	0.380	0.380	0.380
70th perc	0.567	0.567	0.567	0.567
80th perc	0.907	0.907	0.907	0.907
90th perc	1.826	1.826	1.826	1.826
95th perc	3.320	3.320	3.320	3.320
97.5th perc	5.129	5.000	5.129	5.129
99th perc	9.218	5.000	9.218	9.218

Table 24 - Listing of 3m composite statistics at a number of different top-cuts in each mineralised Domain

Domain	Count	Top-cut 5g/t Au		Top-cut 10g/t Au		Top-cut 16g/t Au	
		Mean (g/t)	Variance $(g/t)^2$	Mean (g/t)	Variance $(g/t)^2$	Mean (g/t)	Variance $(g/t)^2$
3mcomposites not de-clustered							
110	100	0.3194	0.1632	0.3194	0.1632	0.3194	0.1632
120	256	0.4420	0.4076	0.4488	0.4782	0.4488	0.4782
130	2,528	0.6915	1.1627	0.7800	2.2939	0.8191	3.2070
140	915	0.7642	1.3958	0.8379	2.2867	0.8618	2.8328
150	354	0.6010	1.0293	0.6528	1.6739	0.6867	2.5098
160	18	0.6296	0.5027	0.6296	0.5027	0.6296	0.5027
170	5	3.0200	5.7647	3.2488	6.8546	3.2488	6.8546
180	40	0.3306	0.1947	0.3306	0.1947	0.3306	0.1947
3mcomposites de-clustered at parent cell size 25x10x10							
110	100	0.3103	0.1540	0.3103	0.1540	0.3103	0.1540
120	256	0.4472	0.4183	0.4552	0.5003	0.4552	0.5003
130	2,528	0.6901	1.1697	0.7772	2.2800	0.8144	3.1489
140	915	0.7825	1.4393	0.8625	2.4053	0.8903	3.0415
150	354	0.5936	1.0078	0.6407	1.5974	0.6729	2.3922
160	18	0.6347	0.4653	0.6347	0.4653	0.6347	0.4653
170	5	3.0200	5.7647	3.2488	6.8546	3.2488	6.8546
180	40	0.3468	0.2140	0.3468	0.2140	0.3468	0.2140
3mcomposites de-clustered at 50x20x50							
110	100	0.3132	0.1533	0.3132	0.1533	0.3132	0.1533
120	256	0.4508	0.4229	0.4593	0.5105	0.4593	0.5105
130	2,528	0.6915	1.1639	0.7763	2.2462	0.8134	3.1123
140	915	0.7954	1.4706	0.8740	2.4125	0.9001	3.0082
150	354	0.6051	1.0316	0.6568	1.6739	0.6900	2.4930
160	18	0.6530	0.4803	0.6530	0.4803	0.6530	0.4803
170	5	3.0200	5.7647	3.2488	6.8546	3.2488	6.8546
180	40	0.3361	0.2008	0.3361	0.2008	0.3361	0.2008
3mcomposites de-clustered at 100x20x100							
110	100	0.3090	0.1627	0.3090	0.1627	0.3090	0.1627
120	256	0.4722	0.5191	0.4842	0.6434	0.4842	0.6434
130	2,528	0.6847	1.1730	0.7695	2.2496	0.8066	3.1187
140	915	0.7405	1.3869	0.8132	2.2770	0.8388	2.8557
150	354	0.5975	1.0253	0.6464	1.6479	0.6874	2.6604
160	18	0.7470	0.5672	0.7470	0.5672	0.7470	0.5672
170	5	3.0200	5.7647	3.2488	6.8546	3.2488	6.8546
180	40	0.3361	0.2008	0.3361	0.2008	0.3361	0.2008
	100	0.3090	0.1627	0.3090	0.1627	0.3090	0.1627

Coffey selected a top-cut of 16g/t Au as the cap for the overall 3m composite data; at this top-cut a total of fifteen composite values are affected. Historical studies by RSG and SRK both capped the high grade to 1oz/t Au or 30g/t Au while the latest study completed in 2012 also capped the data at 16/g/t.

A value of 10g/t corresponding to approximately the 90th percentile of the gold distribution in the major mineralised Domains 130, 140 and 150, was selected as the threshold for restricting the influence of high grades during the Kriging estimation process to a distance of 35m along strike, 35m down depth and 20m across strike.

14.2.5. Bulk density

The average relative dry rock density measurement for each of the lithology codes provided by Columbus is presented in Table 25. The method and procedure used to determine the density is documented in Section 11.

The full database of rock density measurements was perused. The database contains measurements of the Columbus drilling campaigns in 2011 and 2012. Additional density measurement from the 2013 and 2014 drilling are unfortunately not available at the time of the study. Average density values were verified from this database for all major (but simplified) lithological units comprising felsic and silicified felsic tuff, hyperchlorite facies, mafic dyke, and mafic volcanics. An average of 1.89t/m^3 was obtained for saprolitic rocks from the database which is deemed close to the saprolite density used in previous resource estimates. As all other density results are the same as used in earlier estimates, the saprolite density of 1.90t/m^3 was maintained.

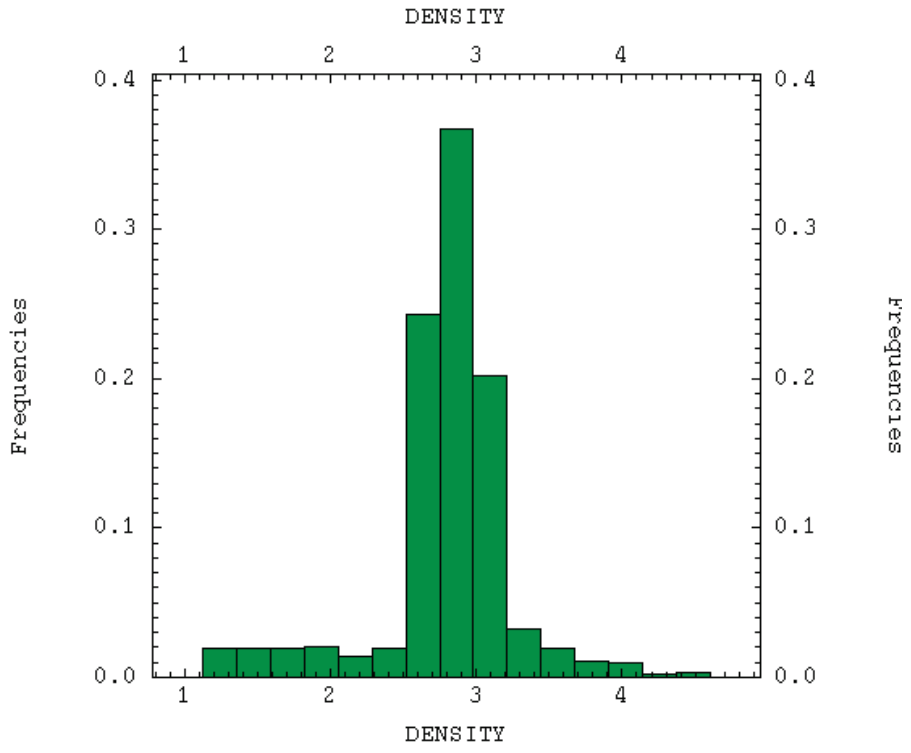
Table 25 - Average Relative Density measurements available from the Columbus 2011 and 2012 and 2012 drilling programme

Lithology	Density (t/m^3)	Number
FT	2.94	328
FTSIL	2.81	405
HYPCHL	3.19	63
MD	3.01	101
MV	3.06	128
SAP	1.89	149

Figure 59 displays a histogram of the available density measurements in Table 25; histograms for density measurements in the individual Domains are provided in Appendix B.

The distribution of the lithological units changes along strike and with depth. The current drillhole spacing has not enabled the development of an unambiguous spatial lithology model for the meta-volcanic package on which to base a deposit density model. The use of a Probability Kriging method was assessed for modelling the distribution of lithology within the deposit but, although realistic patterns to appear, it was decided to not use this further in the block modelling process. Instead, all logged lithological codes were allocated an average dry rock density based on the simplified lithology coding and results are shown in Table 26.

Figure 59 - Histogram of all available density measurements from the 2011-2012 Columbus drilling programme



Isatis

DENSITY/DATA11JUNE
- Variable #1 : DENSITY

Aloysius_Voortman

Jun 11 2014 10:15:40

AA64 COLUMBUS

Monovariate Statistics :

- Nb. samples	:	1211
- Minimum	:	1.1300
- Maximum	:	4.6000
- Mean	:	2.7917
- Std. Dev.	:	0.4506
- Coef of Var.	:	0.161

Table 26 - Allocation of average density values to lithology types in the drillhole database

Litho Code	Lithology starting with	Description	Numerical Litho Code	Density (t/m^3)
OVB	Ovb	Overburden	110	1.90
SAP	Sap	Saprolitic	120	1.90
FT	T1	Tuff, felsic	200	2.94
FTSIL	FT	Tuff, felsic, silicified	210	2.81
TUFINT	T2	Tuff, intermediate	220	2.94
TUFMAF	T3	Tuff, mafic	230	2.94
4HYPCHL	HYPCHL	Hyperchlorite	300	3.19
VOLMAF	V3	Mafic volcanics	430	3.06
INTINT	I2	Intrusive, intermediate	410	3.01
INTMAF	I3	Intrusive, mafic	420	3.01
SEDS	S6	Sediments	800	1.90
QZVEIN	VNQ	Quartz vein	900	1.90
AMPHIB	M16	Amphibolite	440	3.01

As density values are allocated to individual sample lengths based on the logged lithology code, these values will also be subject to changes during sample compositing in tot 3m intervals. Table 27 shows a comparison between the allocated average densities and the results of the density compositing into 3m lengths.

Table 27 - Check statistics between original allocated density values with the 3m composite density values

Rock Type	Description	Lithology Code	Density Allocated	Density 3mcomps
OVB	Overburden	110	1.902	1.92
SAP	Saprolitic	120	1.902	1.92
Arithm. Average			1.902	1.92
FT	Felsic Tuff	200	2.935	2.93
FTSIL	Silicified Felsic Tuff	210	2.807	2.82
TUFINT	Intermediate Tuff	220	2.935	2.94
TUFMAF	Mafic Tuff	230	2.935	2.94
HYPCHL	Hyperchlorite	300	3.195	3.16
VOLMAF	Mafic volcanics	430	3.060	3.05
INTINT	Intermediate intrusive	410	3.011	3.00
INTMAF	Mafic intrusive	420	3.011	3.00
Arithm. Average			2.99	2.98

The corresponding density database produces a valid variogram model for describing the spatial distribution of rock density. Dry rock density was therefore estimated into the block model using Ordinary Kriging. Figure 60 shows the variogram model for density (left) which is well-defined by a large number of available data pairs (right). A well-defined omnidirectional model has been fitted with, as expected, a low nugget effect and a range of influence of up to 370m. The model has been cross-validated and the mean and variance of the standard error are close to zero. The validation results are sufficiently robust to use the model for a Kriging density interpolation. Table 28 lists the model parameters fitted for the density variogram.

Figure 60 - Omni-directional variogram model fitted to all available density measurements (left), and showing number of pairs (right)

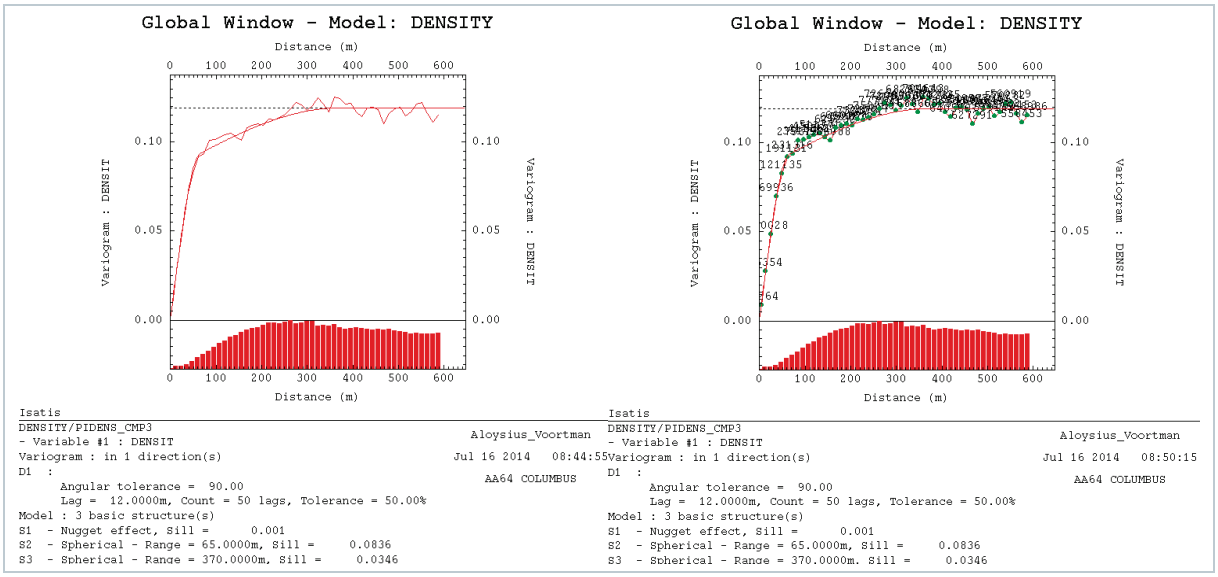


Table 28 - Omni-directional Variogram parameters for the Density variable

No rotation applied	Sill	Proportional Sill	Range (m)
C0	0.001	0.4 %	
C1	0.084	70.3 %	65
C2	0.035	29.2 %	370
Ctot	0.119	100.0 %	

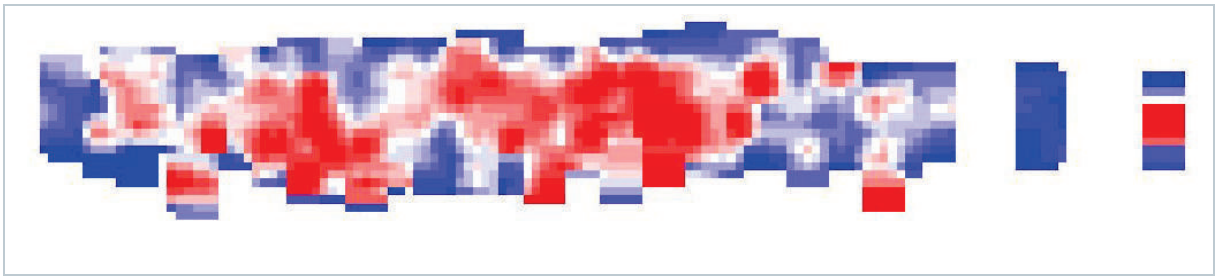
14.2.6. Gold variography

A variogram is a geostatistical tool that is used for predicting the inherent spatial continuity of a dataset as a function of both distance and direction. A variogram parameter is thus a vector describing grade continuity in space. It is important to understand that such a vector describes the continuity in the underlying geology that produced the mineralisation in the first place, and that the fitted variogram model parameters must make “geological sense”. Therefore, variography is closely related to the understanding of the mineralisation and its geological parameters.

There is insufficient data to define spatial models for the mineralisation in each separate domain; 3m composite data from all available mineralised domains has therefore been combined to define a valid spatial structure for the gold mineralisation.

A limited investigation was completed to assess if there were obvious directions or “plunges” in the direction of the gold mineralisation along strike using a “long section” from west to east through the deposit. Figure 61 shows a schematic plot of low (blue) and high (red) Au assays in the raw drillhole data from west (left) to east (right) along strike. The observed patterns suggest at least two major areas along strike with concentrated/elevated gold mineralisation but do not suggest a clear plunge direction for the mineralisation that should be incorporated into the variogram model.

Figure 61 - Schematic Long section from west (left) to east (right) indicating no obvious plunge in the mineralisation (blue is low Au average, red is high)



A series of variogram and correllogram models was generated using the 3m composite data; gold was top-cut at 10g/t Au and at 16g/t Au and the correllogram model at the 10g/t Au top-cut data was selected to best describe the spatial distribution of mineralisation. Figure 62 shows a graphical representation of the rotation of the axes used to define the correllogram model and the search orientation for the estimation passes; Figure 63 shows a graphical representation of the fitted correllogram model and Table 29 provides the relative variogram parameters used in the estimation of gold in all Domains.

Figure 62 – Orientation and size of the search neighbourhoods; left first and right third search neighbourhood.

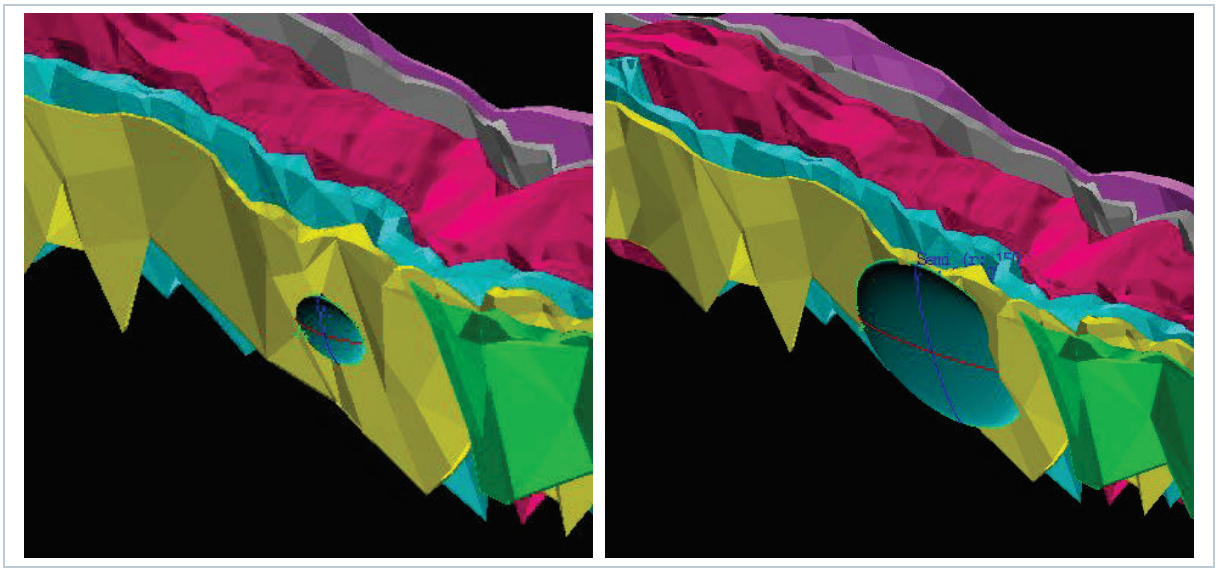


Figure 63 – Correllogram model for all 3m composites within the mineralised Domains

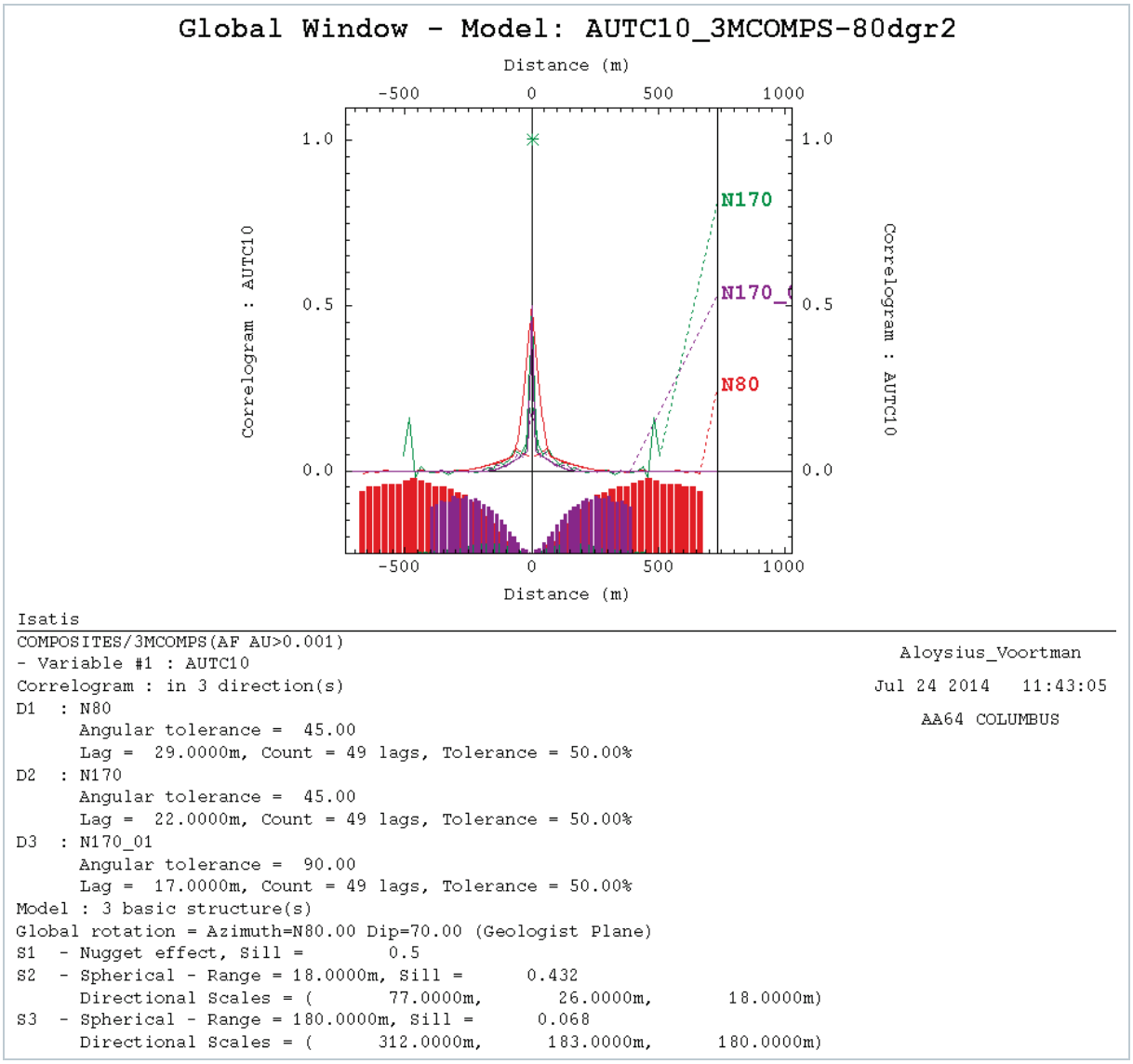
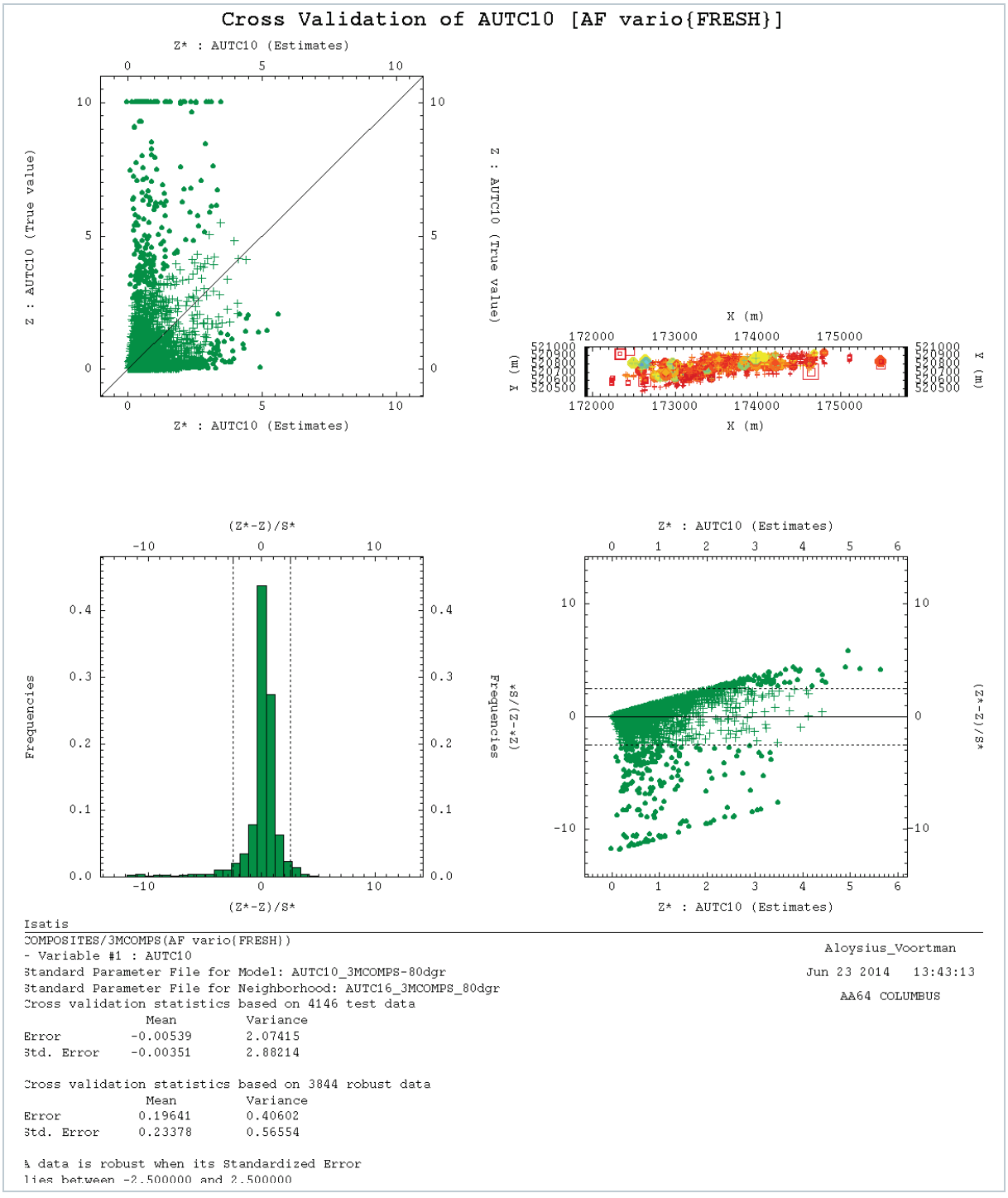


Table 29 - Variogram parameters for Au in all mineralised domains

		Directions after Rotation		
		U (major)	V (semi-major)	W (minor)
		Azimuth 80	Azimuth 170	Azimuth 350
		Dip 0	Dip -70	Dip +20
Variogram Sill		Range U (m)	Range V (m)	Range W (m)
C0	50.0%			
C1	43.2%	77	26	18
C2	6.8%	312	183	180
Total C	100%			

The cross-validation of the Au variogram parameters indicates that a small amount of over- and under-estimation is likely to occur but that the variogram model is robust and valid in principle (refer Figure 64). The mean error and the mean standard error are both reasonably close to zero, however some under/over-estimation is indicated by the statistics of the robust data. This also emphasises that controlling the influence of high grade values during the bock estimation is critical.

Figure 64 - Cross-validation statistics of the Au variogram model parameters using all mineralised data



At this stage there is insufficient data for estimating the mineralisation within the saprolite zone as a separate unit although from geology observations it is advisable to do so in future when sufficient drillhole information has become available.

The current omni-directional model for the saprolite horizon is not a plausible model for the mineralisation in the extensions of the mineralised fresh domains above the top-of-fresh surface. Therefore, these portions have been estimated using the fresh Au variogram.

Model blocks within the waste Domains (numeric code 0) were estimated using an omni-directional variogram fitted to all gold composites occurring outside the mineralised Domains. Figure 65 shows the variogram model used for the estimation of gold in the waste domain below the saprolite surface ("top of fresh") and Figure 66 shows the omni-directional variogram used for the estimation of gold in the waste portions of the saprolite zone.

All waste portions in the block model are estimated separately. Table 30 lists the parameters of the omni-directional variogram models for waste areas.

Figure 65 - Omni-directional variogram model used for the estimation of Au in the fresh waste domain

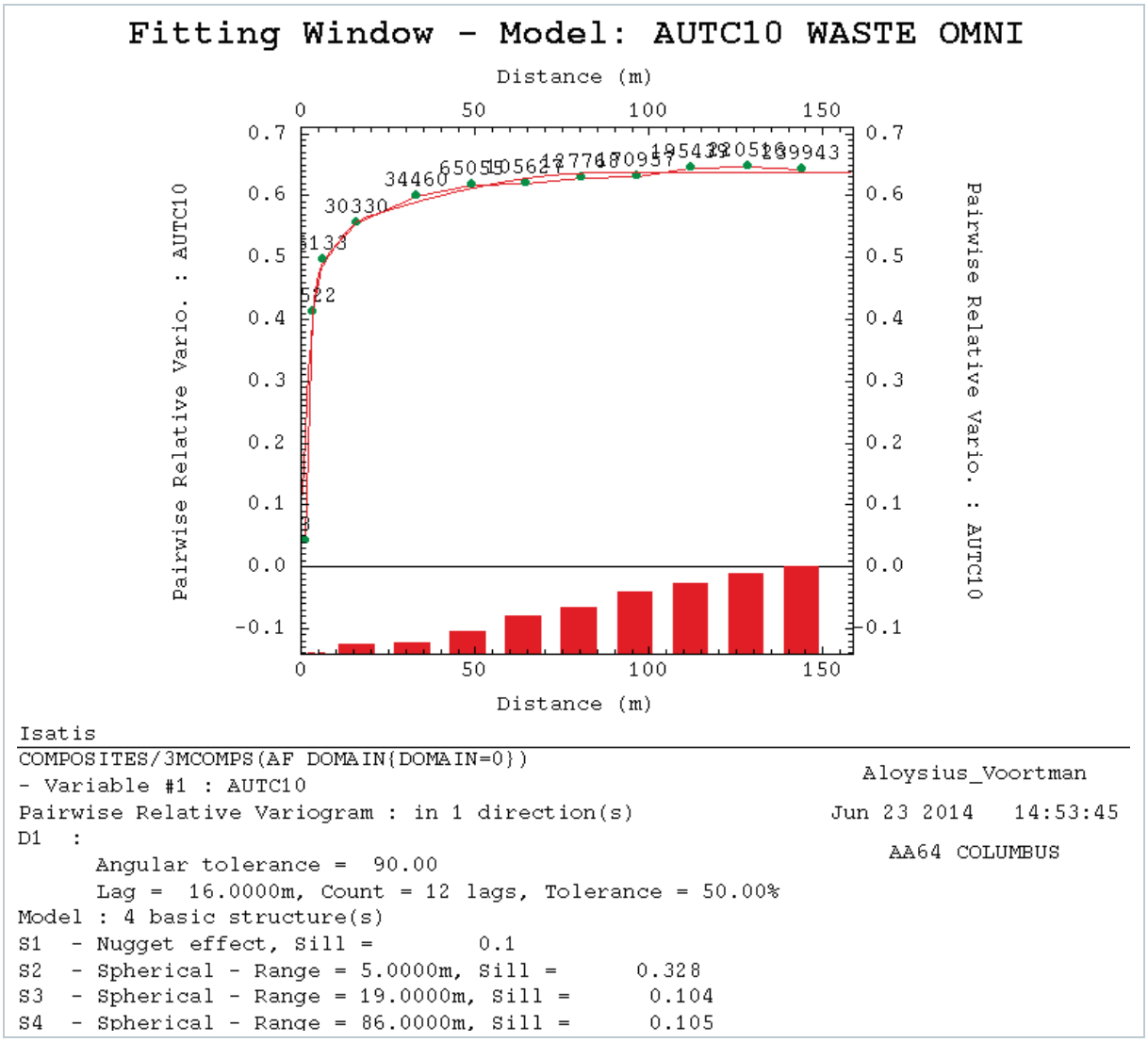


Figure 66 - Omni-directional variogram model used for the estimation of Au in the saprolite waste domain

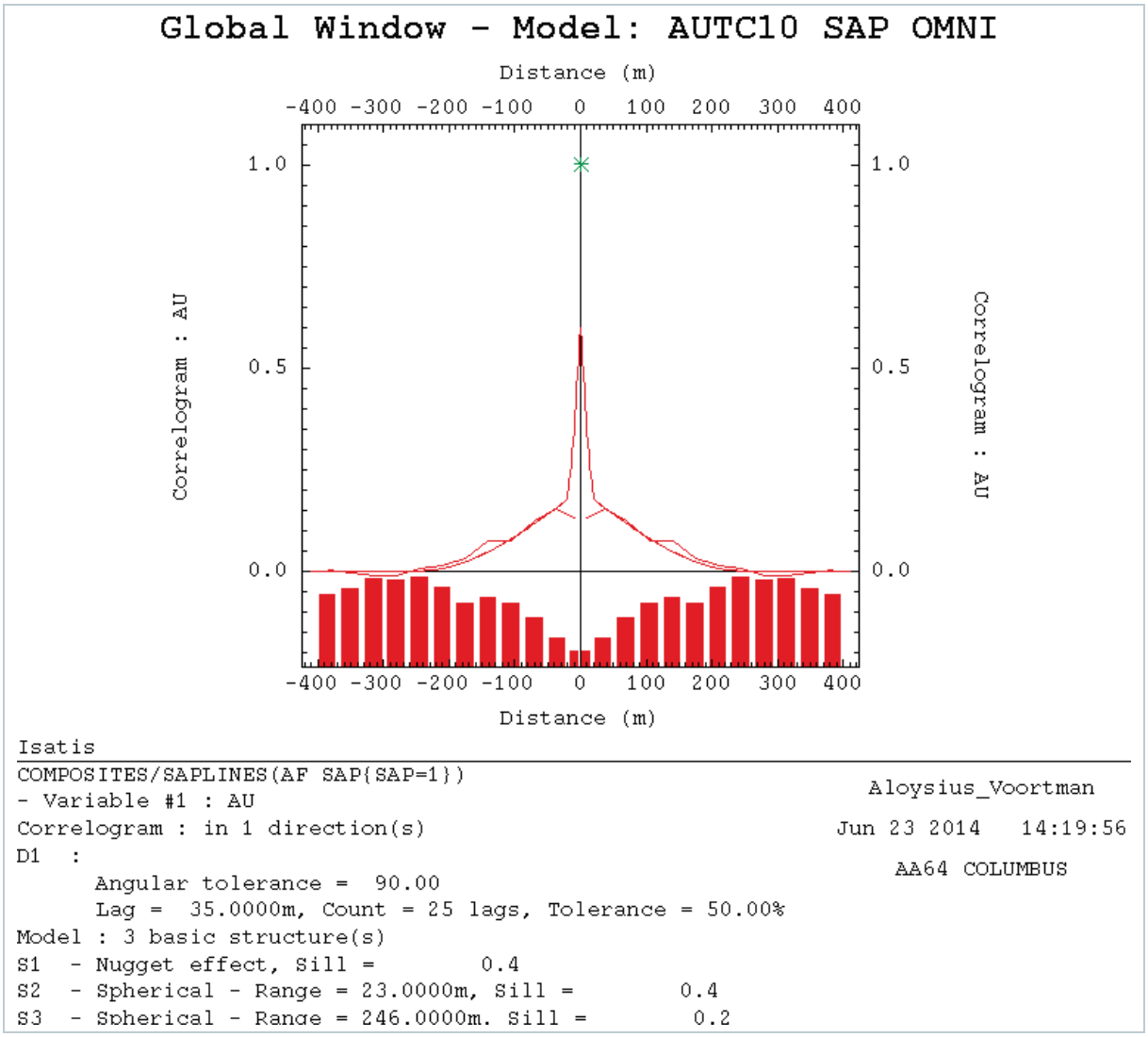


Table 30 - Omni-directional variogram parameters for Au in the fresh and saprolite waste domain

	Fresh waste domain		Saprolite waste domain	
C0	18.8%		40%	
		Range (m)		Range (m)
C1	61.5%	5	40%	23
C2	19.5%	19	20%	246
C3	19.7%	86		
Ctot	100%		100%	

14.2.7. Block model estimation

The Montagne d'Or Prospect is primarily a gold (Au) deposit with associated copper (Cu) mineralisation. In the drillhole logs there is good visual correlation between gold and copper, however copper and gold assays appear to have a weak statistical correlation at current data support. At this stage there is insufficient assay data available for copper grade estimation; therefore, only gold grade has been estimated in this study.

Prior to grade estimation, the raw drillhole data set was coded ("flagged") with the domain code using the wireframes. The result of this flagging was visually checked on the computer screen. The 3m composites were subsequently composited with the flagged domain codes for each individual domain. For a listing of Domain codes refer Table 15 in Section 0 that shows the coding of the individual wireframes. The numeric code for the wireframes and the numeric code for the mineralised Domains in the block model are identical.

Estimation takes place within each mineralised Domain using hard boundaries as defined by the wireframes and the data flagging. Therefore, only composites within a Domain wireframe will be used for the estimation of resources within the Domain. Correspondingly, only gold values located within the waste Domain will be used for the estimation of the waste areas.

A code of zero was allocated to the areas in between the mineralised domains to allow the estimation of a "waste domain". This ensures that all intersected gold values are used in the final block model.

An empty base block model was constructed in Maptek Vulcan software Version 9.0.1 (64-bit, build date 2 March 2014) using the Domain wireframes and the topographic surface provided by Columbus. The surface defining the top of fresh material was re-defined and updated from the latest available drillholes (Columbus 2013 and 2014 campaigns) and incorporated into the block model.

Table 31 - Montagne d'Or Block Model Summary

	Easting (m)	Northing (m)	RL (m)
Minimum Coordinates (m)	171,208	520,002	-375
Maximum Coordinates (m)	176,208	522,002	425
Model Extent (m)	5,000	2,000	800
Block Count	200	200	80
Block Size (m)	25	10	10
Sub-block Size (m)	5	1	2.5
Rotation (degrees)	0	0	0

Table 31 provides a listing of block model parameters and the sub-blocking parameters used to define the volume of the Domain wireframes within the model. The block model Domain flagging and sub-blocking results were checked visually on the computer screen. The block model was not rotated and the model X, Y and Z axes correspond to Easting, Northing and RL respectively. Table 32 gives a listing of the standard block model parameters and their type and default values.

Table 32 - Listing of standard block model parameters

Variable	Default Value	Type	Description
domain	0	integer	Mineralised domain code
geology	0	float	Geology code
regolith	10	float	Regolith code (10=fresh, 100=saprolitic)
topo	0	float	Topography code (1=below, 1000=above)
au_ok	0	float	Kriged Au grade
nsamps	0	integer	Number of samples
nholes	0	integer	Number of Drillholes
estflag_au	0	integer	Estimation Pass (1, 2 or 3)
avedist	0	float	Average distance to samples
density	-999	float	Interpolated dry rock density
resclass	0	integer	Resource class (3=Inferred)
krig_var	0	float	Kriging estimation variance
krig_wt	0	float	Kriging weight
krig_eff	0	float	Kriging efficiency
slopereg	0	float	Theoretical regression slope
block_var	0	float	Block variance
tenement	0	integer	Tenement code'
dclose	-999	float	Average distance, used for density samples
dnsam	0	float	Number of samples, used for density estimation
spare1	-999	float	Not used
spare2	-999	float	Not used

Ordinary Kriging (OK) was selected as the method for the estimation for both Au grade and the dry rock density. Block Kriging was done with a discretisation of the parent cell into a 5x5x2 grid.

All available 3m drillhole composites with a top-cut of 16g/t Au were used in the model estimation. The correllogram (relative sill) parameters and the ranges of influence define by the model described in the previous Section were used for the estimation of all fresh Domains. The search neighbourhood was rotated parallel to the rotation of the variogram and, as a check, the orientation of the search neighbourhood ellipsoid was visually checked on the computer screen.

The estimation was completed using three successive estimation passes with only blocks not estimated in an earlier pass available for estimation during the next pass. Composite data were selected from hard-wired domain criteria in the database and blocks to be estimated were selected using both domain and estimation flag criteria. Blocks in domains that were not estimated using the three estimation passes were left untouched.

As described in Section 11.2.2, dry relative rock density was estimated into the block model by an unconstrained Ordinary Kriging estimation using the omni-directional variogram model described in Section 14.2.5. A large search neighbourhood of 200m by 200m by 200m was used with a minimum of 1 and a maximum of 3 samples used in one estimation pass.

The estimation of Au in the mineralised domains was completed with a search neighbourhood orientated in the direction of the variogram and parallel to the main directions of the mineralised domains. The major direction of the mineralisation is along strike at an azimuth of 80 degrees and a dip of zero degrees, the semi-major direction is down dip at 70 degrees toward the south at an azimuth of 170 degrees. The minor direction has an azimuth of 350 degrees with an upwards dip of 20 degrees. The three estimation passes are completed as follows: using search distances of 50m in the major direction, 50m in the semi-major direction and 10m in the minor direction in pass1, increasing to search distances of 100m in the major direction, 100m in the semi-major direction and 15m in the minor direction in pass2, and 150m in the major direction, 150m in the semi-major direction and 20m in the minor direction in pass3. No octant search was applied.

The minimum number of samples in the first pass is set at 8, decreasing to 4 and 2 composites in the second and third pass respectively, using a maximum number of composites of 36. Estimation is into parent cell size and block discretisation is set at 5x5x2. A maximum of 5 composites was allowed to be derived from one drillhole. Hard boundaries were used to limit the use of composites between domains and all estimation was directly into parent cells. The search ellipse was 50m by 50m by 10m oriented in the plane of the mineralisation and extended to 150m by 150m by 20m in the third estimation pass. High gold assays were capped at 16g/t Au. In all estimation passes, the high grade composite values above 10g/t Au are restricted to a distance (range of influence) of 35m in the major and semi-major direction and 10m in the minor direction.

The sample search parameters were based on limited Kriging Neighbourhood Analysis completed in ISATIS software and are mainly based on the configuration of the available drillhole spacing. A number of different block models were estimated to assess the influence of the search neighbourhood on Kriging Efficiency and the theoretical regression slope. In general, Kriging efficiencies achieved are low or negative and even when taking care that the amount of conditional bias is minimised, the achieved regression slopes in the second and third estimation passes are low. Hence, an unavoidable amount of conditional bias is present in the block model at the current drillhole spacing. This is taken into account during resource classification.

The parent cell size was varied from 25mx25x10m to 25mx10mx10m to assess the degree of smoothing inherent in the OK block estimation. The 25mx10mx10m block size was selected for the final block model. The model represents a global in-situ resource model that is fit for purpose for conceptual pit design.

A certain amount of internal waste material is (unavoidably) incorporated as wire-framing with the current drillhole spacing cannot fully exclude all portions of mineralisation below the nominal wire-frame boundary of approximately 0.25g/t Au.

14.2.8. Block model validation

A number of different block models with different parent cells were estimated, visually checked on the computer screen and validated using swatch plots. Parent cell size varied from 25mE by 10mN by 25m Elevation to 25m Easting by 10m Northing by 10m Elevation

The block model built with a parent cell size of 25m Easting by 10m Northing by 10m Elevation was selected as the final block model. The final validated block model has the Vulcan file name “pi_june17_251010_run2.bmf”.

Block model validation was completed on the computer screen through comparing the location of high grade drillhole intersections with estimated model blocks per each Domain, by a statistical comparison of mean composite values per Domain with average Domain block results and by slicing through the block model along Easting, Northing and Elevation and comparing input composite values against average block values ("swath plots"). Figure 67, Figure 68 and Figure 69 show the graphics of the swath plots for the first pass model blocks through this block model along easting, northing and elevation (RL) respectively.

Figure 67 - Validation "swath plot" of the block model along Easting showing composite values vs. pass1 block results

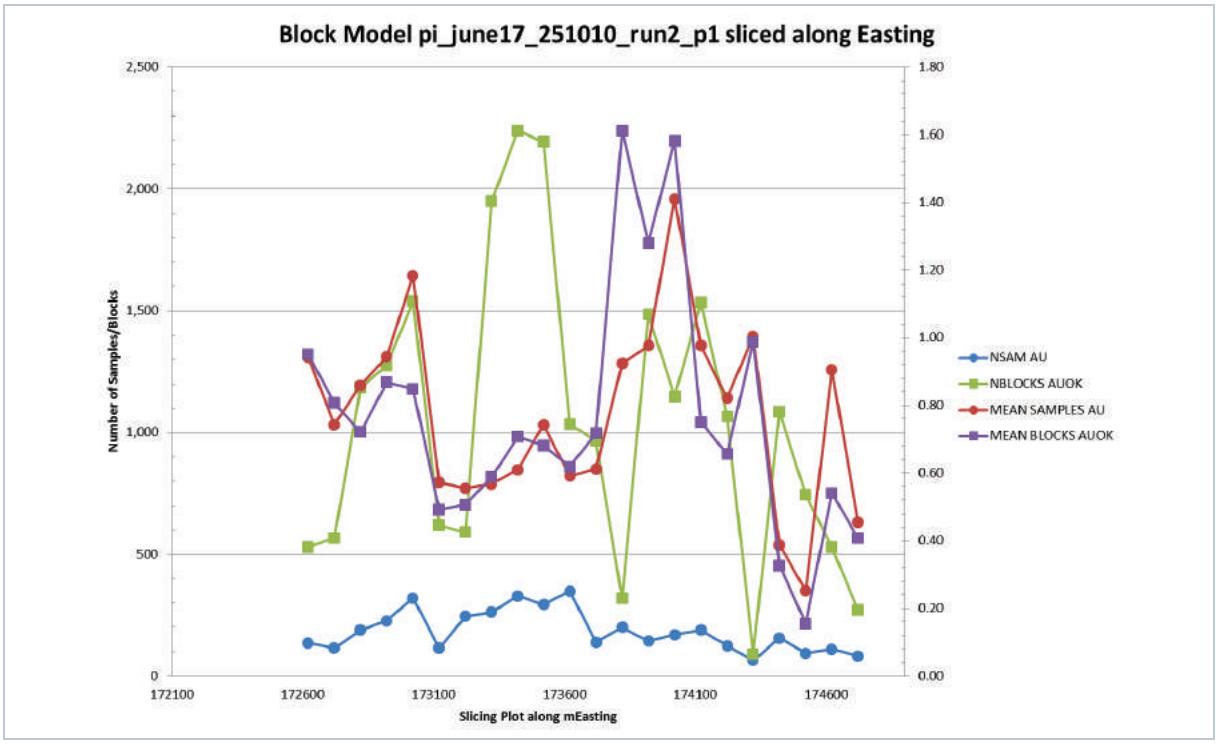


Figure 68 - Validation “swath plot” of the block model along Northing showing composite values vs. pass1 block results

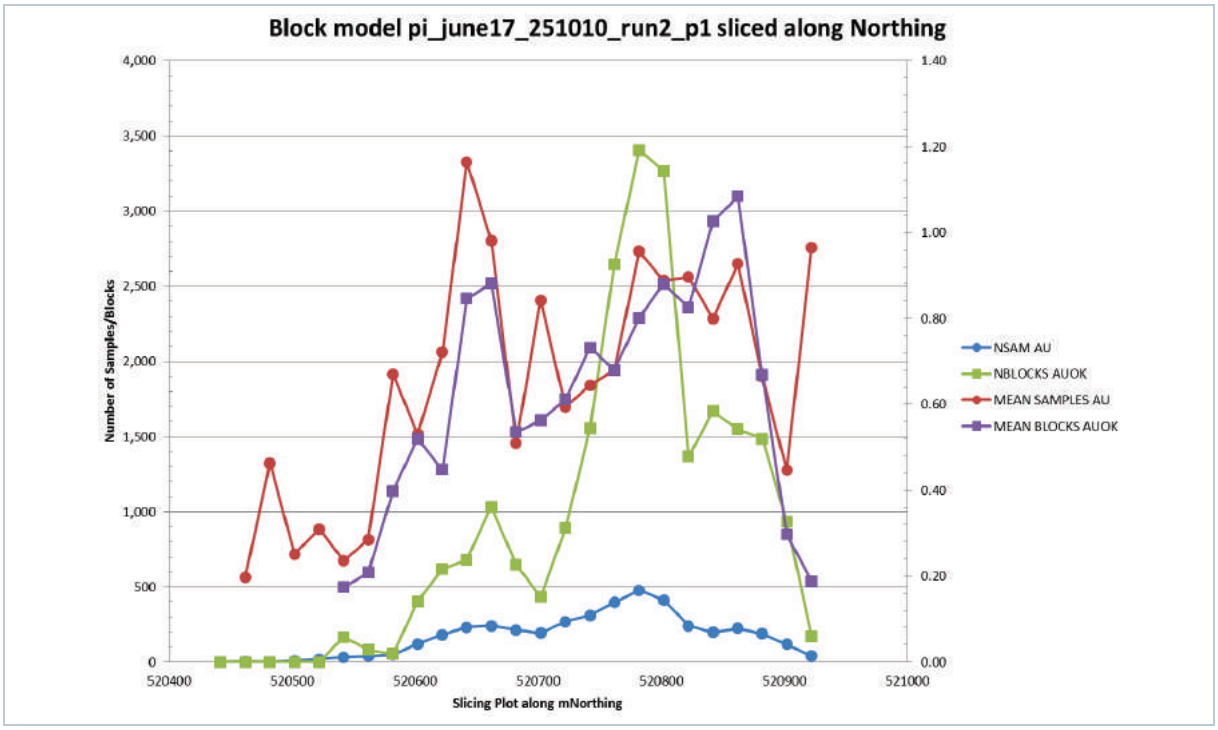
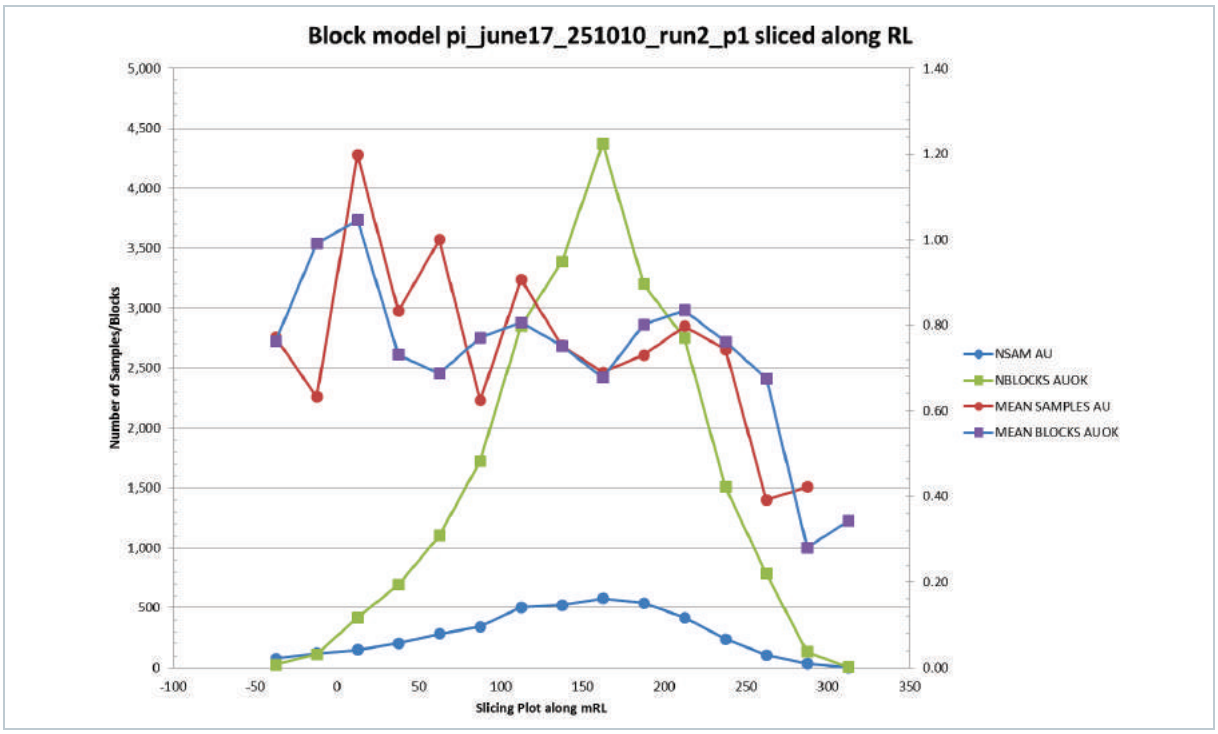


Figure 69 - Validation “swath plot” of the block model along RL showing composite values vs. pass1 block results



Block estimation during the first estimation pass is appropriate, however estimation quality deteriorates in the second and the third passes. This is taken into account during the resource classification.

Table 33 shows a comparison between the input composite data and the average of the blocks per domain. The reduction in the estimated mean in the model from the man value in the composites is explained by the drillhole spacing, by the unavoidable inclusion of internal waste, and by the restriction of the spatial influence of gold composites with values above 10g/t Au.

Table 33 - Statistical comparison of input data vs. first pass block results

Domain	Number Composites	Declustered Au (top-cut 16g/t)	Number Blocks	Block model au_ok (1st pass)
110	100	0.31	201	0.29
120	256	0.48	1,563	0.45
130	2,528	0.81	12,397	0.74
140	915	0.84	7,890	0.89
150	354	0.69	1,004	0.58
160	18	0.75	0	0.00
170	5	3.25	0	0.00
180	40	0.34	0	0.00

The OK block model at a block support of 25x10x10m parent cell size is, obviously, more smooth than the 3m input composite data.

14.3. Resource classification

The following rationale underlies the strategy for resource classification. OK block grade estimates were generated based on the 3m composites, applying a restricted number of composite data during estimation in three successive passes, and by the use of hard boundaries restricting block estimation to within individual domains. The three successive estimation passes use similar sample search neighbourhoods that differed only in the maximum distance to composite samples and the minimum number of composites. A top-cut of 16g/t Au was applied to the composites and the influence of high grade composites above 10g/t Au were restricted to a maximum distance of 35m along strike, 35m down-depth and 10m across strike. Portions of mineralised domains above the saprolite surface have been estimated with the variogram model defined from fresh material. A waste model was estimated separately using omni-directional variogram models for fresh and saprolitic waste. The estimation was completed with a 5x5x2 block discretisation and estimation was directly into parent cell block size. Sample search parameters were based on a number of Kriging neighbourhood test runs in ISATIS but were subjectively designed to restrict smoothing to appropriate levels. The OK grade estimation results represent a global in-situ resource model incorporating approximately 20% low grade material below 0.25g/t Au as “internal waste”. Therefore, the resource model is most valid for reporting at cut-off grades that are close to the mineralisation cut-off grade of nominal 0.25g/t Au that was used to define the mineralised Domains. Grades and tonnages of resources reported at higher cut-off grade need to be re-estimated within higher grade envelopes to restrict the mineralisation and/or taking a proper change-of-support model into account.

Key criteria for establishing confidence levels for resource classification are listed in Table 34. Diamond drilling, sample recovery, database integrity, Domain definition, block modelling and open pit mining assumptions score high on this list. Surveying, core logging, density measurement, density interpolation, geological understanding and sample verification score moderate to high, while data quality and drillhole spacing still provide some concern.

Table 34 - Key criteria for establishing confidence levels for resource classification

Subject	Confidence	Discussion
Drilling Technique	High	Diamond drilling is an Industry Standard approach and highly adequate for this type of deposit.
Drill Sample Recovery	High	Good core recovery recorded.
Database Integrity	High	No Material errors identified.
Estimation and Modelling Techniques	High	Standard Ordinary (Block) Kriging applying a top-cut and restricting the influence of higher grade composite values (>10g/t Au) to within a box of 35m along strike by 25m down-dip to 10mN across strike.
Cutoff Grades	High	A mineralisation cut-off of nominal 0.25g/t Au applied to define mineralised Domains.
Mining Factors or Assumptions	High	Standard open pit mining methods envisaged using standard industry bench heights, standard mining equipment and well controlled blasting practices. Global resource model is NOT a recoverable resource model and is fit for reporting global resources at lower cut-off grades of up to 0.3g/t and 0.4g/t values. Global model is fit for conceptual open pit design.
Logging	Moderate - High	Standard nomenclature of apparent high quality. Some discrepancies due to different geologists responsible for core logging. Only limited drillcore photography available.
Bulk Density	Moderate-High	Dry relative rock density measured using water immersion method and a scale with an accuracy to 0.1g. Samples were not waxed but porous samples were wrapped in plastic. Kriging interploation of lithology-based average density values is fit-for-purpose for global resource model.
Verification of Sampling and Assaying	Moderate-High	The accuracy of the Guyanor cannot be assessed which is a flaw that means that continued use of the Guyanor assay data in future resource estimates will keep the classification category at best as Inferred Mineral Resources. Umpire samples taken in 2012 reported results within acceptable precision levels and available duplicate check samples analysed by OMAC do not indicate significant issues. The results from Columbus Phase 1 and Phase 2 drilling are considered acceptable for use at the current stage of the project.
Location of Sampling Points	Moderate-High	Early collar surveys used a variety of methods some of which did not give azimuth data however collar data are fit-for-purpose. Columbus down-hole surveys are missing for 14 holes 2011/2012 drillhole; collar and down-hole surveying of 2013/2014 drillholes is much improved.
Geological Interpretation	Moderate-High	Broad mineralisation constraints are subject to a moderate amount of uncertainty concerning mineralisation trends as a reflection of drilling density and geological complexity. Closer spaced drilling is recommended especially to further outline and define constraints for higher grade domains. Geological and structural interpretation is much improved by work done by the University of Quebec and this information is incorporated in the definition of mineralised Domains.
Data Density and Distribution	Moderate	Data density and drill spacing is irregular varying from less than 50x50m to drilling sections over 200m apart. Geology/grade continuity reasonably well established in areas of higher drillhole spacing but deteriorates along deposit margins. The 2013/2014 infill drilling concentrated on central and northern-most margins, leading to good coverage of shallower portions of the deposit along strike from 127,500mE to 174,700mE.

Subject	Confidence	Discussion
Data Quality	Moderate	The accuracy of the Guyanor drillhole data cannot be assessed which means that continued use of the Guyanor assay data in future resource estimates will keep the classification category at best as Inferred Mineral Resources. Blanks and certified reference samples inserted by Columbus for Quality Control and results within acceptable limits. Some data quality issues observed in 2011/2012 drilling but data are deemed "fit for purpose". Pulp duplicates show acceptable precision and accuracy. Columbus data collection followed Procedures and is comparable to Industry Best Practice. Reported pulp check assays did not show issues but did not include blanks or reference materials. Assay data is of acceptable quality for current resource estimation.
Audits or Reviews	N/A	Coffey is unaware of independent external reviews.

The resource classification therefore also takes the following factors into account.

- Some precision problems were reported earlier between the two analytical laboratories FILAB and ALS, and an investigation of the quality of the early drillhole data has confirmed that there have been some issues with data quality which are most likely due to either sample preparation or laboratory precision. These issues increasing the risk with the 1996 to 1998 Guyanor and the 2011 to 2012 Columbus drillhole data but are not considered significant enough to impact the resource estimate more than in a minor way.
- Average density data have been allocated to the lithological codes in the raw database, composited to 3m and interpolated. The density model is not constructed by assigning average density values to an unambiguous geological model and will have some higher estimation risk. However, the interpolation of the density variable into the model is deemed to be “fit for purpose”.
- At the current drillhole spacing, first pass block estimation is appropriate, however estimation quality deteriorates in the second and the third estimation passes. An unavoidable amount of conditional bias is present in the block model, and this increases block estimation risk.

The classification process consists of two successive steps:

Step 1: Applying the above confidence criteria, the mineral resource is in principle classified as an Inferred Mineral Resource.

Step 2: A volume was digitised on drillhole sections that defines a portion of the block model that is located within a distance of approximately 150m from the nearest drillholes and forms a continuous, and mineable in principle, spatial volume. This volume does not extend to a depth of more than nominal 350m below topography and contains material that is defined as material that has reasonable prospects of being of potential economic value. Only model blocks that lie within this continuous volume are reported as Inferred Mineral Resource.

14.4. Resource reporting

The summarised Montagne d'Or Resource Statement presented in Table 37 has been determined with an effective date of 29 June 2014 and has been prepared and reported in accordance with Canadian National Instrument 43-101, Standards of Disclosure for Mineral Projects (the Instrument) and the classifications defined in CIM Definition Standards (2010).

The definitions of resources established by CIM are as follows:

- A Mineral Resource is a concentration or occurrence of diamonds, natural solid inorganic material, or natural solid fossilized organic material including base and precious metals, coal, and industrial minerals in or on the Earth's crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge.
- An "Inferred Mineral Resource" is that part of a Mineral Resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes.
- An "Indicated Mineral Resource" is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics, can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes that are spaced closely enough for geological and grade continuity to be reasonably assumed.
- A "Measured Mineral Resource" is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are so well established that they can be estimated with confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drillholes that are spaced closely enough to confirm both geological and grade continuity.

This resource estimate has been classified as Inferred Mineral Resources based on the confidence of the input data, geology interpretation and grade estimation.

The cut-off grade value estimated by Coffey Mining based on mining and processing costs, overheads and process recovery as previously reported by SRK (2012), and a three year trailing average gold price of US$1,487/oz gold as listed in Table 35.

In this report Inferred Mineral Resources are reported at a cut-off grade close to 0.3g/t gold (rounded up to first decimal place).

Table 35 - Montagne d'Or deposit reporting cut-off estimation parameters

Item	Unit	Value	Value
Mining cost	$/t	2.50	2.50
Processing cost	$/t	10.00	10.00
G&A	$/t	2.00	2.00
Recovery	%	95	95
Gold Price	$/oz	1,580	1,200
Cut-off grade	Au (g/t)	0.3	0.4

14.4.1. Mineral resource statement

A summary of the estimated resources for the Paul Isnard Project at different cut-offs is provided in Table 36, Table 39 and Table 40.

The Mineral Resource was classified as Inferred Resources due to available drillhole spacing and distance between drillholes down dip. Kriging interpolation was completed in three successive passes within the plane of the mineralised Domains and using the domain boundaries as hard boundaries over search distances of 50mx50mx10m, 100mx100mx15m and 150mx150mx20m respectively. Composite values of over 10g/t Au were restricted to a distance of 50mx50mx10m within the plane of the mineralised Domains. Only model blocks that are located within a continuous envelope up to distances of nominal 150m away from drillholes and are located within one of the mineralised Domains are included in the classified Resource.

Further infill drilling is essential to bring the project to Indicated Resources and to define higher grade Domains that occur within the current mineralised Domains.

Table 36 - Montagne d'Or Prospect Inferred Resources reported at 0.3g/t cut-off

Resources in all Mineralised Domains				
Domain	Tonnes (Mt)	Grade (g/t)	MOzs	Density (t/m^3)
110	4.5	0.5	0.07	2.72
120	9.1	0.5	0.14	2.84
130	107.7	0.9	2.97	2.86
140	30.5	1.0	1.01	2.89
150	14.4	0.7	0.34	2.90
160	0.5	0.7	0.01	2.74
170	0.8	2.9	0.08	2.91
180	1.6	0.5	0.03	2.73
Total	169.2	0.9	4.64	2.86

Note: Figures are rounded

Table 37 - Montagne d'Or Inferred Resources reported at three successive cut-offs

Total Resources in all Mineralised Domains				
Cut-off (g/t)	Tonnes (Mt)	Grade (g/t)	MOzs	Density (t/m^3)
0.3	169.2	0.9	4.64	2.86
0.4	140.1	1.0	4.31	2.87
0.5	116.0	1.1	3.96	2.87

Note: Figures are rounded

Only a small portion of the mineralised Domains occurs above the saprolite surface. Due to the scarcity of drillhole information in the saprolitic zone, Coffey decided to estimate the mineralisation in this small portion part of the mineralised Domains using the variogram model that is defined from all fresh composite samples until further saprolite drilling information is available. Table 38 shows the proportion of the Inferred Resources within the mineralised domains (4.8%) and located above the top-of-fresh surface as determined from the current drillhole spacing. Coffey has concluded that the current Inferred Resource classification takes some inherent risk in the estimation in the saprolitic zone into account, but recommends that a programme of shallow drilling dedicated to the saprolitic zone (e.g. auger drilling) is undertaken.

Table 38 - Proportion of Inferred Resource in mineralised Domains above the top-of-fresh surface

Listing of proportions above and below top-of-fresh					
	Tonnes (Mt)	Grade (g/t)	Density (t/m^3)	MOzs	Proportion
Above top-of-fresh	8.0	0.8	1.90	0.20	4.8%
Below top-of-fresh	161.1	0.9	2.94	4.44	95.2%
Total	169.2	0.9		4.64	

The independent Qualified Person responsible for the mineral resource estimate in this report is Mr Louis Voortman. Mr Voortman is a professional Principal Resource Geologist with 30 years of experience in mineral resource and mineral reserve estimation. His experience is with precious metals and base metals. Mr Voortman is a Chartered Professional Geologist (CP) and a Fellow of the Australasian Institute of Mining and Metallurgy (AusIMM). Mr Voortman is independent of Columbus in the manner that this term is defined in Section 1.5 of the Instrument.

Mineral resources which are not mineral reserves do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, marketing, or other relevant issues.

Figure 70 to Figure 78 illustrate the distribution of resource model block grades in a number of typical cross sections from south to north along the strike length of the deposit and in plan view.

Figure 70 – Typical cross section from south (left) to north (right) at approximately 172,590mE

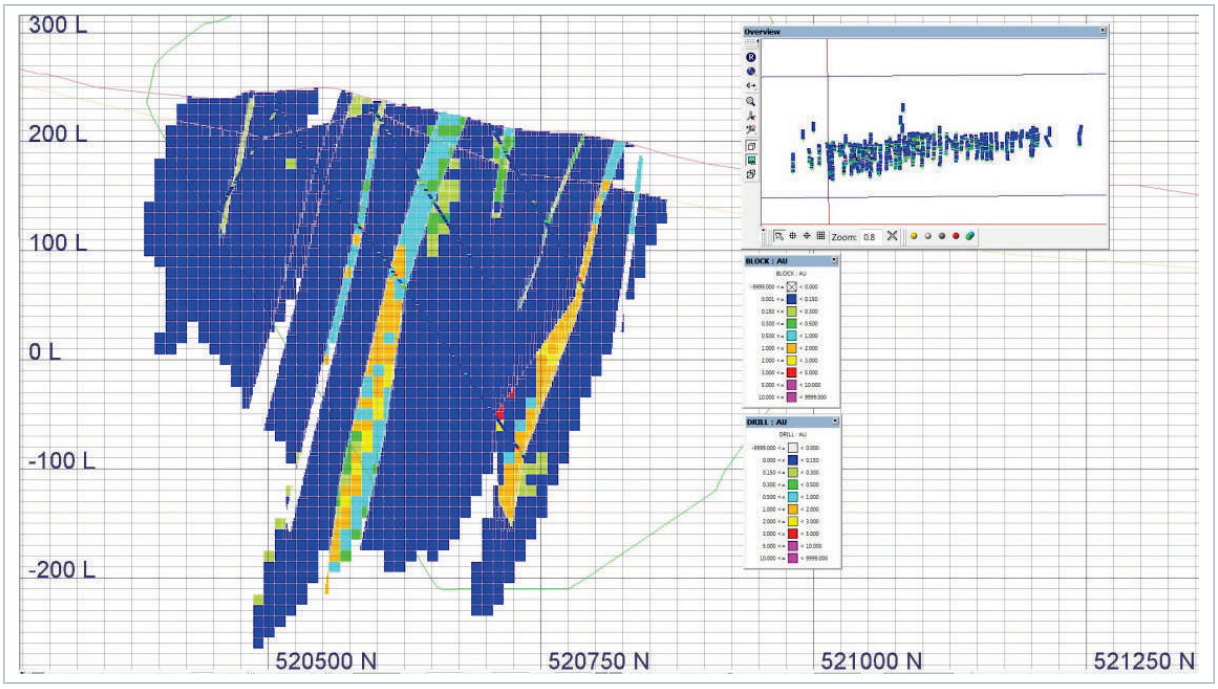


Figure 71 – Typical cross section from south (left) to north (right) at approximately 173240mE

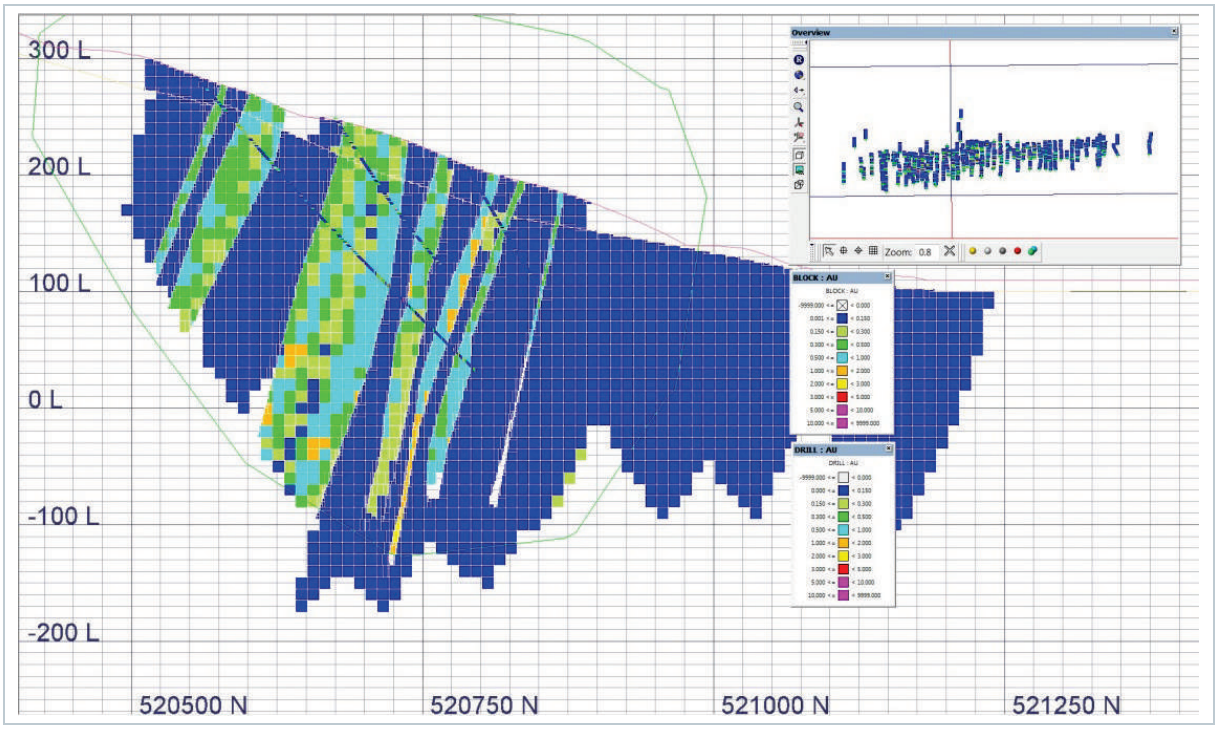


Figure 72 - Typical cross section from south (left) to north (right) at approximately 173630mE

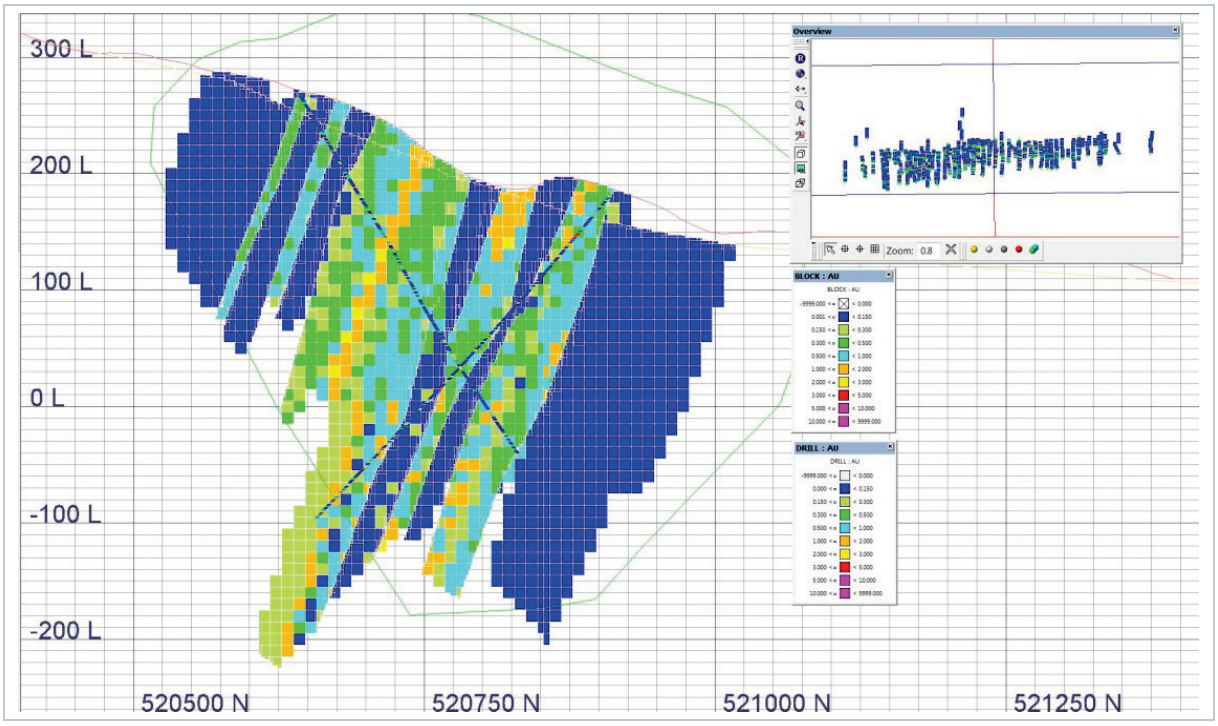


Figure 73 - Typical cross section from south (left) to north (right) at approximately 174070mE

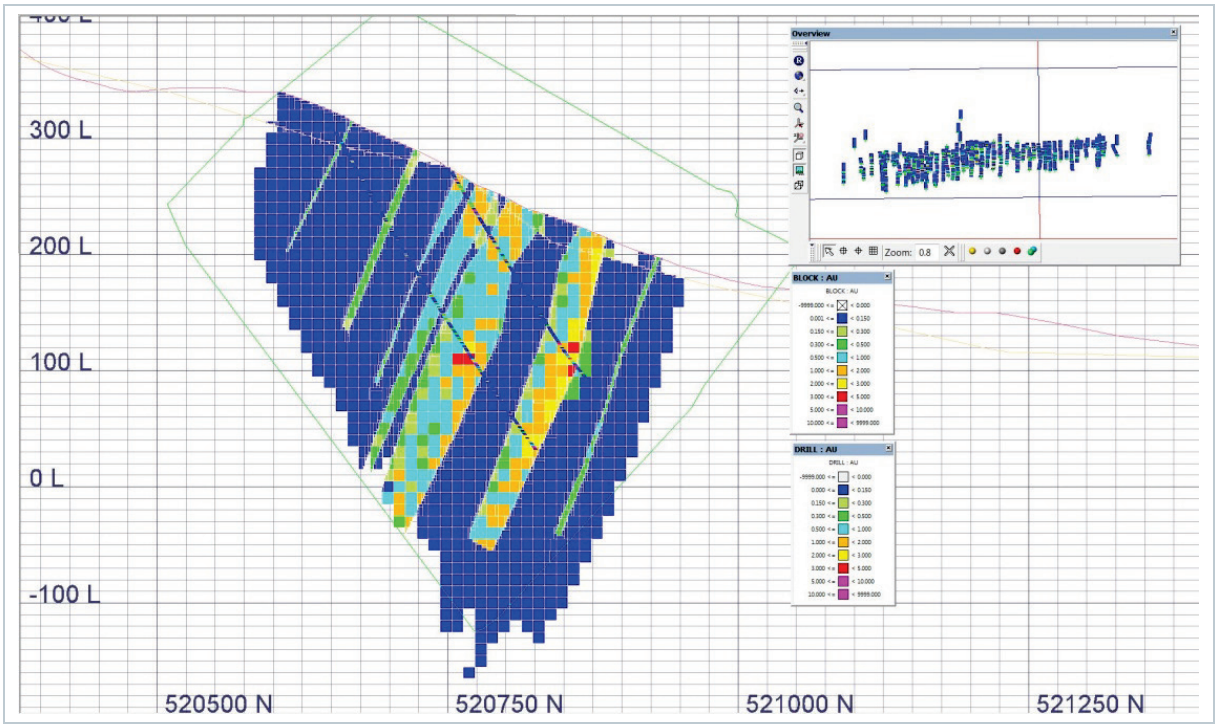


Figure 74 - Plan view through the model at 0mRL

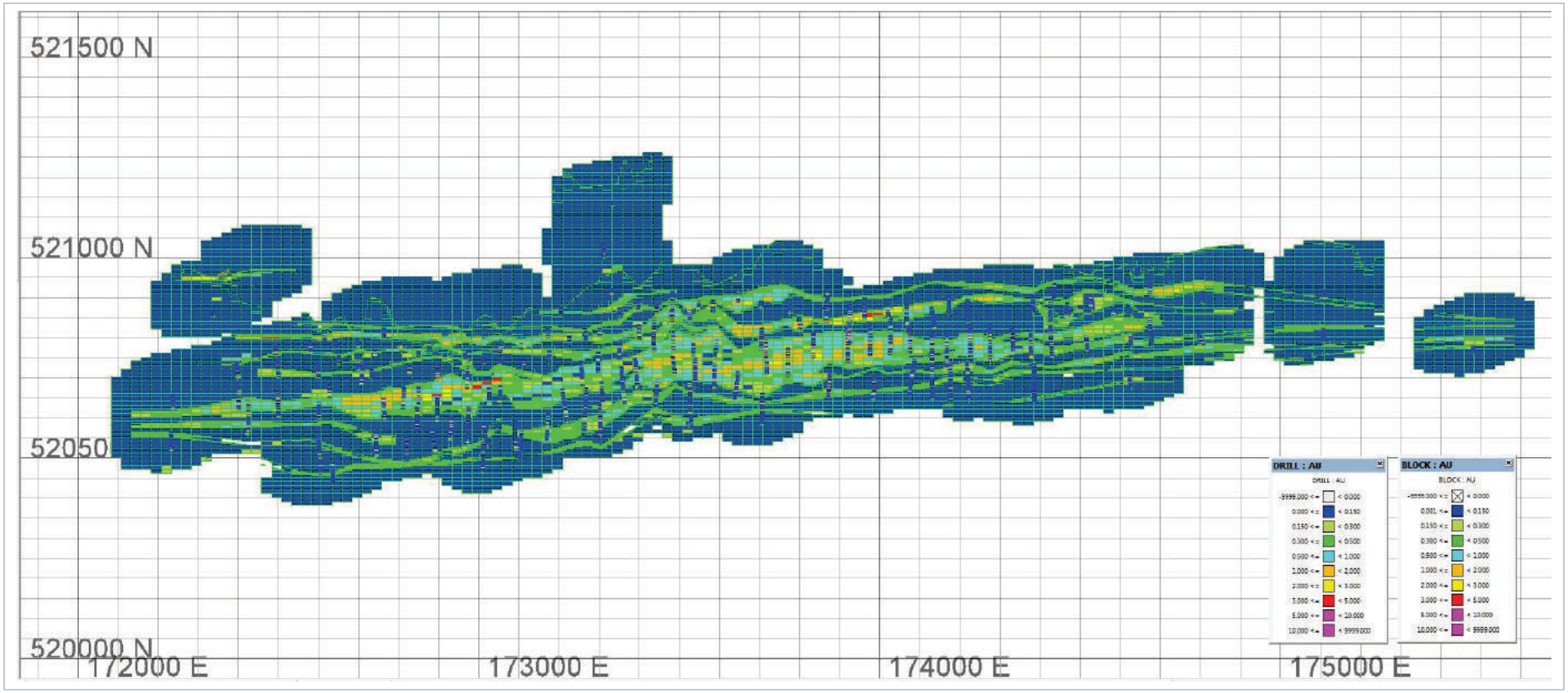


Figure 75 - Plan view through the model at 50mRL

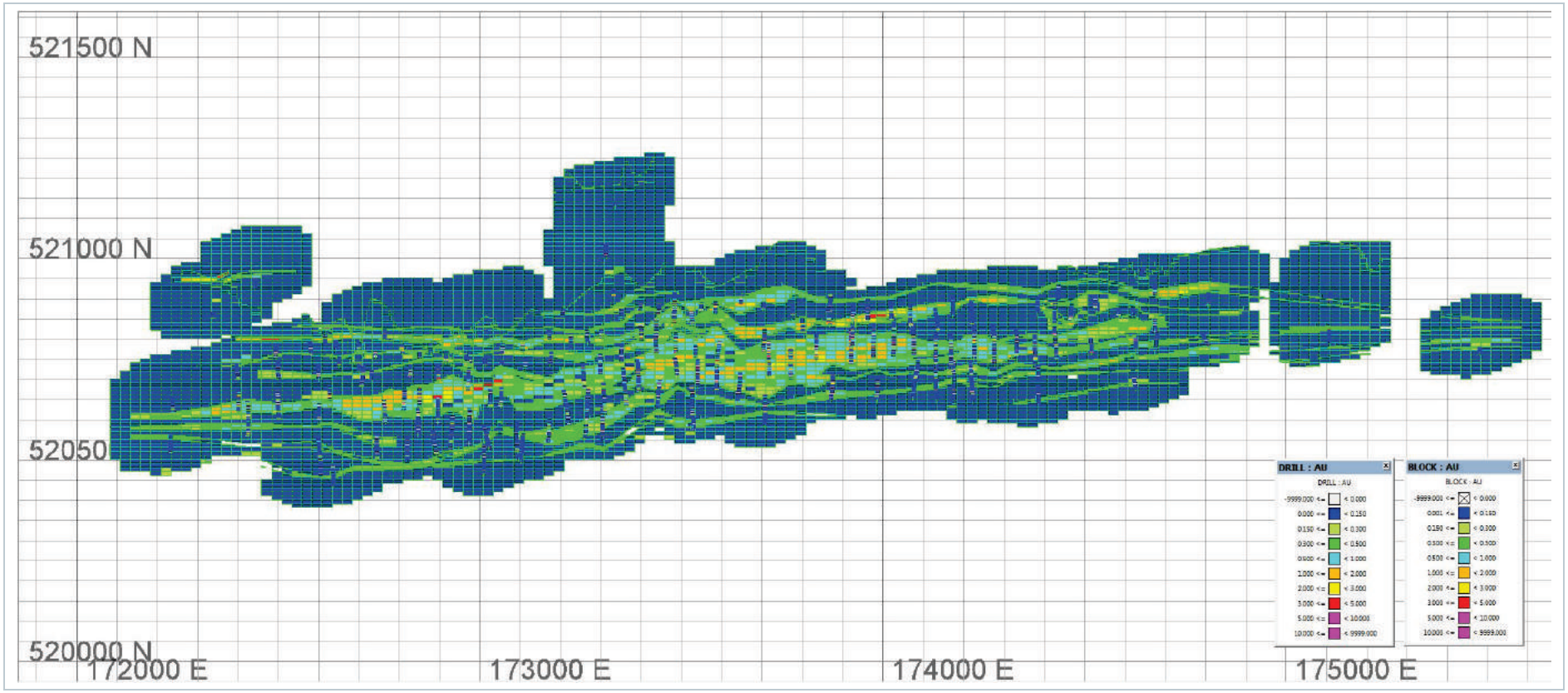


Figure 76 - Plan view through the model at 100mRL

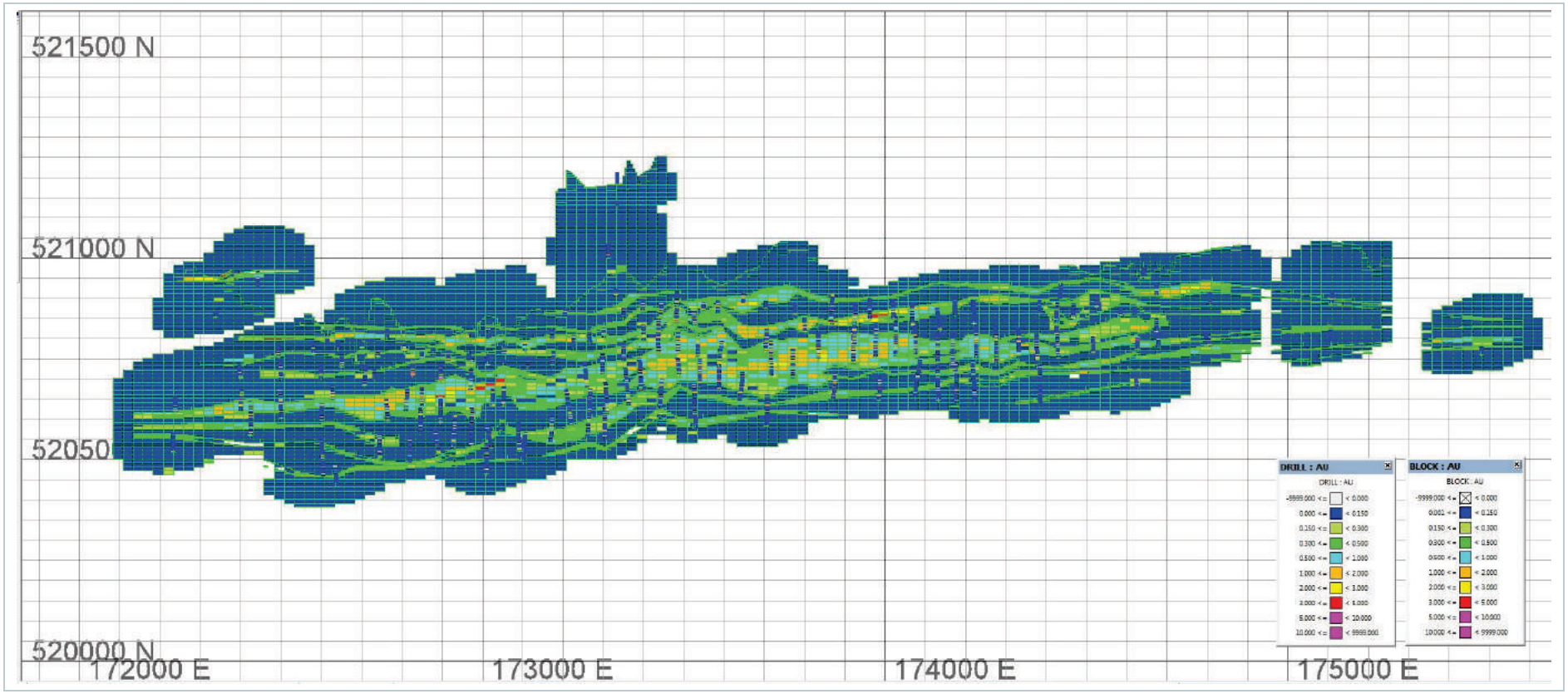


Figure 77 - Plan view through the model at 150mRL

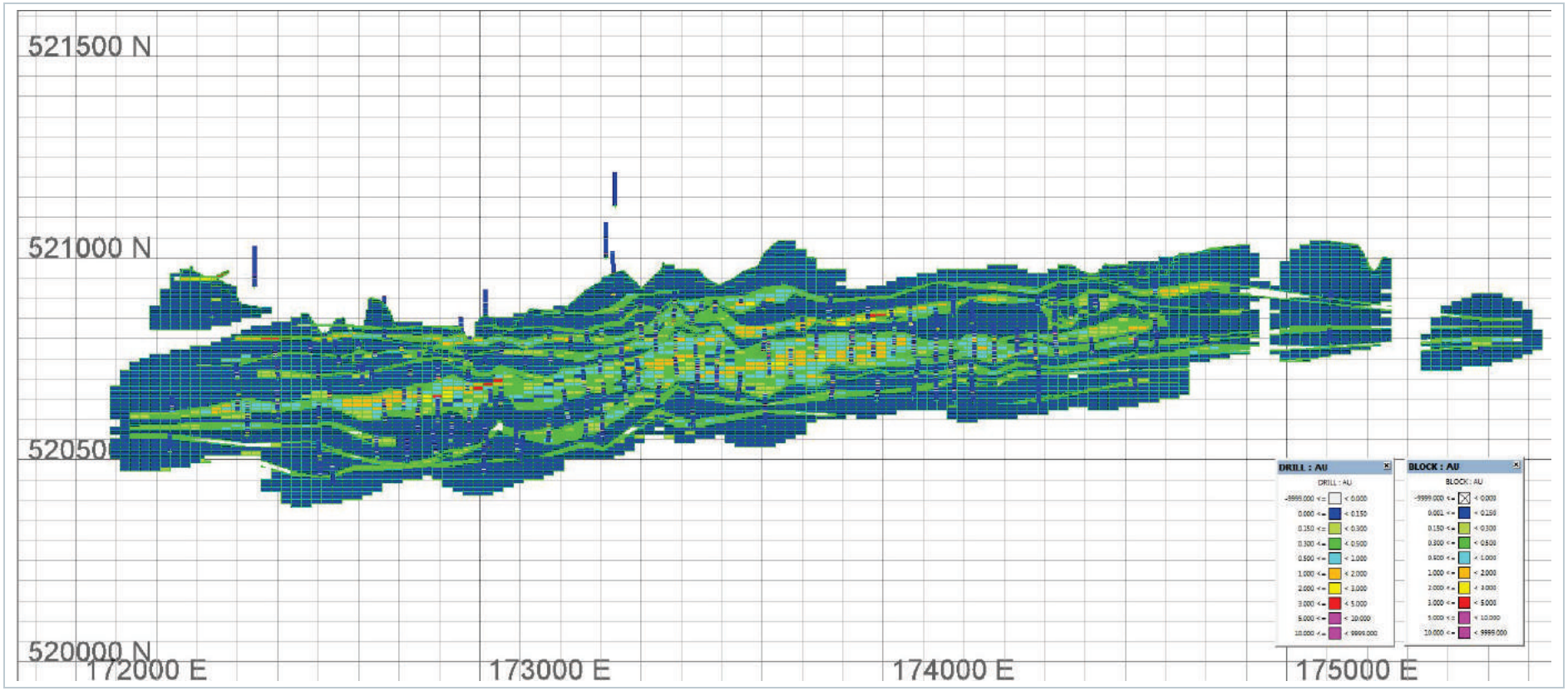
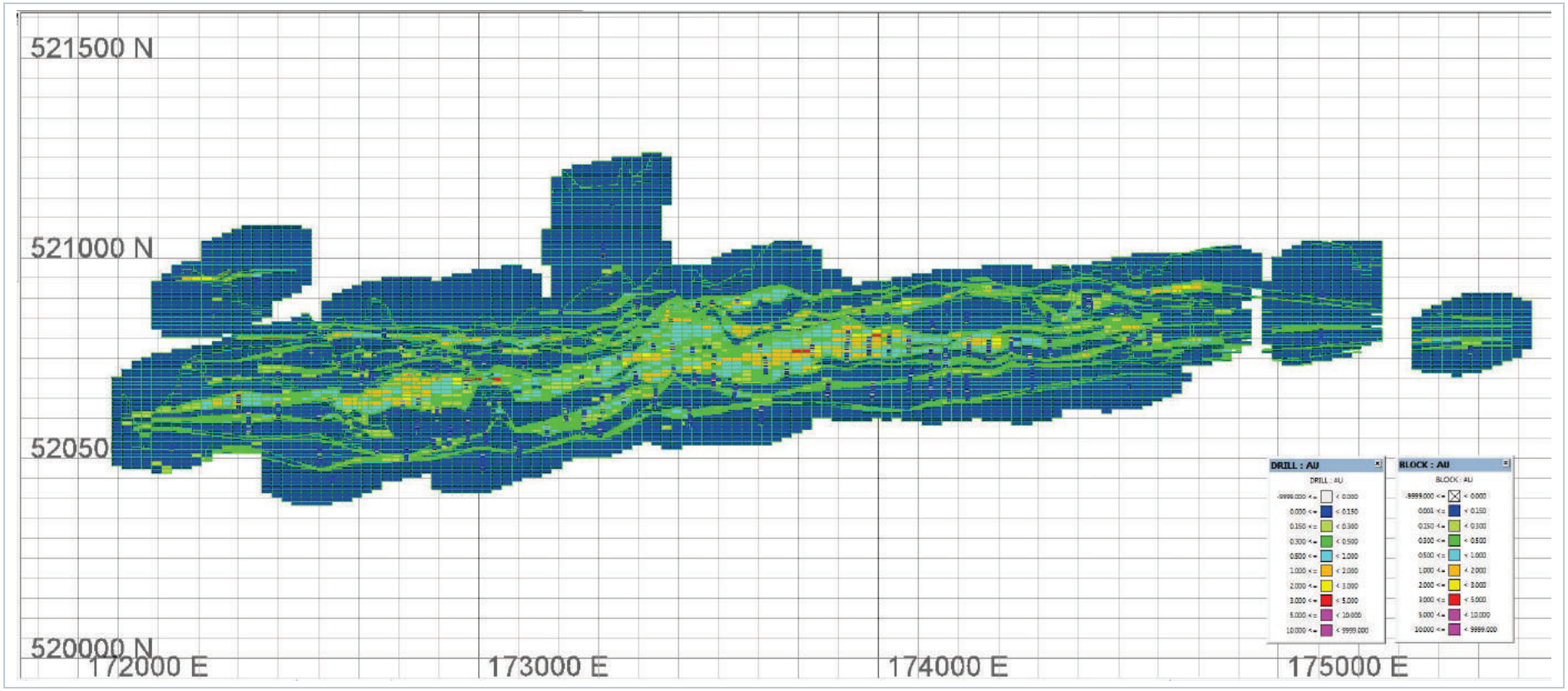


Figure 78 - Plan view through the model at 200mRL



Mineral resource sensitivity

To assess how sensitive the model is to different cut-off grades, Table 39 is a summary of tonnage and grade at a cut-off grade of 0.4g/t and Table 40 is a summary at a cut-off grade of 0.5g/t.

The model is defined within mineralised Domains based on a nominal mineralisation cut-off of 0.25g/t and the model is a smoothed global resource model and not a recoverable resource model, the grade-tonnage relationship only provides an indication and does NOT represent realistic recoverable resources. The resources reported at a cut-off around 0.3g/t, up to 0.4g/t, provide a most realistic grade-tonnage for the deposit at this stage. It is recommended to carry out a conceptual pit analyses using tonnages and grade at these cut-offs.

Table 39 - Montagne d'Or Prospect Inferred Resources reported at 0.4g/t cut-off

Resources in all Mineralised Domains				
Domain	Tonnes (Mt)	Grade (g/t)	MOzs	Density (t/m^3)
110	2.6	0.6	0.05	2.78
120	5.2	0.6	0.10	2.81
130	90.7	1.0	2.78	2.86
140	27.1	1.1	0.97	2.89
150	12.0	0.8	0.31	2.89
160	0.4	0.8	0.01	2.72
170	0.8	2.9	0.08	2.91
180	1.1	0.6	0.02	2.72
Total	140.1	1.0	4.32	2.87

Note: Figures are rounded

Table 40 - Montagne d'Or Prospect Inferred Resources reported at 0.5g/t cut-off

Resources in all Mineralised Domains				
Domain	Tonnes (Mt)	Grade (g/t)	MOzs	Density (t/m^3)
110	1.5	0.7	0.03	2.78
120	3.0	0.7	0.06	2.82
130	76.0	1.1	2.57	2.86
140	24.1	1.2	0.93	2.89
150	9.6	0.9	0.27	2.90
160	0.3	0.9	0.01	2.74
170	0.8	2.9	0.08	2.91
180	0.7	0.6	0.02	2.74
Total	116.0	1.1	3.97	2.87
Note: Figures are rounded				

15. Mineral reserve estimates

At this stage only Inferred Resources have been estimated and no predictions of mineral reserves have been made.

16. Mining methods

At this stage it is assumed that the resources are mineable-in-principle by standard large scale open pit mining practices up to a depth of around 300m to 350m below topography. Mining costs assumed for the calculation of a realistic cut-off grade are reported in Section 14.4.

17. Recovery methods

A detailed discussion of recovery method is not applicable at this stage. For the calculation of a realistic cut-off grade, a metallurgical recovery of 95% is assumed as described in Section 14.4.

18. Project infrastructure

At this stage only Inferred Resources have been estimated and no predictions of mineral reserves have been made. Current project infrastructure is limited and discussed in Section 4.

19. Market studies and contracts

At this stage only Inferred Resources have been estimated and analysis of market studies and contracts will be developed.

20. Environmental studies, permitting and social or community impact

Discussed in Section 4.

21. Capital and operating costs

At this stage only Inferred Resources have been estimated and no predictions of mineral reserves have been made. Not applicable at this stage.

22. Adjacent properties

There are no significant properties adjacent to the Montagne d'Or Prospect. Within the western portion of the Paul Isnard concession area, at a distance of approximately 15km from Montagne d'Or Prospect, there exists a current alluvial mining area (Auplata).

23. Economic analysis

At this stage only Inferred Resources have been estimated and no predictions of mineral reserves have been made. Not applicable at this stage.

24. Other relevant data and information

No other additional information or explanation is necessary to make the technical report understandable and not misleading.

25. Interpretation and conclusions

Columbus has outlined a significant tonnage of low grade gold mineralisation at the Montagne d'Or Prospect on the Paul Isnard Concessions in French Guiana. Columbus drilled a total of 101 holes for 22,906.45m. The resource estimate incorporated all of the Columbus drillholes plus the drilling undertaken by previous interests (56 Guyanor drillholes for a total of 10,916m) provides a total of 157 drillholes aggregating 33,822.45m. At the time of the resource study, two additional drillholes were completed by Columbus but results were not yet available for the study.

The deposit consists of a series of linear mineralised tabular bodies within laminated felsic and mafic volcanic and volcaniclastic rocks intruded by narrow mafic to felsic dykes. Mineralisation has been encountered over a strike length of approximately 2,500m and to a vertical depth of at least 300m below topography. The mineralisation is open at depth, along strike and internally between widely spaced drillholes.

The mineralisation occurs in a total of four main minerals zones ("Domains") along with four additional but lesser well-defined hanging wall and footwall zones. The main zones referred to in the resource estimation as Domain 130, 140 and 150 average about 50 and 17.5m in thickness respectively. Mineralisation consists of semi-massive sulphide bands stingers and disseminated mineralisation. Visible gold is rarely observed and preliminary mineralogical work suggests that is occurs along micro-fractures and on sulphide grain boundaries.

Columbus protocols for drilling, sampling, analysis, security and database management meet industry accepted practices. The drillhole database was verified by Coffey and is suitable for Mineral Resource estimation work.

Coffey Mining estimated Inferred Mineral Resources for the Montagne d'Or Prospect using drillhole data available as of 18 June 2014. At a lower grade cut-off of 0.3g/t Au, Inferred Mineral Resources are estimated to total 169.2 million tonnes at a grade of 0.9g/t Au. The total contained gold not taking into consideration mining dilution or recovery is 4.64 million ounces.

A separate saprolitic domain has been partially delineated by drilling to date and at this stage Coffey has estimated the portion of the mineralised Domains extending into this saprolitic zone as an Inferred Resource in the same manner as the underlying fresh material. The proportion of the currently estimated resource located within the saprolitic zone is estimated at 4.8% of the total Inferred Resource (a total of 8.0 million tonnes at 0.8g/t Au for 0.2 million ounces). Coffey is of the opinion that this is currently the best estimate of this portion of the mineralisation. However, Coffey is of the opinion that it will be a future improvement to obtain sufficient drilling formation from the saprolitic zone to be able to treat this as a separate mineralised domain.

There has been a long history of alluvial gold mining and mineral exploration in the area and the understanding of the geology and the possible controls on gold mineralisation has changed markedly over time. Many researchers have pointed out that gold mineralisation in the area is not one of simply hydrothermal disseminated gold but is likely to be the result of both a primary volcanogenic massive sulphide (VMS) style combined with possibly remobilisation through structural controls as a result of strong regional shearing. The current interpretation therefore recognises both a possible VMS origin for gold as well as strong structural controls on the mineralisation. The modelled series of linear mineralised tabular bodies within laminated felsic and mafic volcanic rocks is concurrent with this model of mineralisation and captures most intersections. However, additional drilling information is required before the higher grade portions that are clearly recognised in drillhole intercepts can be adequately modelled in space and captured validly into a representative block model. Columbus is already concentrating on this next stage of work by continuing the current drilling programme.

The current updated resource estimate of 169.2 million tonnes at 0.9g/t Au (Table 41) reflects a decrease in grade from the prior resource published in 2012 which published a grade of 1.14g/t. However, the previous resource reported a total of 115.2 million tonnes while the newly updated resource is much larger at 169.2 million tonnes and contains all possible low grade and high grade portions within the updated mineralised Domains.

Table 41 - Montagne d'Or Prospect Inferred Resources reported at 0.3g/t cut-off

Resources in all Mineralised Domains				
Domain	**Tonnes (Mt)**	**Grade (g/t)**	**MOzs**	**Density (t/m^3)**
110	4.5	**0.5**	**0.07**	**2.72**
120	9.1	**0.5**	**0.14**	**2.84**
130	107.7	**0.9**	**2.97**	**2.86**
140	30.5	**1.0**	**1.01**	**2.89**
150	14.4	**0.7**	**0.34**	**2.90**
160	0.5	**0.7**	**0.01**	**2.74**
170	0.8	**2.9**	**0.08**	**2.91**
180	1.6	**0.5**	**0.03**	**2.73**
Total	169.2	**0.9**	**4.64**	**2.86**
Note: Figures are rounded				

Drill sections were spaced at a nominal separation of 50m to 200m along strike with intercepts on each section varying from 50m to over 100m. The resource remains open in several directions. Additional in-fill drilling to a nominal spacing of 50m between drillholes along the full strike length as well as further down-dip drilling could convert a realistic portion of the existing Inferred Mineral Resource to an Indicated Mineral Resource. Additional shallow drilling in the saprolitic zone, for example a dedicated programme of close spaced shallow auger drilling, could well enable the treatment of the saprolitic zone as a separate mineralised Domain.

No Mineral Reserves have been estimated on the Property.

As far as can be verified the density measurements available from the 2011 and 2012 Columbus drilling programme is valid on average and has been related to lithology codes of the original ample lengths. Compositing of the drillhole densities into 3m composite values does not produce significant deviations of average density for lithologies and the composited density data is applicable in a Kriging estimation interpolation of density values into the block model using a valid (cross-validated) omni-directional variogram model. Confidence in the generated density model is considered moderate to high.

It is assumed that mining will be feasible using standard large scale open pit mining methods and that average estimates of costs (mining, processing, etc) and metallurgical recovery are practical, order of magnitude correct and applicable. A cut-off grade of 0.4g/t, or 0.3g/t at a higher gold price, is therefore deemed practical. Reporting resources at higher cut-off grades will introduce errors due to the inherent smoothing of the global block model.

Coffey believes that risk in the resource model is related to the use of the historic Guyanor drilling information, the definition of the density model, and the definition of the mineralised Domains on locally still widely spaced drillhole data. Coffey is of the opinion that ongoing geological, petrological and structural research on the deposit by for example researchers from the Université de Québec is providing important new indications on the genesis and controls of the mineralisation and that such improved understanding will help to define the higher grade portions of the deposit.

Coffey is also of the opinion that an additional drilling programme and budget is warranted to upgrade the resource in both fresh rock and the saprolitic cover.

26. Recommendations

The Montagne d'Or Prospect is a property of merit and hosts a significant gold resource that warrants considerable additional exploration work. Most important is to continue drilling with the aim to adequately define higher grade domains (defined at a for example 1.0g/t cut-off) within the currently established mineralised Domains (defined at a 0.25g/t cut-off), and to build a plausible lithology/geology model on which to base an improved average rock density model. In order to achieve Indicated Resource status it will also be advantageous to carry out twin drillhole drilling of a number of former Guyanor drillholes to support the use of the 1996/1998 Guyanor drillhole information.

The drillcore of the earlier Guyanor drillholes are stored on site and although no longer fully sorted and possibly not in unflawed sequential order, it is available for verification of the mineralisation that is intersected, for geology and lithology. Coffey has concluded that the Guyanor drillholes are "fit for purpose" for use in the current resource study. However as far as can be verified the Guyanor analytical data appears to be of lower quality than the Columbus drillhole data. The risk with the earlier Guynaor drillhole data has been taken into account in the resource classification to Inferred Resource.

Coffey recommend that Columbus aim to replace all Guyanor drill holes with new drill holes sampled with modern QAQC protocols to allow confidence in the project to be increased. Continued use of the Guyanor assay data in future Resource Estimates will keep the classification category as Inferred Resource.

At this stage the drilling spacing allows the estimation of a global Inferred Resource model and it is strongly recommended to carry out further drilling to upgrade at least portion of the deposit to Indicated status. The current model makes use of Kriging interpolation of drillhole density values defined on the basis of average density values allocated to lithologies logged in the diamond drillholes. It is also strongly recommended to use additional drilling information for the creation of a plausible geological/lithological model that will support a better defined density model.

Based on the confidence levels as established by Coffey the resource within the mineralised Domains is classified in its total as an Inferred Resource. Coffey believes that by using a nominal 50m by 50m spacing along the full strike length, covering all the mineralised Domains now recognised from south to north, and by obtaining successful drilling results along strike and down dip, and by defining a plausible lithology/geology model as a support for an improved density model, a proportion of the Inferred Resource could be upgraded to the Indicated Resource category.

Coffey recommends further work should concentrate on converting as much as possible of the known Inferred Resources to at least the Indicated Resource category as well as to continue to explore strike and dip extensions.

Additional targets in the general Montagne d'Or Prospect area and the Paul Isnard Concessions can be defined and initial drilling undertaken. Metallurgical testing should be conducted to follow-up and confirm previous work and further refine the recovery process. Baseline environmental studies should be undertaken during future drilling phases along with a study of flora and fauna. Upon completion of additional drilling the resource estimate should be updated, with a geological, lithological and structural modelling associated to the resource model.

This should also taking into account realistic ways to model higher grade portions located within the currently defined mineralised Domains, and using a non-linear estimation method to define recoverable resources at a series of specific and realistic Selective Mining Unit volumes. If results are sufficiently encouraging, a Preliminary Economic Assessment (PEA) could then be undertaken.

Based upon the review of the recent drilling program Coffey makes the following recommendations in terms of procedures.

- Down-hole surveying must be done in all drillholes. Given the remote nature of the project, consideration should be given to having a second down-hole survey instrument on site.
- All Guyanor holes to be re-drilled.
- Columbus needs to determine the analytical batch size used by the principal laboratory and sufficient standards and blanks need to be inserted so that at least one of each is included in each batch assayed by the laboratory. QAQC assessment should be completed immediately after batch results have been received and in case of any issues this should be resolved through immediate communication by the project geologist with the analytical laboratory. Where possible blanks should be inserted immediately following any suspected higher grade mineralisation in order to check for contamination in the early stages of sample preparation.
- All core needs to be photographed routinely and systematically. The core should be photographed after washing and reconstitution and prior to any geological or geotechnical logging.
- Additional dry relative rock density measurements need to be taken using wax immersion and with a balance with an accuracy of at least 0.01 g in the newly established work space that has specifically been dedicated for this work, is clean and has a controlled temperature for the water in which the samples are immersed. Relevant QAQC “dummy core samples” should be made and inserted as part of the routine process with a frequency of 1 in 50 measurements and at the start and end of each work shift (day).

26.1. Next phase of work

Coffey understands that the following work is budgeted by Columbus for the Phase 2 program post November 2013.

- 25,700m of infill drilling (HQ saprolite, NQ fresh rock) on the Montagne d’Or Prospect to a drillhole spacing approximating 50m by 50m and to a vertical depth of 200m below topography is currently under way. All permits have been received for this work and 8,500m of drilling has been completed to date.
- Gold plus ICP-MS 40-element analysis including, silver, copper, zinc, lead and arsenic and check assaying and litho-geochemical analysis for all samples.
- QAQC and drilling protocols and validations of current drillhole database by MDA in Reno, Nevada.
- A program of shallow but closely spaced Auger drilling of the saprolitic zone to verify the grade and extent of gold mineralisation and obtain sufficient information to treat the saprolitic horizon as a separate mineralised domain on its own.
- A metallurgical test work program of both fresh sulphide and saprolitic mineralisation including mineralogical work, complementary to the ongoing study with six larger diameter twin drillholes.
- Updated resource estimate, preliminary mine planning, design and engineering, and Preliminary Economic Analysis (PEA).
- Completion of the ongoing baseline environmental studies including the study of the flora and fauna and stakeholder consultation as part of the ESIA.
- Community programs.

The budget for this phase of work is USD$10.8M as described in Table 43.

Table 42 - Montagne d'Or Prospect Phase 2 Exploration Budget Post November 2013.

Item	USD$ Million
General Exploration	2.09
Management	0.78
Land	0.04
Drilling	6.33
Geology	0.17
QAQC Validation	0.03
Metallurgy	0.39
ESIA Baseline	0.52
Community	0.81
PEA	0.34
TOTAL	**10.8**

Coffey considers the type of work and expense appropriate for the current stage of the project.

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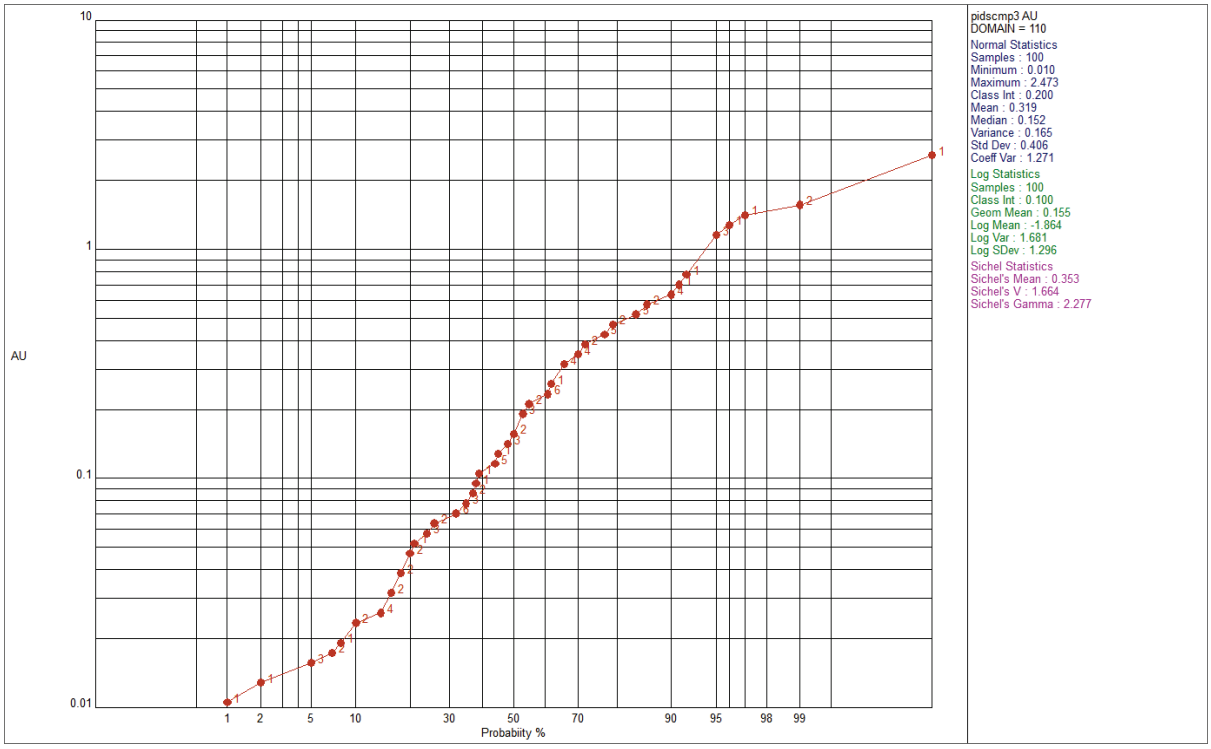
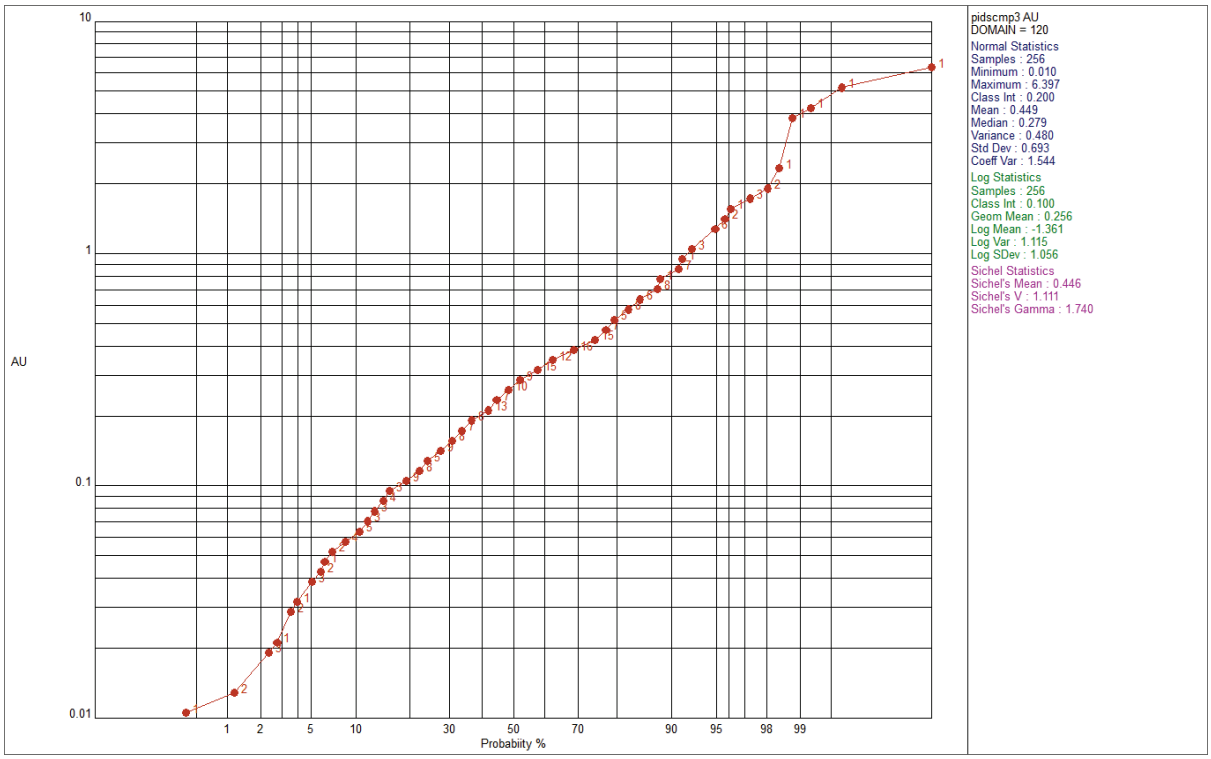
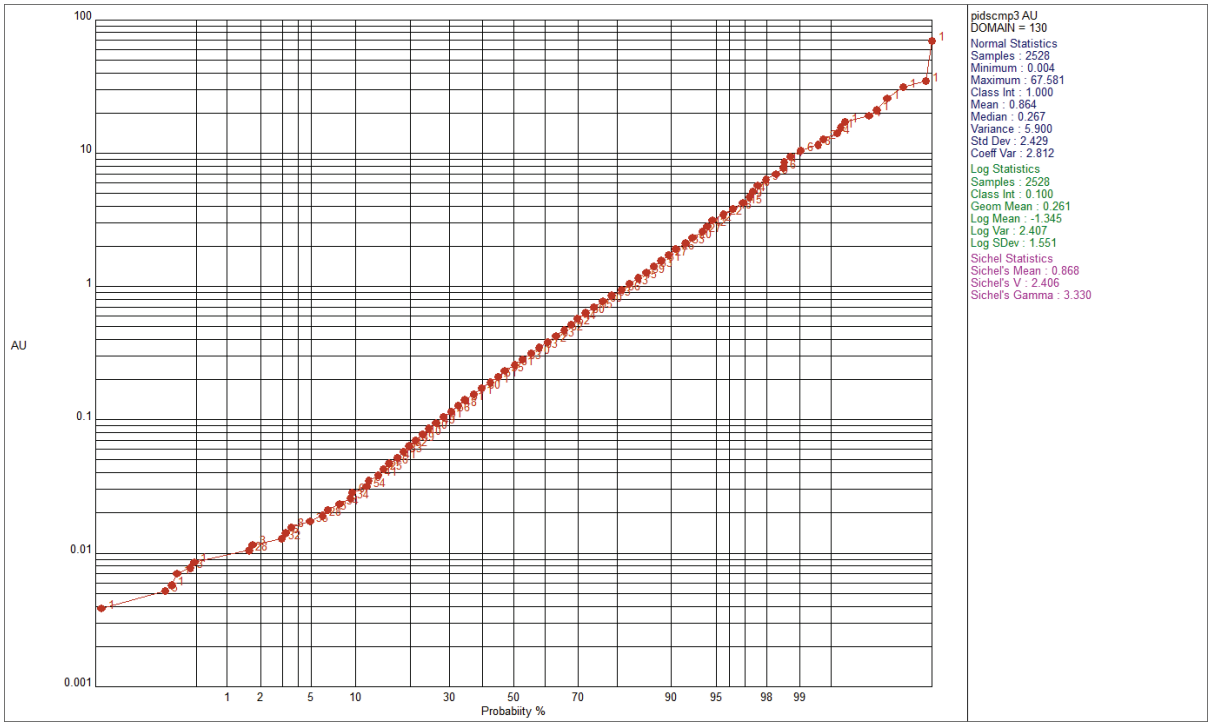
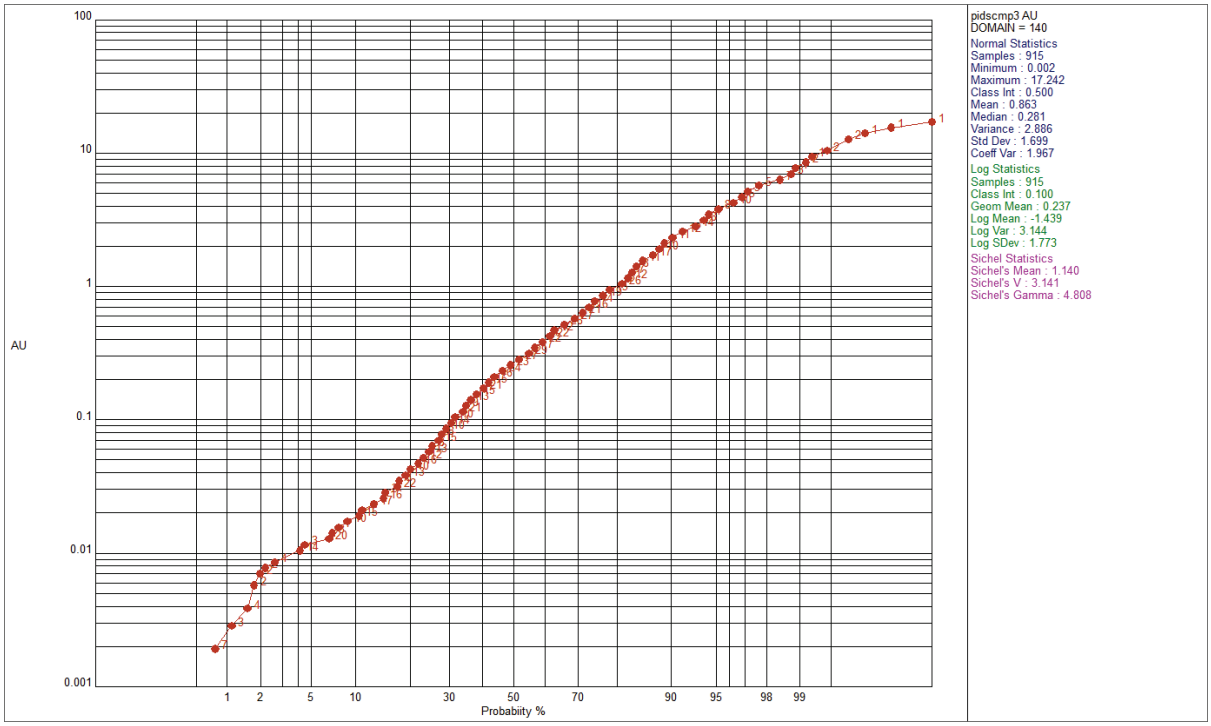
Appendix A -
Cumulative Histogram Plots for Mineralised Domains 110 to 180



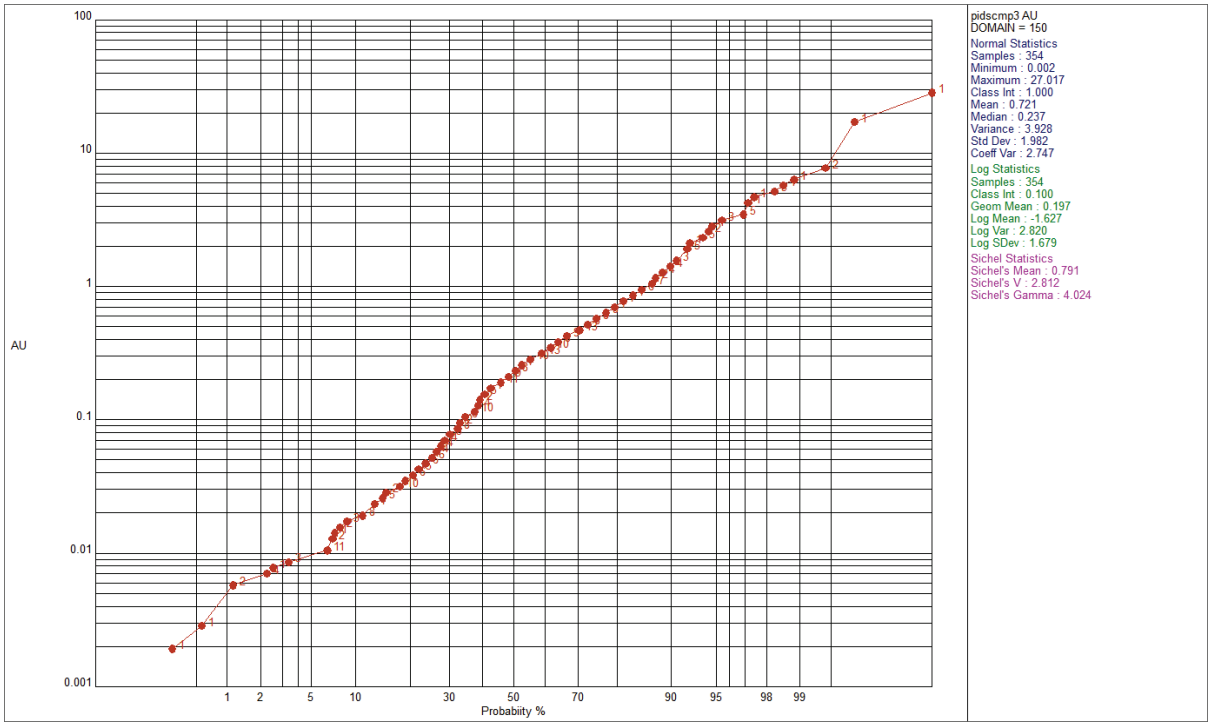


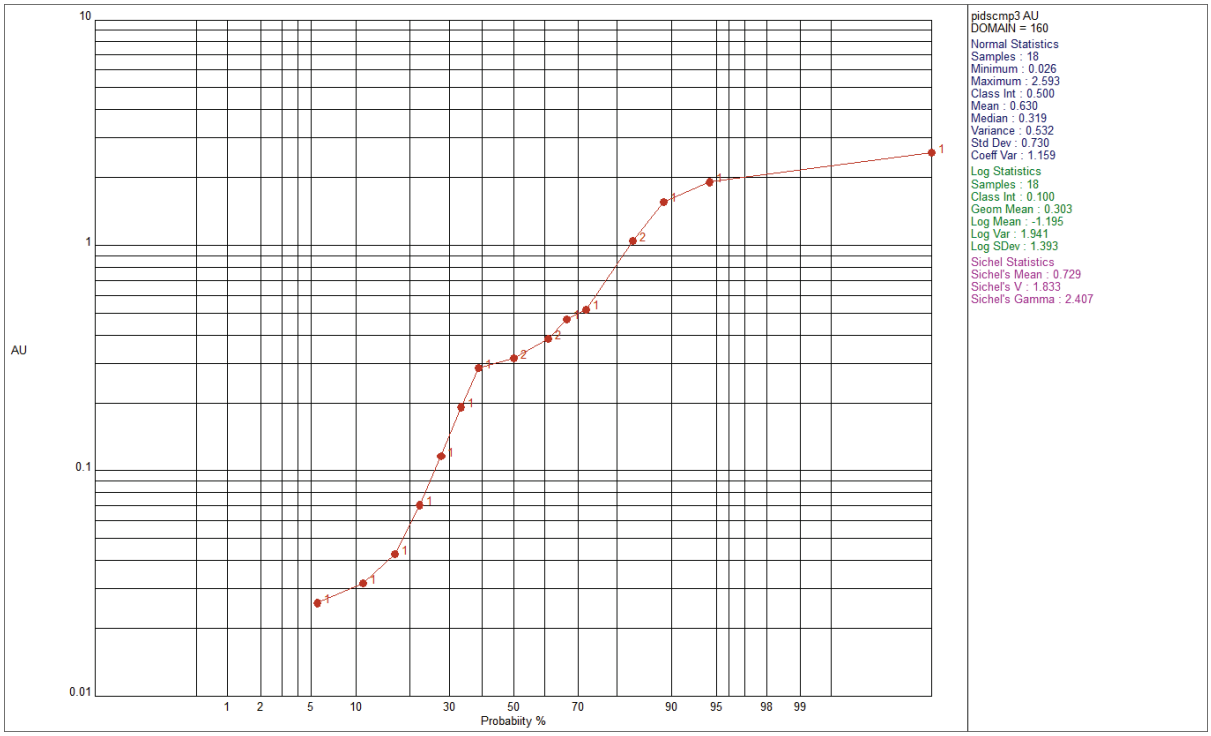
Cumulative Histograms for Au (g/t) in 3m composites in Domain 110 (top) and Domain 120 (bottom)



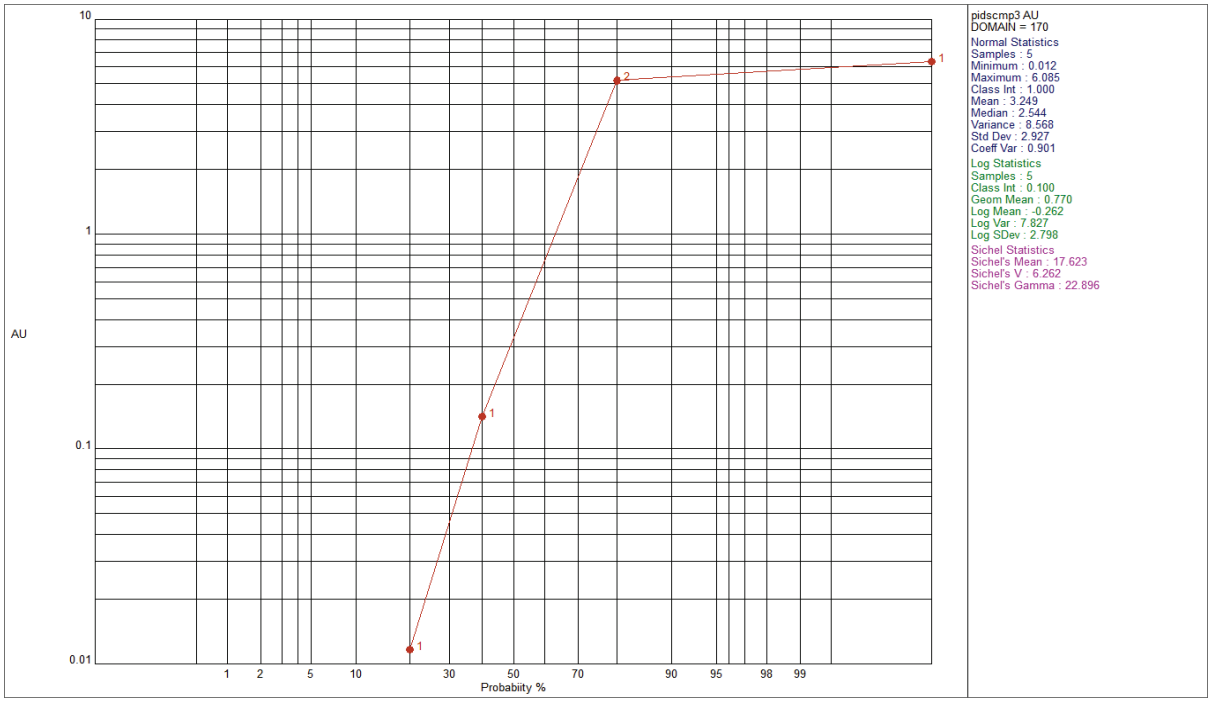


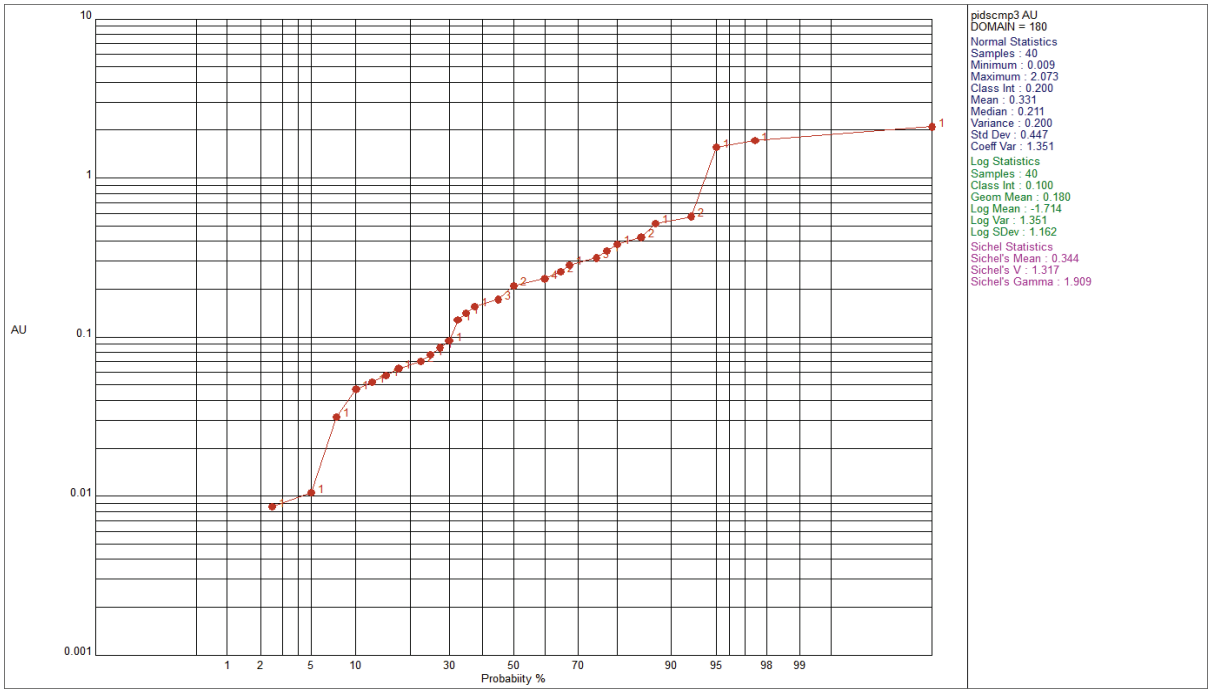
Cumulative Histograms for Au (g/t) in 3m composites in Domain 130 (top) and Domain 140 (bottom)





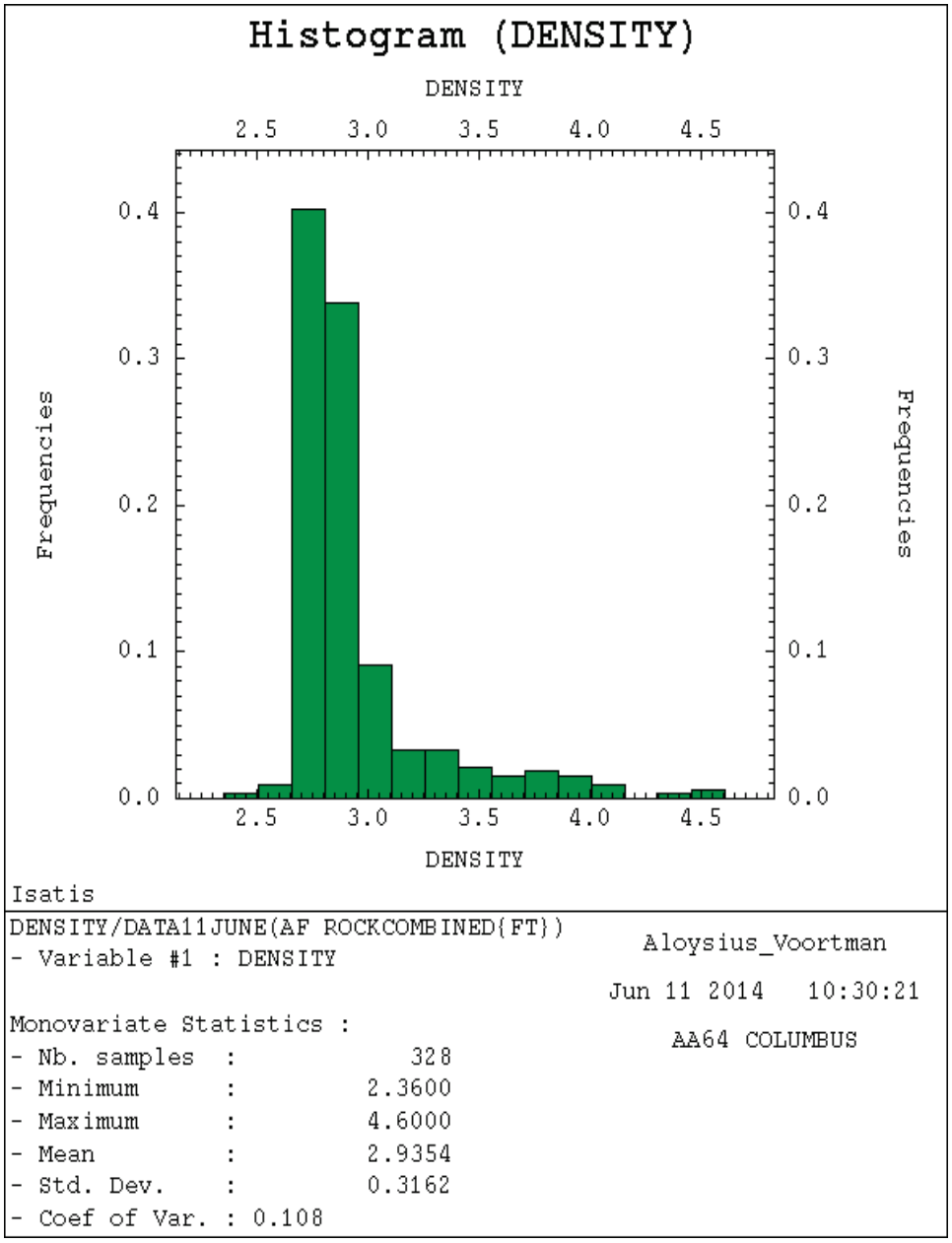
Cumulative Histograms for Au (g/t) in 3m composites in Domain 150 (top) and Domain 160 (bottom)



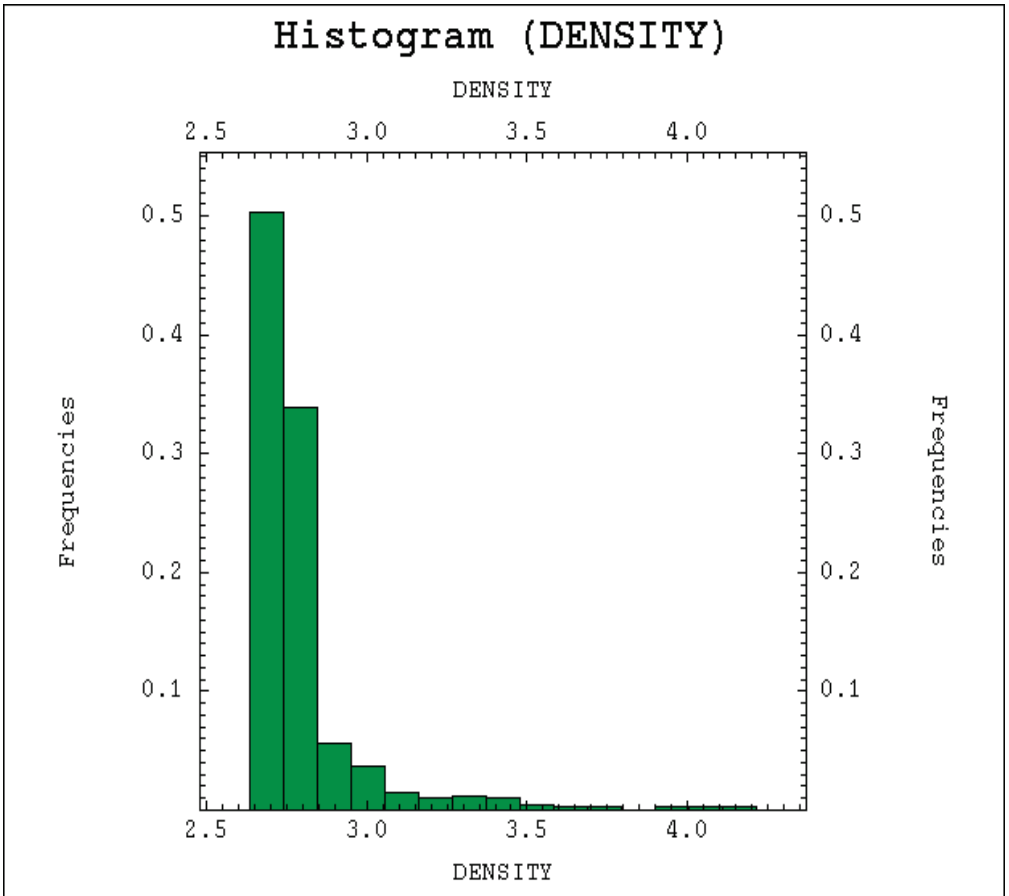


Cumulative Histograms for Au (g/t) in 3m composites in Domain 170 (top) and Domain 180 (bottom)

Appendix B - Histograms of Density per Lithology Type



Histogram of density measurements completed on felsic tuffs



DENSITY/DATA11JUNE(AF ROCKCOMBINED{FTSIL})
- Variable #1 : DENSITY

Aloysius_Voortman

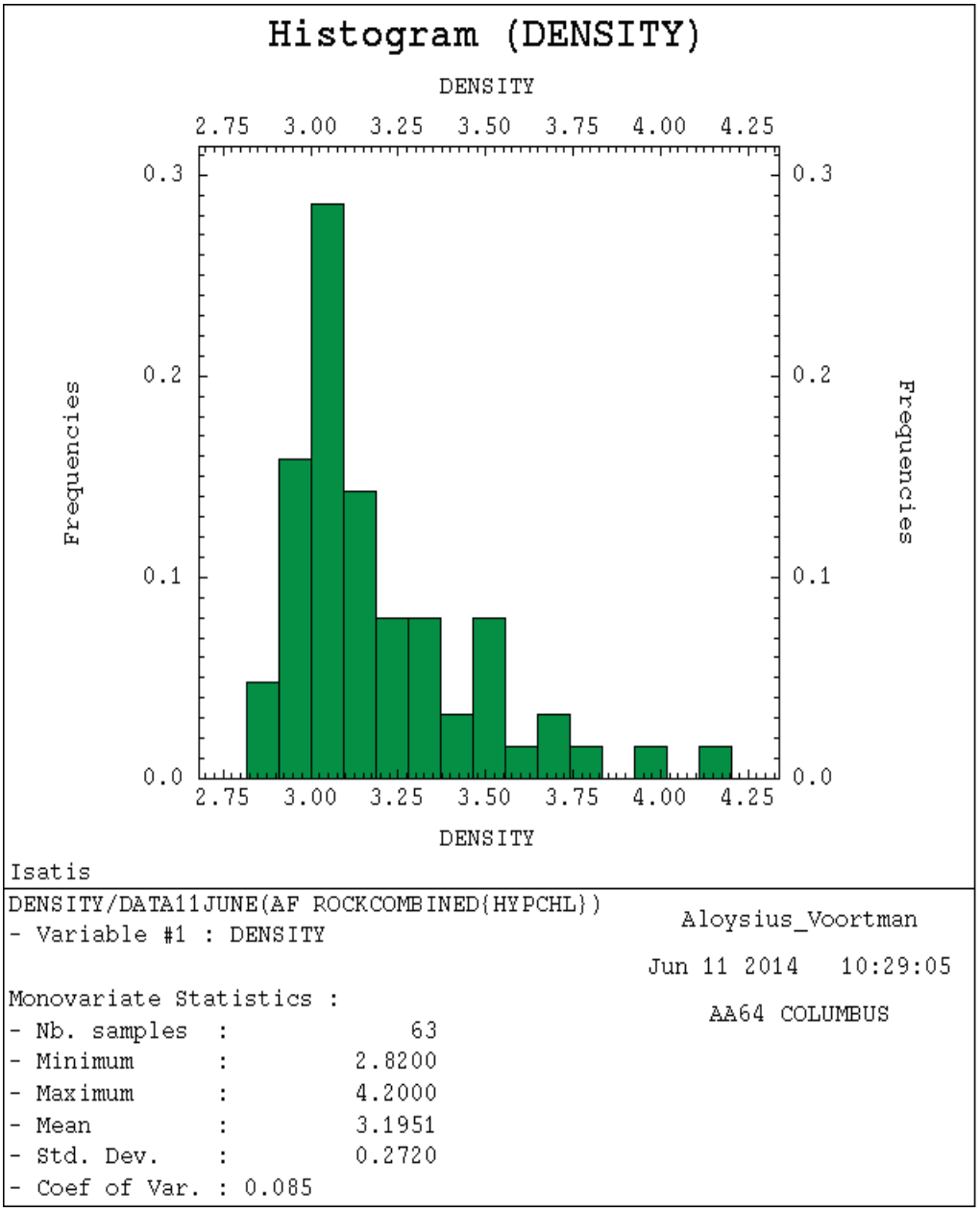
Jun 11 2014 10:30:45

AA64 COLUMBUS

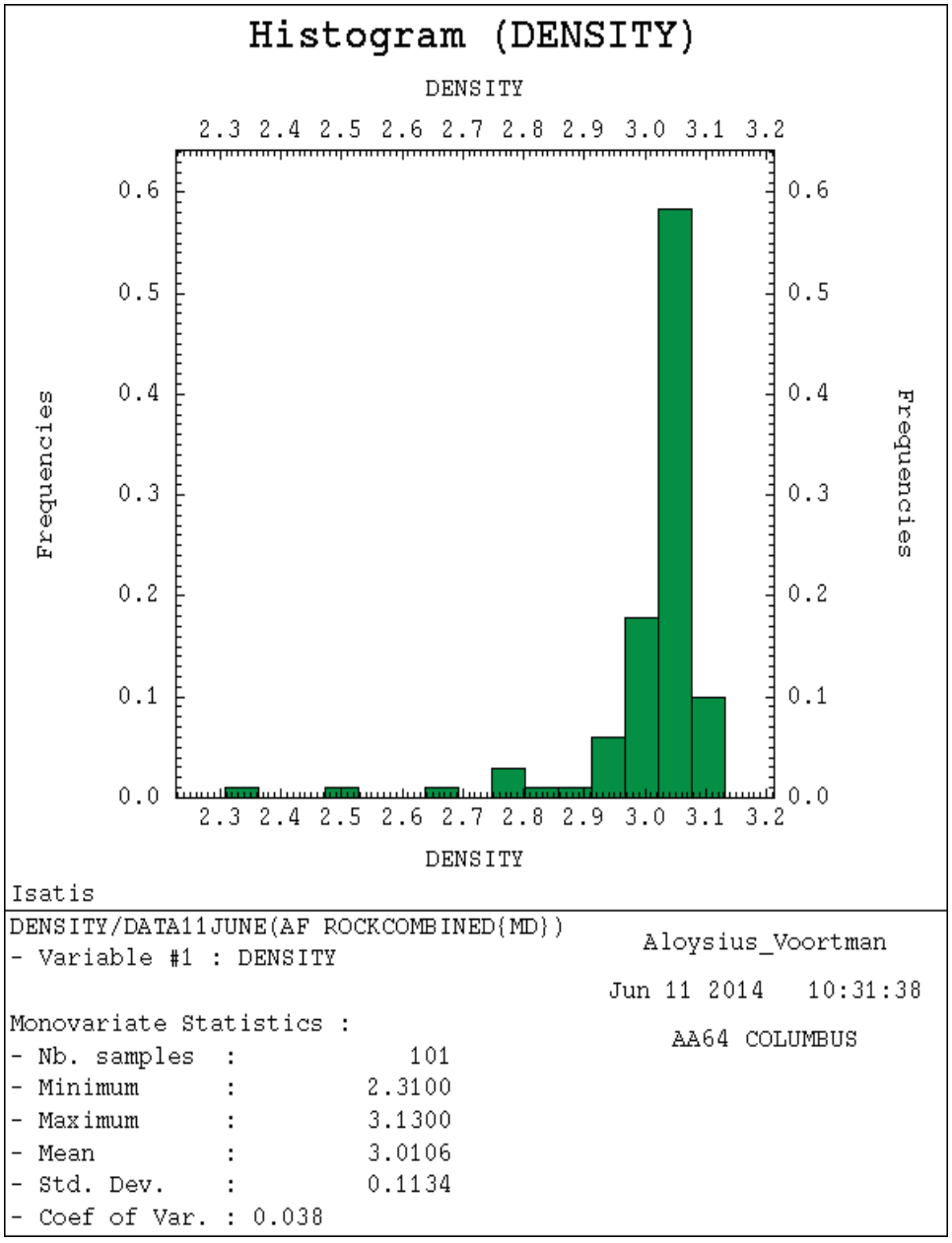
Monovariate Statistics :

- Nb. samples	:	405
- Minimum	:	2.6400
- Maximum	:	4.2100
- Mean	:	2.8067
- Std. Dev.	:	0.1876
- Coef of Var.	:	0.067

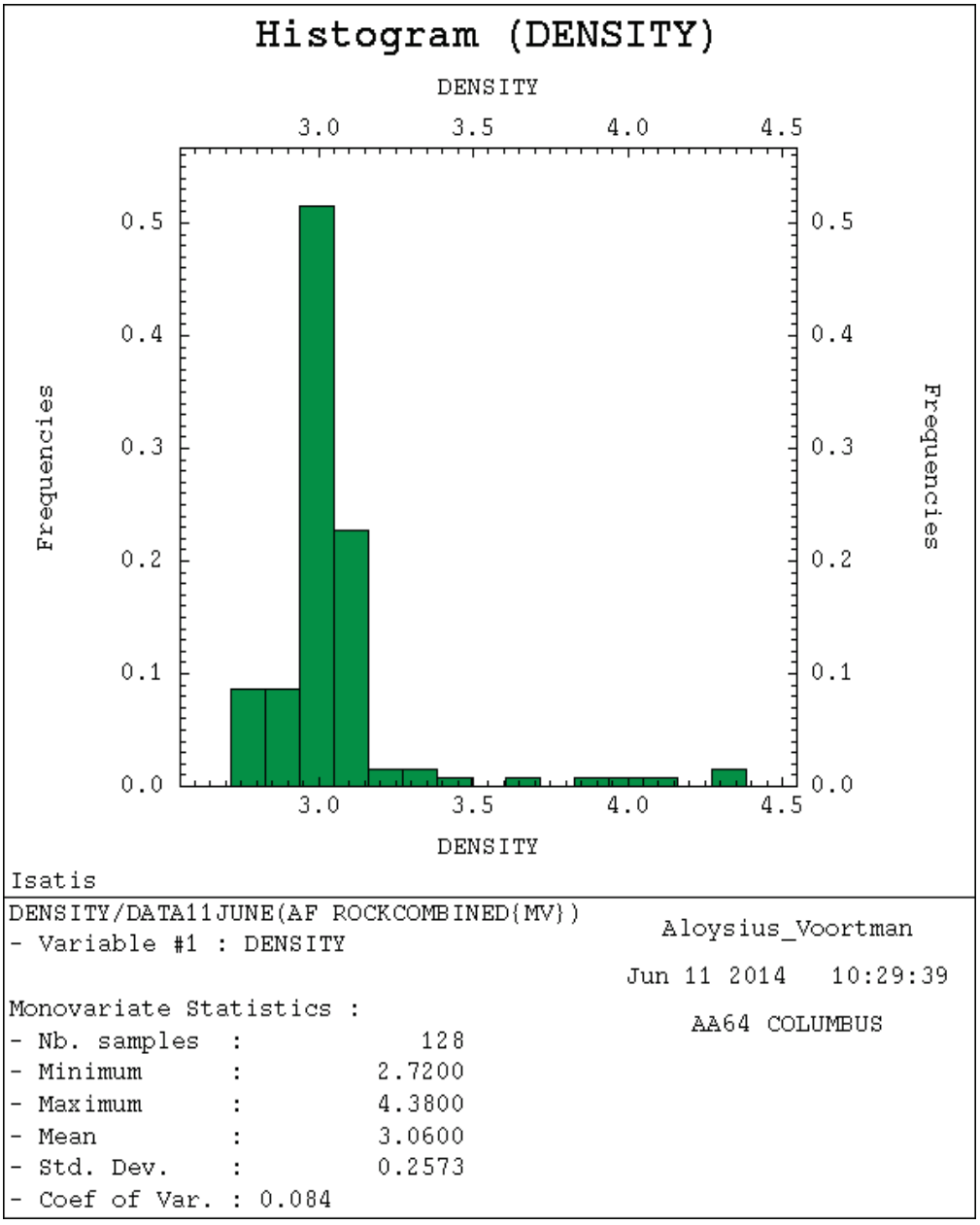
Histogram of density measurements completed on silicified felsic tuffs



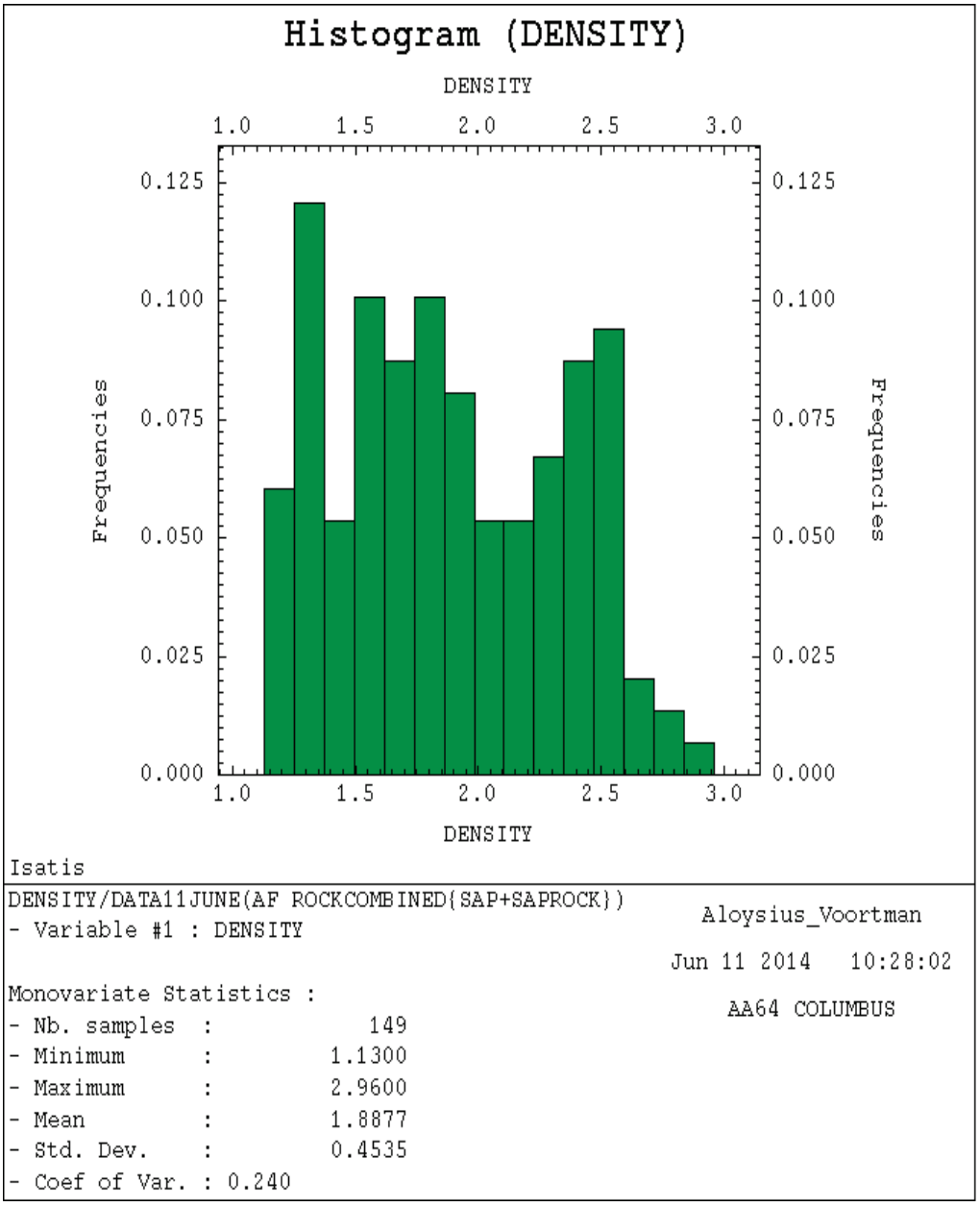
Histogram of density measurements completed on hyperchlorite



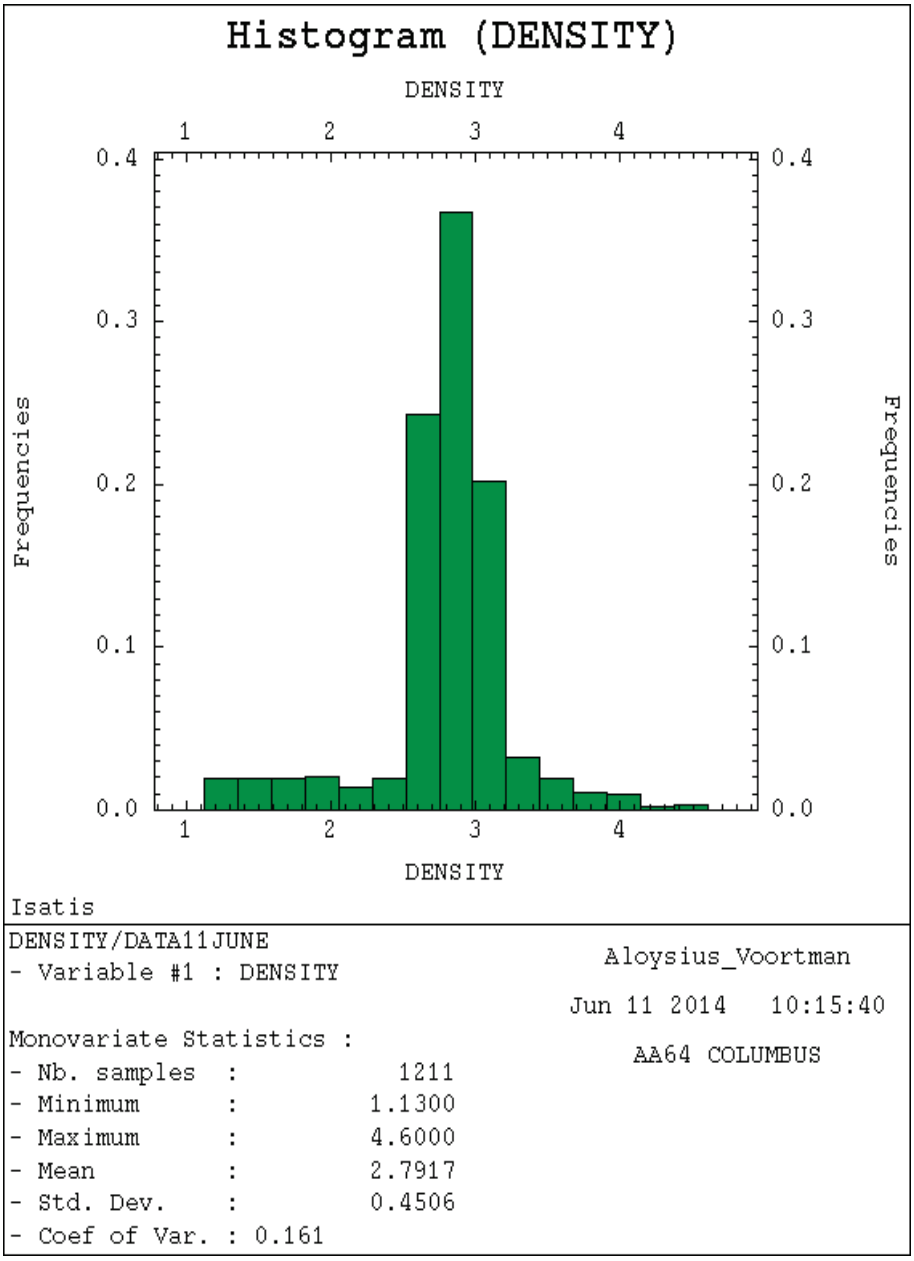
Histogram of density measurements completed on mafic intrusives



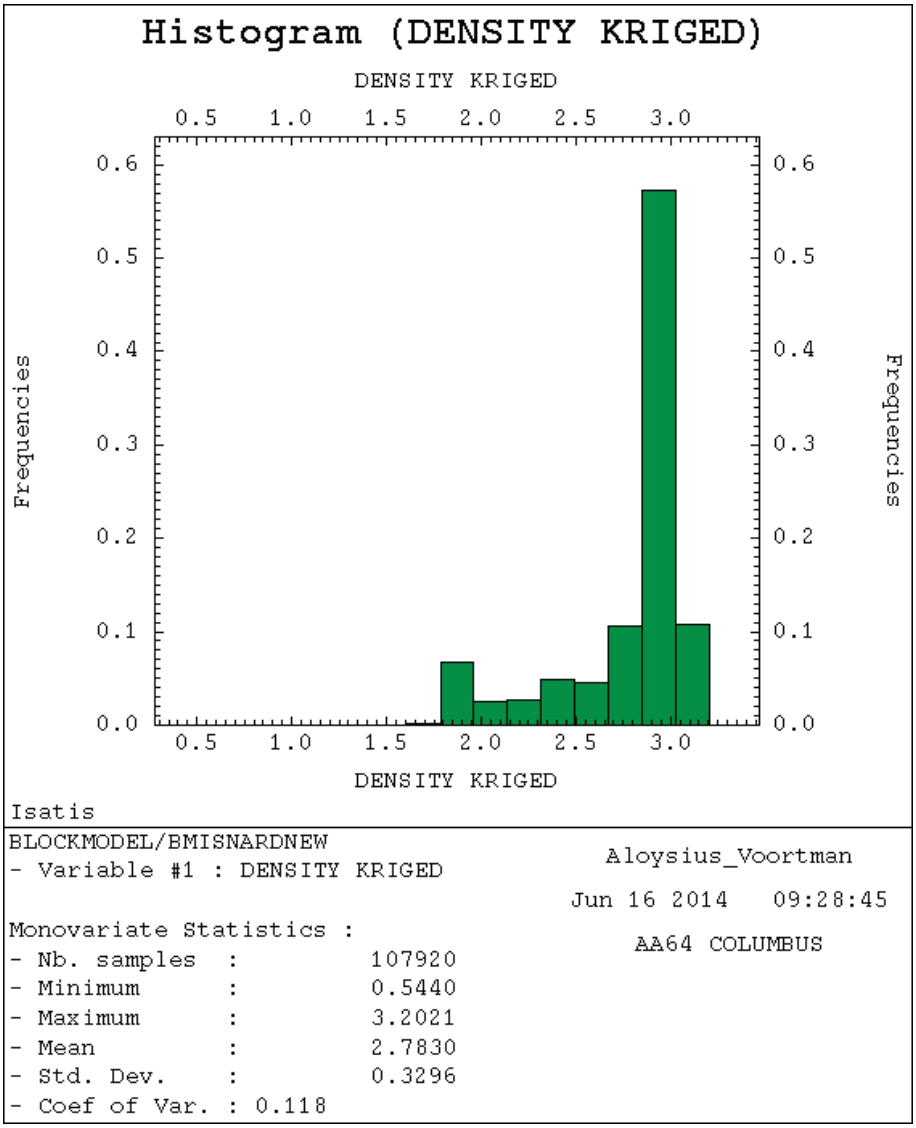
Histogram of density measurements completed on mafic volcanics



Histogram of density measurements completed on saprolite and saprock



Histogram of density measurements completed on all lithologies



Histogram of density estimates in the block model