

PAN AMERICAN SILVER CORP
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Washington, D.C. 20549

FORM 6-K

Report of Foreign Private Issuer
Pursuant to Rule 13a-16 or 15d-16 of
the Securities Exchange Act of 1934

For the month of, February
Commission File Number 000-13727

2010

Pan American Silver Corp
(Translation of registrant's name into English)

1500-625 Howe Street, Vancouver BC Canada V6C 2T6
(Address of principal executive offices)

Indicate by check mark whether the registrant files or will file annual reports under cover of Form 20-F or Form 40F:

Form	Form	X
20-F	40-F	

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Yes	No	X
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DOCUMENTS INCLUDED AS PART OF THIS REPORT

Document

- 1 Technical report entitled "Pan American Silver Corp: Navidad Project, Chubut Province, Argentina", dated February 4, 2010.
-

Pan American Silver Corp: Navidad Project, Chubut Province, Argentina

February 2010

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This report was prepared as a National Instrument 43-101 Technical Report, in accordance with Form 43-101F1, for Pan American Silver Corp. by Snowden. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Snowden's services, based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This report is intended to be used by Pan American Silver Corp., subject to the terms and conditions of its contract with Snowden. That contract permits Pan American Silver Corp. to file this report as a Technical Report with Canadian Securities Regulatory Authorities pursuant to provincial securities legislation. Except for the purposes legislated under provincial securities law, any other use of this report by any third party is at that party's sole risk.

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Summary

This Technical Report refers to the Navidad Project, an advanced stage silver-lead mineral exploration project located in Chubut Province, Argentina, owned by Pan American Silver Corp. (Pan American) through its subsidiary Aquiline Resources Inc. (Aquiline), who in turn conduct business in Argentina through its subsidiaries Minera Aquiline Argentina S.A. (Minera Aquiline), and Minera Argenta S. A.. Pan American is a silver mining company based in Canada and listed on the Toronto Stock Exchange (TSX:PAA) and on NASDAQ (PAAS).

The Supreme Court of British Columbia awarded ownership of the Navidad Project to Minera Aquiline on 14 July 2006 following a court case with IMA Exploration Inc. (IMA) where IMA was found to have breached a Confidentiality Agreement with Minera Normandy Argentina S.A. (Minera Normandy), then a subsidiary of Newmont Mining Corporation. Minera Normandy was subsequently acquired by Aquiline and its name was changed to Minera Aquiline. IMA appealed the trial court decision to the Appeal Court of British Columbia which denied the appeal in reasons for judgment dated 7 June 2007. In September 2007 IMA submitted an Application for Leave to Appeal to the Supreme Court of Canada. Sole ownership rights were granted to Aquiline by the Supreme Court of Canada on 20 December 2007, subject to Aquiline making payment to IMA which would reimburse the latter for its accrued exploration expenditures up to the July 2006 court decision. Aquiline's final payment to IMA was made on 8 February 2008 giving Aquiline full ownership of the Project.

On 14 October 2009, Pan American announced a friendly offer to acquire all of the issued and outstanding securities of Aquiline. On 7 December 2009, Pan American acquired approximately 85% of the issued and outstanding shares of Aquiline and extended its bid to 22 December 2009, and on that latter date, Pan American took up an additional approximately 7% of the issued and outstanding shares in the capital of Aquiline. Since the offer to acquire the Aquiline shares was accepted by holders of more than 90% of the Aquiline shares, on 23 December 2009, Pan American provided notice to the remaining shareholders of its intention to exercise its right to acquire the remaining issued and outstanding Aquiline shares pursuant to the compulsory acquisition provisions of the Business Corporation Act (Ontario). Pan American was deemed to have acquired the balance of the Aquiline shares not already owned by it pursuant to the compulsory acquisition on or about 22 January 2010.

As a result of its acquisition of Aquiline, Pan American is required to file a technical report on the Navidad Project pursuant to NI 43-101. This Technical Report is prepared to fulfil this requirement and is based on information disclosed in the Technical Report filed on SEDAR by Aquiline on 2 June 2009, and dated May 2009, amended June 2009 (Snowden, 2009). There are no other material changes to the Navidad Project to report aside from the acquisition of Aquiline by Pan American.

The June 2009 Technical Report (Snowden, 2009) disclosed recently updated Mineral Resources at the Calcite NW, Calcite Hill, Navidad Hill, Connector Zone, Galena Hill, Barite Hill, and Loma de La Plata, and disclosed the first Mineral Resource for Valle Esperanza at the Navidad Project. The amended report dated June 2009 included the assay results of independent samples selected by Snowden in April 2009, which were not available at the time of the original filing on SEDAR in May, 2009.

Mineral Resource estimates were reported at the Navidad Property (Table 1.1) effective April 2009. Tonnes and grades were reported above a cut-off grade of 50 g/t silver

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equivalent. To date, no analysis has been made to determine the economic cut-off grade that will ultimately be applied to the whole Navidad Project. Silver equivalence was calculated using three year rolling average prices for silver (\$12.52 per oz) and an approximate ten year rolling average price for lead (\$0.50 per lb). The following formula, which does not include any other factors such as variable metal recoveries, was applied to reach the silver equivalent value: $AgEQ(g/t) = Ag(g/t) + (Pb(\%) \times 10,000/365)$.

The deposit areas at Navidad occur within a sedimentary package known as the Cañadón Asfalto Formation hosting an intermediate volcanic rock identified as trachyandesite, referred to locally as latite. Lithologies described as the Cañadón Asfalto may occur both above and below intercalated bodies of latite. The entire sequence is interpreted to have been deposited within a lacustrine basin environment.

A group of eight individual deposits and six prospects have been identified at the project and seven of these have been the subject of previous Mineral Resource estimates (Snowden 2006a, Snowden 2006b, and Snowden, 2007). All of these deposits are either hosted in the latite unit itself or in the sedimentary sequence proximal to the latite. Base metals, principally lead and to a lesser extent copper, are typically present but are largely not significant in quantity except at Galena Hill. There has been virtually no gold detected to date.

Since the filing of the November 2007 Technical Report, additional geochemical and geophysical surveys plus 367 diamond drillholes totalling 92,540 m have been done on the Project. The geophysical surveys over the core area of the property have included gravity, deep-array pole-dipole IP, CSAMT, and a high definition ground magnetometer survey. At Navidad only the latter technique has shown some continued promise as an exploration guide through the interpretation of the detailed structural setting in the district.

The drilling programme continued to yield significant results during the past 18 months, and of particular significance is the discovery of the Valle Esperanza deposit which in this estimate contains in the Indicated category 12.2 Mt at a grade of 172 g/t Ag, above a cut-off grade of 50 g/t AgEQ. In the Inferred category, the deposit contains 10.8 Mt at a grade of 123 g/t Ag above the same cut-off grade. The grade, geometry, and depth of this deposit are such that underground mining is a potential option.

Early metallurgical testing of Galena Hill has proved that differential flotation was effective in producing a lead concentrate and silver-rich concentrate, although it was recommended significant work was required to increase overall silver recovery and improve the quality of the concentrate for sale. Subsequent analysis of the pyrite concentrate mineralogy (XPS, 2007) identified the potential to upgrade the concentrate by inserting cleaning and entrainment controls into the circuit such as froth washing and column flotation, that improve concentrate grades by a factor of 2.5.

Initial metallurgical testing of Loma de La Plata proved highly successful especially as recovery of silver exceeded 80% and the concentrate was high in silver (around 50 kg/t Ag), but low in lead with a combined base metal (copper plus lead) content of 15% to 25%. Subsequent efforts were directed at testing the variability of the deposit in support of a Preliminary Economic Assessment of Loma de La Plata only. The test work at both G&T and XPS concluded that Loma de La Plata ore responds well to flotation, with high recoveries and concentrate grades. A simple crushing, grinding, and single product

flotation concentrator was proposed for the PEA, and the concentrate sold to an offshore copper smelter with minor penalties for lead.

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With the discovery of Valle Esperanza and its similarity in mineralisation style to Loma de La Plata, metallurgical testing was expanded to incorporate deposits likely to produce a high-value silver concentrate with low lead content. Testing of Valle Esperanza and Barite Hill samples yielded satisfactory results, and as with Loma de La Plata, silver recoveries of 80% or better appear likely. The concentrate grades from Valle Esperanza are particularly high (over 50 kg/t Ag to 60 kg/t Ag), while those from Barite Hill are also satisfactory containing 20 kg/t Ag to 25 kg/t Ag. However, the individual concentrates contain high levels of penalty elements such as arsenic and antimony. Mr. Wells believes that Loma de La Plata, Barite Hill, and Valle Esperanza can all be treated in the same, simple, one-product concentrator.

The testing of Loma de La Plata is likely to be sufficient to support a Feasibility Study. A large quantity of core has been kept in sealed bags and is sufficient for a pilot plant test should this be considered necessary.

The Preliminary Economic Assessment of Loma de La Plata (Snowden, 2008), concluded the development of Loma de La Plata would deliver a pre-tax NPV at 7.5% of US\$135.6 million, and internal rate of return (IRR) of 22%, and a 25 month payback period.

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Table 1.1 Navidad April 2009 Mineral Resources reported above a cut-off grade of 50 g/t AgEQ

Deposit	Classification	Tonnes (Mt)	AgEQ g/t	Ag g/t	Pb%	Cu%	Contained Ag (Moz)	Contained Pb (Mlb)	Contained Cu (Mlb)
Calcite Hill NW	Measured	-	-	-	-	-	-	-	-
	Indicated	14.8	94	78	0.59	-	37	194	-
	Meas. + Ind.	14.8	94	78	0.59	-	37	194	-
	Inferred	14.6	74	52	0.82	-	24	265	-
Calcite Hill	Measured	-	-	-	-	-	-	-	-
	Indicated	17.5	115	100	0.55	-	56	212	-
	Meas. + Ind.	17.5	115	100	0.55	-	56	212	-
	Inferred	4.9	106	96	0.36	-	15	39	-
Navidad Hill	Measured	8.4	122	109	0.46	-	29	85	-
	Indicated	5.6	96	90	0.24	-	16	29	-
	Meas. + Ind.	14	112	101	0.37	-	45	114	-
	Inferred	1.8	81	70	0.41	-	4	16	-
Connector Zone	Measured	-	-	-	-	-	-	-	-
	Indicated	8.2	102	91	0.41	-	24	74	-
	Meas. + Ind.	8.2	102	91	0.41	-	24	74	-
	Inferred	9.9	88	74	0.49	-	24	107	-
Galena Hill	Measured	7	242	170	2.62	-	38	404	-
	Indicated	44.7	166	117	1.78	-	168	1,754	-
	Meas. + Ind.	51.7	176	124	1.89	-	206	2,158	-
	Inferred	1.7	116	80	1.35	-	4	50	-

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Deposit	Classification	Tonnes (Mt)	AgEQ g/t	Ag g/t	Pb%	Cu%	Contained Ag (Moz)	Contained Pb (Mlb)	Contained Cu (Mlb)
Barite Hill	Measured	-	-	-	-	-	-	-	-
	Indicated	7.7	161	153	0.28	-	-	38	48
	Meas. + Ind.	7.7	161	153	0.28	-	-	38	48
	Inferred	0.9	100	81	0.69	-	-	2	13
Loma de La Plata	Measured	-	-	-	-	-	-	-	-
	Indicated	29.1	172	169	0.09	0.05	0.05	158	58
	Meas. + Ind.	29.1	172	169	0.09	0.05	0.05	158	58
	Inferred	1.3	82	76	0.21	0.05	0.05	3	6
Valle Esperanza	Measured	-	-	-	-	-	-	-	-
Valle Esperanza	Indicated	12.2	178	172	0.21	-	-	68	56
	Meas. + Ind.	12.2	178	172	0.21	-	-	68	56
	Inferred	10.8	133	123	0.35	-	-	43	84
Total	Measured	15.4	177	137	1.44	-	0	67	489
	Indicated	139.8	147	126	0.79	0.05	0.05	565	2,425
	Meas. + Ind.	155.2	150	127	0.85	0.05	0.05	632	2,914
	Inferred	45.9	97	81	0.57	0.05	0.05	119	580

Notes:

The most likely cut-off grade for these deposits is not known at this time and must be confirmed by the appropriate economic studies.

Silver equivalent grade values are calculated without consideration of variable metal recoveries for silver and lead. A silver price of US\$12.52/oz and lead price of US\$0.50/lb was used to derive an equivalence formula of $AgEQ\ g/t = Ag\ g/t + (Pb\% \times 10,000 / 365)$. Silver prices are based on a three-year rolling average and lead prices are based on an approximate ten-year rolling average.

The estimated metal content does not include any consideration of mining, mineral processing, or metallurgical recoveries.

Tonnes, ounces, and pounds have been rounded and this may have resulted in minor discrepancies in the totals.

Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability. No Mineral Reserves have been estimated.

The estimate of Mineral Resources may be materially affected by environmental, permitting, legal, title, taxation, socio-political, marketing, or other relevant issues.

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Measured and Indicated Mineral Resources silver ounces have increased by 40% since the November 2007 Mineral Resource estimate. This increase is mainly contributed by the upgrade of Inferred resources to Indicated resources, defined during infill drilling at Loma de La Plata. Valle Esperanza is now estimated to contain the largest Inferred resource of the Project. With additional infill drilling on 50 m sections at Valle Esperanza, the conversion rate of Inferred resources to Indicated resources is anticipated to be as high as that experienced at the other deposits at the Project.

No Mineral Reserves have been estimated at this time. Additional studies will be required to determine technical, economic, legal, environmental, socio-economic, and governmental factors. These modifying factors are normally included in a mining feasibility study and are a pre-requisite for conversion of Mineral Resources to, and reporting of, Mineral Reserves. The CIM Standards (CIM, 2005) describe completion of a Preliminary Feasibility Study as the minimum prerequisite for the conversion of Mineral Resources to Mineral Reserves.

The following recommendations are made for the further advancement of the Project:

- Continue metallurgical definition of the deposits with particular emphasis on Galena Hill, which hosts 30% of the Indicated Resource silver ounces as well as 2,158 Mlb of lead in the Measured and Indicated categories.
- Using the Loma de La Plata Preliminary Economic Assessment study as a model, develop an expanded model to include Valle Esperanza and Barite Hill as sources of high-grade silver concentrates with relatively low base metal content.
- Develop a global Preliminary Economic Assessment that takes all deposits into consideration with emphasis on an optimum extended mine life.
- Continue selective exploration of the best targets in the core project area that have Loma de La Plata or Valle Esperanza type potential. The continued exploration in the extended Valle Esperanza Valley is one of the highest priority areas.
- Continue to evaluate and prioritise the various mining concessions that Pan American controls along the Gastre Fault structural trend.
- Continue to advance the Navidad environmental base line studies in anticipation of an eventual filing of the appropriate environmental impact statement (EIS). In the short term Pan American plans to engage an international-level consultant to conduct a baseline review and plan the outstanding baseline work to complete the environmental impact assessment (EIA) for the proposed mine. This consultant would conduct an independent evaluation and consult with the Chubut Provincial authorities. The consultant would then assist with baseline studies and ultimately be responsible for preparation of the mine EIA.
- Pan American should continue and increase efforts to explain and present the Navidad Project to the authorities in the Chubut Provincial government, especially stressing the benefits in

employment, infrastructure, and tax revenue that would accrue to the community if the authorities were to rescind legislation that currently prohibits open pit mining.

Pan American should continue to implement their proposed continuous improvement practices on diamond drilling, QAQC, sampling, density determinations, and resource modelling aspects at the Project, including:

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- Survey all drillholes regardless of their orientation, with the first measurement taken at the collar of the drillhole, to ensure that the spatial location of mineralisation is well defined.
- Continue to refine the effectiveness of the QAQC database through more accurate documentation of the QAQC sample type and the analytical method, and by following the recommendations made by Smee (2008); these recommendations are being implemented.
- Determine the density of drill core prior to splitting with a diamond saw to reduce the error in the calculation introduced by a small sample size. Samples should be coated with a material such as wax or varnish to prevent water retention in the sample from influencing the calculated specific gravity value. Samples should be selected according to a representative suite of lithologies, mineralisation, and alteration types, through spatially representative locations throughout the area covered by drilling. The representativity can be confirmed by consulting the number of density determinations tabulated by grade estimation domain for each deposit in Table 17.10, and increasing the number of density samples in domains with low sample numbers relative to the number of sample assays in the domain. Spatial representativity can be confirmed by plotting the location of specific gravity samples on the drillhole trace in plan and in section.
- Further refine the geological interpretation to incorporate all available geological information, including surface mapping (including the position of outcropping mineralisation), geophysical information, structural information, and core logging detail in digital, three dimensional format.
- Continue the modelling of fault interpretations for use in future resource estimations.
- Undertake a study of the differences between the oxide and sulphide zones for modelling in future resource estimations.

Snowden further recommends that Pan American undertake a drillhole spacing study at Loma de La Plata using conditional simulation to quantify the optimal drillhole spacing required to achieve a range of estimation qualities. Some close-spaced drilling should be performed in a representative mineralised domain to characterise the short-range behaviour of the mineralisation. Aquiline has already drilled 23 holes at Loma de La Plata in anticipation of such a drillhole spacing study. The outcome of this approach would be an understanding of the degree of grade estimation error associated with particular volumes of mineralisation for a range of drillhole spacing patterns. The grade estimation error and other important aspects of the project data, described in Section 17.10, are considered while assigning Mineral Resource confidence categories.

Pan American plans to proceed to an expanded Preliminary Economic Assessment (PEA) of the Navidad Project, using the Loma de La Plata PEA study published in October 2008 as a basis (Snowden, 2008), focussing on deposits that are likely to produce a high-value silver concentrate with low lead content and maximise the operational mine life. The study will utilise the updated resource models produced as part of this report, in addition to the metallurgical testing of Valle Esperanza and Barite Hill. A more detailed evaluation of the market for silver/copper concentrates is also required. In addition to examining open pit mining methods, those deposits with likely

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high strip ratio cutbacks such as Valle Esperanza, Loma de La Plata, and Barite Hill will be evaluated for extraction by underground methods.

More test work with fresh core samples is essential to take Barite Hill and Valle Esperanza to Feasibility Study level to enable Bond Mill work indices to be determined, further tailings settling tests and potential penalty elements including arsenic and antimony.

Further studies of Galena Hill will focus on developing a programme to test the metallurgical variability of the deposit including initial modelling of the geo-metallurgical domains and designing the drill programme for fresh samples. The design of the metallurgical test programme should incorporate opportunities for improving concentrate quality already identified.

Continued exploration in the company's land package in the Navidad district will be directed towards additional Jurassic-age basins in the Gastre structural corridor with Cañadón Asfalto lithologies. Geochemical sampling techniques should be effective tools to efficiently explore these basins. The distribution of associated potassic-style alteration such as adularia within the regional basins may be detected through the interpretation of the 2008 airborne radiometric survey.

Approximately US\$500,000 was expended per month in Argentina on the exploration programme and related activities for the Navidad Property in 2009. Pan American will continue exploration drilling on several open or new targets along the mineralised trends. Infill drilling is planned for Loma de la Plata, Valle Esperanza, Barite Hill, and Galena Hill during 2010. These drillholes will also provide new samples for metallurgical analysis. Additional condemnation and geotechnical drilling is planned for potential future infrastructure sites.

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Introduction

This Technical Report has been prepared by Snowden Mining Industry Consultants Inc. (Snowden) for Pan American Silver Corp. (Pan American), in compliance with the disclosure requirements of Canadian National Instrument 43-101 (NI 43-101), to disclose relevant information about the Navidad Project. This information has resulted from the acquisition of Aquiline Resources Inc. (Aquiline) by Pan American. On 14 October 2009, Pan American announced a friendly offer to acquire all of the issued and outstanding securities of Aquiline. On 7 December 2009, Pan American acquired approximately 85% of the issued and outstanding shares of Aquiline and extended its bid to 22 December 2009, and on that latter date, Pan American took up an additional approximately 7% of the issued and outstanding shares in the capital of Aquiline. Since the offer to acquire the Aquiline shares was accepted by holders of more than 90% of the Aquiline shares, on 23 December 2009, Pan American provided notice to the remaining shareholders of its intention to exercise its right to acquire the remaining issued and outstanding Aquiline shares pursuant to the compulsory acquisition provisions of the Business Corporation Act (Ontario). Pursuant to the compulsory acquisition, Pan American has been deemed to have acquired the balance of the Aquiline shares not already owned by it on or about 22 January 2010.

As a result of its acquisition of Aquiline, Pan American is required to file a technical report on the Navidad Project pursuant to NI 43-101. This Technical Report is prepared to fulfil this requirement and is based on information disclosed in the Technical Report filed on SEDAR by Aquiline on 2 June 2009, and dated May 2009, amended June 2009 (Snowden, 2009). There are no other material changes to the Navidad Project to report aside from the acquisition of Aquiline by Pan American.

The June 2009 Technical Report (Snowden, 2009) was prepared to disclose information from additional Mineral Resource delineation drilling, Mineral Resource estimations, exploration drilling, and metallurgical test work completed since the previous Technical Reports (Snowden 2006a, Snowden 2006b, and Snowden, 2007). The June 2009 Technical Report was intended to disclose recently updated Mineral Resources at the Calcite NW, Calcite Hill, Navidad Hill, Connector Zone, Galena Hill, Barite Hill, Loma de La Plata, and Valle Esperanza deposits at the Navidad Project. The amended report dated June 2009 included the assay results of independent samples selected by Snowden in April 2009, which were not available at the time of the original filing on SEDAR in May, 2009.

The Supreme Court of British Columbia awarded ownership of the Navidad Project to Minera Aquiline on 14 July 2006 following a court case with IMA Exploration Inc. (IMA) where IMA was found to have breached a Confidentiality Agreement with Minera Normandy Argentina S.A. (Minera Normandy), then a subsidiary of Newmont Mining Corporation. Minera Normandy was subsequently acquired by Aquiline and its name was changed to Minera Aquiline. IMA appealed the trial court decision to the Appeal Court of British Columbia which denied the appeal in reasons for judgment dated 7 June 2007. In September 2007 IMA submitted an Application for Leave to Appeal to the Supreme Court of Canada. Sole ownership rights were granted to Aquiline by the Supreme Court of Canada on 20 December 2007, subject to Aquiline making payment to IMA which would reimburse the latter for its accrued exploration expenditures up to the July 2006 court decision. Aquiline's final payment to IMA was made on 8 February 2008 giving Aquiline full ownership of the Project.

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Pan American is a silver mining company based in Canada and listed on the Toronto Stock Exchange (TSX:PAA) and NASDAQ (PAAS).

Unless otherwise stated, information and data contained in this report or used in its preparation has been provided by Aquiline and Pan American. This Technical Report has been compiled from sources cited in the text by Ms. Pamela De Mark, P. Geo., Senior Consultant at Snowden, and under the supervision of Snowden by Mr. John J. Chulick, formerly Vice President of Exploration at Aquiline, Mr. Dean K. Williams, formerly Chief Geologist at Aquiline, Mr. Damian Spring, Chief Mining Engineer at Aquiline, and by John A. Wells, consultant metallurgist. Ms. De Mark, Mr. Chulick, Mr. Williams, Mr. Spring, and Mr. Wells are Qualified Persons as defined by NI 43-101. Ms. De Mark visited the Navidad Project site in September 2007 and in April 2009. The responsibilities of each author are provided in Table 2.1.

This report is intended to be used by Pan American subject to the terms and conditions of its contract with Snowden. That contract permits filing this report as a Technical Report with Canadian Securities Regulatory Authorities pursuant to provincial securities legislation. Except for the purposes legislated under provincial securities laws any other use of this report by any third party is at that party's sole risk.

Reliance on the report may only be assessed and placed after due consideration of Snowden's scope of work, as described herein. This report is intended to be read as a whole, and sections or parts thereof should therefore not be read or relied upon out of context. Any results or findings presented in this study, whether in full or excerpted, may not be reproduced or distributed in any form without Snowden's written authorisation.

Table 2.1 Responsibilities of each co-author

Author	Responsible for section/s
Dean K. Williams	7: Geological setting; 8: Deposit types
John J. Chulick	4: Property description and location; 6: History; 9: Mineralisation; 10: Exploration; 11: Drilling; 12: Sampling method and approach; 13: Sample preparation, analyses, and security; 15: Adjacent properties
John A. Wells	16: Mineral processing and metallurgical testing
Damian Spring	18: Other relevant data and information
Pamela De Mark	All other sections

Unless otherwise stated, all currencies are expressed in US dollars (\$). Coordinates for the Navidad Project grid, including drill coordinates referred to in this Technical Report are in the Gauss Kruger projection, Zone 2, relative to the Campo Inchauspe datum. Mining claims are registered using the Gauss Kruger projection, Zone 2, relative to the WGS 84 datum.

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Reliance on other experts

There has been no reliance on experts who are not Qualified Persons in the preparation of this report except for information cited in Section 15 regarding Adjacent Properties, where unverified information has been obtained from the company website of Patagonia Gold Plc. at www.patagoniagold.com.

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Property description and location

Information in this section has been sourced from Snowden (2009).

The Navidad Project is located in Gastre Department in the Province of Chubut, southern Argentina, at approximately 42°24' 54" S and 68°49' 12" W.

4.1 Land tenure

The Navidad Property is divided into four property claims (registration numbers 14340/04, 14341/04, 14902/06, and 14903/06), each of which is 2,500 ha in area. Additional Aquiline Property claims held or applied for in the name of Minera Argenta S. A. and Minera Aquiline Argentina S.A. in Chubut Province are shown in Table 4.1 and Table 4.2. A plan of the tenements held by Pan American in Chubut Province is shown in Figure 4.1.

In Argentina, exploration concessions are not physically surveyed or staked in the field, but are electronically filed using the Gauss Kruger coordinate system, zone (faja) 2, relative to the WGS 84 datum. There are three levels of mineral rights (which do not include surface rights):

- Cateo – an exploration permit granting any mineral discoveries on the cateo to the applicant. Cateos are measured in units of 500 ha, with a minimum of one unit (500 ha) and a maximum of 20 units (10,000 ha) granted to any holder. Cateo units must be reduced over time relative to the number of units held; the maximum duration for any granted cateo is three years. The holder may conduct prospecting, mapping, sampling, and geophysical surveys, and drilling and trenching after notifying the mining office of the exploration plan.
- Manifestacion de Descubrimiento (MD) – once mineralisation is discovered on a cateo, the cateo lease expires and the permit is upgraded to a manifestacion. The maximum area of a manifestacion is 7,000 ha. A basic environmental impact assessment, a physical survey, and boundary markers are required at this stage.
- Pertenencia – a lease allowing mining. A physical survey and boundary markers are required.

Snowden has not reviewed the land tenure situation and has not independently verified the legal status or ownership of the properties or any agreements that pertain to the Navidad Project. Land tenure aspects have been provided by Aquiline; Snowden has reviewed the information and believes it is reliable.

Table 4.1 Tenement details in Chubut Province operated as Minera Argenta S.A.

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Registration number	Property name	Area(ha)	Tenement type*	Property status*
14340/04	Navidad Este	2,500	MD	GMD; LL & MC IP
14341/04	Navidad Oeste	2,500	MD	GMD; LL & MC IP
14352/04	Pampa 1	2,975	MD	GMD; LL & MC IP

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Registration number	Property name	Area(ha)	Tenement type*	Property status*
14367/04	Colonia Este	1,596	MD	GMD; LL & MC IP
14368/04	Colonia Oeste	2,990	MD	GMD; LL & MC IP
14369/04	Sierra	3,469	MD	IP
14370/04	Sierra 1	2,856	MD	GMD
14446/05	Pampa III	2,500	MD	GMD; LL & MC IP
14731/05	Sierra Cacique II	3,025	MD	GMD; LL & MC IP
14732/05	Sierra Cacique I	3,025	MD	GMD; LL & MC IP
14742/05	Carlota 1	3,481	MD	IP
14830/06	Sierra Cacique III	3,484	MD	IP
14831/06	Sierra Oeste	3,105	MD	IP
14832/06	Colonia Este 1	1,622	MD	GMD
14833/06	Colonia Este 2	1,596	MD	IP
14834/06	Sierra Sur 1	2,840	MD	IP
14902/06	Navidad Este 1	2,500	MD	GMD; LL & MC IP
14903/06	Navidad Oeste 1	2,500	MD	GMD; LL & MC IP
15302/07	Trucha A	2,926	MD	IP
15303/07	Alamo A	2,990	MD	IP
15304/07	Mara A	2,486	MD	IP
15305/07	Mara B	2,486	MD	IP
15306/07	Condor C	2,024	MD	IP
15307/07	Condor D	1,957	MD	IP
15323/07	Trucha B	3,001	MD	IP
15426/08	Alamo B	4,752	MD	IP
15439/08	Mara C	2,486	MD	IP
15455/08	Puente 1	2,499	MD	IP
15456/08	Puente 2	2,499	MD	IP
15488/08	Carlota 3	3,448	MD	IP
15493/08	Nina 3	3,448	MD	IP
15525/08	Noelita	9,405	MD	IP

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15528/08	Julie	3,577	MD	IP
15529/08	Navidad 3	2,968	MD	IP
15530/08	Navidad II Oeste	2,748	MD	IP
15531/08	Navidad II Este	2,365	MD	IP
15532/08	Puente 3	6,624	MD	IP

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Registration number	Property name	Area(ha)	Tenement type*	Property status*
15545/09	Navidad 4	7,000	MD	IP
15550/09	Nuevo Condor	4,800	MD	GMD
15555/09	Los Loros	8,470	CA	IP

*Tenement type codes:

CA = Cateo, exploration permit

MD = Discovery claim (Manifestacion de Descubrimiento), advanced exploration permit

*Property status codes:

IP = In progress. Application submitted

LL = Labour legal, the legal declaration of work that proves existence of mineralisation. Initial process prior to sub-division into mining claims

GMD = Granted discovery claim (Manifestacion de Descubrimiento)

MC = Mining claims (Pertenenencias)

JV = Joint venture

Table 4.2 Tenement details in Chubut Province held in the name of Minera Aquiline Argentina S.A.

Registration number	Property name	Area(ha)	Tenement type*	Property status*
14170/03	Calquitas 1	5,165	MD	GMD; LL & MC IP
14171/03	Calquitas 2	5,150	MD	GMD; LL & MC IP
14728/05	Calquitas 3	6,472	MD	GMD
14729/05	Calquitas 4	4,111	MD	IP
15527/08	Flamingo	5,635	MD	IP
14195/04	Regalo II	10,000	CA	JV
14399/04	Regalo III	7,670	CA	JV
14616/05	Regalito 1	2,500	MD	JV
14617/05	Regalito 2	2,500	MD	JV
14642/05	Regalo IV	2,350	CA	JV
14643/05	Regalo V	4,000	CA	JV
14644/05	Regalo VI	4,200	CA	JV
15053/06	Regalito 3	2,500	MD	JV
15054/06	Regalito 4	2,500	MD	JV

*Tenement Type codes:

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CA = Cateo, exploration permit

MD = Discovery claim (Manifestacion de Descubrimiento), advanced exploration permit

*Property status codes:

IP = In progress. Application submitted

LL = Labor legal, the legal declaration of work that proves existence of mineralisation. Initial process prior to sub-division into mining claims

GMD = Granted discovery claim (Manifestacion de Descubrimiento)

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Registration number	Property name	Area(ha)	Tenement type*	Property status*
MC = Mining claims (Pertenencias)				
JV = Joint venture				

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Figure 4.1 Plan of tenements held by Pan American in the province of Chubut

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4.2 Agreements and encumbrances

Silverstone Resources has rights to 12.5% of the eventual silver produced at Loma de La Plata under a “silver stream” agreement. Pan American has represented that Navidad is not subject to any other royalties, back-in rights, payments, agreements, or encumbrances.

In 2006 the government of Chubut Province decreed a three year moratorium on all mining activities, including exploration, in the western part of the Province. This moratorium is due to expire on 29 June 2009, and the government of Chubut has publicly declared that it intends to extend the moratorium for another three years. The government asserts this is to enable the completion of a province-wide map of the mineral potential. The Navidad Property lies outside of and to the east of these “no-mining” zones. The government of Chubut Province has also decreed a Province-wide ban on the use of cyanide for mining purposes and the development of open pit mines. The law states that the government of Chubut Province will accept and review mining proposals, including open pit and cyanide based mining operations, on a case by case basis and determine at that point whether permits may be issued.

4.3 Environmental liabilities

The Province holds the Property administrator responsible for any potential environmental damage liabilities that may arise.

Navidad is flanked by the communities of Gastre to the northwest, Gan Gan to the east and Blancuntre and Lagunita Salada to the southwest. Blancuntre is the closest recognised indigenous community to the Project, with approximately 50 indigenous families living within the town and surrounding area.

Pan American is in the process of completing environmental and social baseline studies for the Project. The bulk of baseline work done to date has been contracted to local Argentine consultants working under the supervision of international firms including Water Management Consultants (WMC)/Schlumberger Water Services, Ground Water International, On Common Ground Consultants Inc., and Klohn Crippen Berger Ltd. Pan American is currently selecting an international consultant that will finalise the baseline work and prepare the future Environmental Impact Assessment (EIA) for the Project.

Key studies underway or completed to date include:

- Climate and air quality
- Surface and groundwater
- Water resources
- Flora, fauna, limnology and ecosystem characterisation
- Archaeology and palaeontology
- Soils, geomorphology, and seismic
- Toxicology and ecotoxicology
- Noise
- Acid Rock Drainage

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4.4 Permits

Drilling at the Navidad Project requires a separate permit for each affected tenement valid for one year, subject to the approval of an Environmental Impact Statement (EIS). Pan American is required to submit an EIS which covers the impacts and mitigation/monitoring procedures for the exploration activities, in order to obtain environmental permits. The level of the exploration activity dictates the level of study required.

The Navidad Project is in an advanced exploration stage involving drilling and trenching activities. Aquiline submitted the most recent EIS update in 2008 which was approved in January 2010. Until this EIS update was approved the Project operated under the existing valid permit which was modified in 2008. As a result of the EIS approval, a new drilling permit was issued for a one year period and this new permit allows for the operation of up to eight drill rigs. Rehabilitation of the drilling platforms and impacted areas is carried out throughout the year.

Water rights are treated separately from environmental permits. Aquiline has permitted two extraction wells for use in exploration activities.

Depending on overall project timing, Pan American plans to finalise an Environmental and Social Impact Assessment report for the Project and present it to the provincial Chubut Government in 2010. While the Government has publicly indicated its support for the Navidad Project proceeding, the status of a 2003 provincial law banning open pit mining would need to be clarified before permits for mining can be obtained. Other than the legal/political matter raised above, Pan American does not identify any specific or unique environmental or social risks associated with the Navidad site or Project aspirations.

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

Information in this section has been sourced from Snowden (2009).

5.1 Accessibility

The nearest towns to the Property are Gastre, with a population of about 500, 40 km to the northwest, and Gan Gan, with a population of about 600, about 40 km to the east. Both towns are located on Provincial Route 4, a gravel highway that passes just north of the Property. Aquiline established offices, accommodation, and facilities for core storage and logging in Gastre and to a lesser degree in Gan Gan. The Property is accessible year round except in very wet conditions.

Daily scheduled flights are available from the city of San Carlos de Bariloche, a tourism centre with a population of approximately 100,000, located about 355 km by road to the northwest. Daily flights are also available through Trelew, located about 390 km by road to the southeast near the coast, with a population of approximately 90,000. The nearest airport, which has regularly scheduled flights, is located in Esquel, about four hours drive to the southwest by gravel road. The provincial capital of Rawson, located 20 km east of Trelew, has a population of approximately 23,000. Aquiline established an office from which to advance the technical studies of the Project in Puerto Madryn, a city with a population of approximately 70,000, located 60 km north of Rawson. There are at least three scheduled flights per week between Puerto Madryn and Buenos Aires. Pan American also maintains offices in Buenos Aires and in the regional centre of Ingeniero Jacobacci, which has a population of approximately 8,000, located two hour's drive to the north of Gastre.

5.2 Climate

The climate is semi-arid with average annual temperatures ranging from 1°C to 20°C. High winds frequently occur from October through December, but may also occur throughout the year. Annual precipitation averages between 5 mm to 10 mm per month, but during the winter months from May to August, higher accumulations ranging from 15 mm to 20 mm may occur as either rain or snow. Field activities run

throughout the year and are not curtailed by weather conditions.

5.3 Infrastructure and local resources

Pan American's base of operation for the Navidad Project is in Gastre. Facilities include offices, modular living facilities, and core-storage warehouses. Communications are provided by land line telephone service, national mobile phone operator, and a satellite internet dish. The modular living facilities provide lodging and meals for up to 20 people. The warehouses include three drill core storage sheds, a logging and sampling shed, metal shop, vehicle workshop, and a regional exploration office. In the logging shed there are four diamond saws used to cut drill core.

In Gan Gan the company has built two core storage facilities as well as an office on land purchased on the western edge of town in 2007. The office serves as a base of operation for its social and community relations personnel, while the warehouses contain older drill core from the Navidad Property.

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On the Navidad Property a small camp facility has been installed with electrical power provided by several small generators. Communication is provided by a satellite internet uplink. Other infrastructure on site includes storage areas for drill supplies. There are two water bores authorised by the Chubut Province Hydrology Department to pump water for use with diamond drilling. Water pumping is accomplished by one of two company owned water pumps. To provide access for drilling a total of 26 km of access roads have been constructed on the Property.

During 2008, the drilling contractor, Boart Longyear, installed a transportable 60-person camp in the Yanquetru Valley, on company-owned land to the south of the Project. The company installed a water tank and sewerage facilities in support of the camp.

5.4 Land access

Access to land for drilling and other exploration activities is allowed through outright surface ownership as well as through a series of easement contracts with the remaining surface owners. Aquiline continued land acquisition to facilitate unimpeded land access to the Navidad Project through land swap deals and direct land purchases.

Pan American reports the current status of its land acquisition process as follows:

- Santana Sarmiento Property: Land swap completed
- Santana Horacio Property: Direct purchase of land completed
- Montenegro Succession: Direct purchase of land with agreements signed and title transfer to occur in July 2009
- Raileff Succession: Land swap agreements signed, titles to be transferred when the IAC (Colonisation Office) grants property to the Raileff family
- Llanquetru Eleuterio Property: In progress

Figure 5.1 shows a plan of the properties now owned by Pan American shaded in red, while agreed sales transactions or negotiations continue on the properties shaded in green. The blue outlines represent the previous cateos, now re-applied for as Manifestaciones de Descubrimientos (MD), while the dashed bold blue line represents the MDs covering the main area of the Project. The properties previously owned by Sarmiento and Horacio Santana contain the Loma de La Plata Project and the favoured sites for the associated waste dump, tailings dam, and concentrator (Snowden, 2008).

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Figure 5.1 Navidad surface landholders with status of negotiations or agreements

5.5 Physiography

The Property is located in the Patagonian Plateau region with steppe vegetation characterised by low and compact bushes of grass and by stocky shrubs of less than a metre high. Elevation ranges from 1,060 m to 1,460 m with gentle topographic relief interrupted by local structurally controlled ridges.

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6 History

Information in this section has been sourced from Snowden (2009), which excerpted and updated from Cuburu (2007).

The first exploration programme that included the Navidad Project area consisted of a preliminary regional geochemical sampling programme conducted by Normandy Argentina (Normandy) in mid 2000 to locate additional deposits to supplement those known at its Calcatreu Property, a gold and silver deposit located approximately 80 km from Navidad. The programme consisted of 1,200 bulk leach extractable gold (BLEG) stream sediment samples taken from drainage systems overlying Jurassic volcanic rocks in Chubut Province in the general vicinity of Calcatreu, Mina Angela, Gastre, Lagunita Salada, Gan Gan, and other areas. This programme took place on what was then considered open exploration ground, and resulted in the identification by Normandy of various anomalies, including the Flamingo Prospect and Sacanana, which is today known as Navidad.

In January and February 2002, Newmont Mining (Newmont) purchased Normandy's worldwide mining interests, and in March 2002, Newmont decided to sell all of its interests in Argentina. In September 2002, IMA signed a confidentiality agreement (Confidentiality Agreement) in order to obtain a copy of the Information Brochure and technical data related to Newmont's Argentinean interests, which included the Calcatreu Project. In December 2002, IMA applied for an exploration concession (cateo) over the area formerly known as Sacanana and now known as Navidad, utilising and relying upon the Normandy BLEG data (known as BLEG A), and began undertaking a regional exploration programme over the Navidad area, including regional mapping and sampling. From December 2002 to July 2006, IMA conducted diamond drilling, geochemical sampling, geophysical exploration, and Mineral Resource estimates at Navidad.

In January 2003 Aquiline entered into an agreement with Newmont, which was completed in July 2003, to purchase all of the shares of Normandy and Newmont's 100% interest in Calcatreu, and acquired all of Newmont's assets including the BLEG A data. In May 2003 Aquiline reviewed the BLEG A data and found that the ground covered by the BLEG A data had already been claimed by IMA. After failure to receive a

credible response from IMA as to how they could otherwise have made a legitimate discovery at Navidad without having breached the terms of the Confidentiality Agreement, Aquiline went on to file suit in the Supreme Court of British Columbia in March 2004.

The Supreme Court of British Columbia awarded ownership of the Navidad Project to Aquiline on 14 July 2006 following a court case with IMA where IMA was found to have breached the Confidentiality Agreement. IMA subsequently appealed to the Court of Appeal for British Columbia, but lost the appeal by unanimous decision in June 2007. An Application for Leave to Appeal to the Supreme Court of Canada was filed by IMA in September 2007. Sole ownership rights were granted to Aquiline by the Supreme Court of Canada on 20 December 2007, subject to Aquiline making payment to IMA which would reimburse the latter for its accrued exploration expenditures up to the July 2006 court decision. Aquiline's final payment to IMA was made on 8 February 2008, giving Aquiline full ownership of the Project.

Since October 2006, Aquiline undertook diamond drilling, geophysical and geochemical exploration, metallurgical test work, resource estimates (Snowden, 2007), including the

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2009 Mineral Resource estimate, and a Preliminary Economic Assessment for Loma de La Plata (Snowden, 2008).

On 14 October 2009, Pan American announced a friendly offer to acquire all of the issued and outstanding securities of Aquiline. On 7 December 2009, Pan American acquired approximately 85% of the issued and outstanding shares of Aquiline and extended its bid to 22 December 2009, and on that latter date, Pan American took up an additional approximately 7% of the issued and outstanding shares in the capital of Aquiline. Since the offer to acquire the Aquiline shares was accepted by holders of more than 90% of the Aquiline shares, on 23 December 2009, Pan American provided notice to the remaining shareholders of its intention to exercise its right to acquire the remaining issued and outstanding Aquiline shares pursuant to the compulsory acquisition provisions of the Business Corporation Act (Ontario). Pursuant to the compulsory acquisition, Pan American has been deemed to have acquired the balance of the Aquiline shares not already owned by it on or about 22 January 2010.

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7 Geological setting

Information in this section has been sourced from Snowden (2009).

7.1 Regional geology

The Navidad Project is located on the southwest edge of the Northern Patagonia Massif in southern Argentina. This boundary of the massif is coincident with the “Gastre Fault System”, which was originally interpreted as a large-scale dextral shear zone (Figure 7.1). This mega-structural feature is now believed to be the result of continental-scale northeast to southwest extension that produced through down-faulting a series of northwest to southeast trending half grabens and tectonic basins. (von Gosen et. al. 2004)

Granitoid rocks of the basement in northern Chubut Province belong to the Palaeozoic age Mamil Choique and Lipetren formations. Locally these rocks are exposed at surface in windows through the overlying Mesozoic age volcanic and sedimentary rocks. At Navidad the Mesozoic sequence consists of the Lonco Trapial Formation and overlying Cañadón Asfalto Formation. The latter of these formations hosts the Navidad mineralisation.

Chubut Province was tectonically active during the Jurassic with abundant evidence of syn-sedimentary faulting observed in the Cañadón Asfalto Formation. Continued post- sediment tectonic activity resulted in the faulting, tilting, and local folding of the Lonco Trapial and Cañadón Asfalto formation stratigraphies. This resulted in the formation of a series of northwest trending half and full horsts and grabens.

Overlying these tilted Jurassic age volcanics and sediments are the generally flat lying sediments and pyroclastic rocks of the Cretaceous age Chubut Group Formation. To the east and south these are covered by Tertiary age plateau basalts.

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Figure 7.1 Regional geology plan

7.2 Local geology

The local geology as shown in Figure 7.2 consists of exposures of the Palaeozoic age Mamil Choique Formation along the western side of the map area. This unit is composed of red and grey granitoids and aplite dykes with quartz-rich pegmatites.

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These crystalline basement rocks are overlain by Jurassic age rocks of the Lonco Trapial and Cañadón Asfalto formations. These formations are unconformably overlain by the Cretaceous age Chubut Group of the Cerro Barcino Formation of continental sandstones, conglomerates and tuffs and by plateau basalts of the Miocene age Pire Mahuida Volcanic Complex.

The contact between the Mamil Choique Formation basement rocks and the volcanic rocks of the Lonco Trapial Formation is located 6.5 km southwest of the Navidad Trend.

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Figure 7.2 Local geology plan from Andolino (1999)

Units present in Navidad Project Area listed below:

39 Alluvial and colluvial deposits, fine to medium sands, silts and clays subordinate; disperse boulders

38 Deposits in lows and lakes. Silts and clays; salts

36 Deposits that cover undifferentiated layers. Sands, gravels and silts

35 Deposits that cover the second layer in the Gan Gan low. Sands, gravels and silts

34 Deposits that cover the first layer in the Gan Gan low. Sands, gravels and silts

30 Pire Mahuida Volcanic Complex. Basalts (flows), nepheline

16 Colhué Huapi Formation (continental). Tuffs, lapilli tuffs and sinters

13 Catán Lil Ignimbrites. Rhyolitic ignimbrites.

10 La Colonia Formation. (continental, lagunal, marine). Pelites; subordinate fine sandstones

7 Chubut Group – Cerro Barcino Formation (continental). Sandstones, conglomerates and tuffs

6 Cañadón Asfalto Formation (continental lacustrine). Fine sandstones, limestones and volcanics

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- 4 Lonco Trapial Formation. Ignimbrites, andesites, porphyritic andesites, andesite breccias
- 3 Garamilla Formation. Ignimbrites and rhyolite lavas and dacites
- 1 Mamil Choique Formation. Red and grey granites; sheared granites 1a: Aplite dykes and quartz
(translated from the original Spanish by Lhotka, 2003)

7.2.1 Lonco Trapial and Garamilla formations

The Lonco Trapial Formation is the oldest Jurassic age unit located in the vicinity of the Navidad Project area. It forms the northeast contact with the exposed batholithic rocks of the Mamil Choique Formation. The unit is characterised by lavas and volcanic breccias of intermediate composition. Locally it may become intercalated with the typically more felsic and pyroclastic rocks of the Garamilla Formation. This latter unit consists of multiple pyroclastic flow events and reworked volcanoclastics.

7.2.2 Cañadón Asfalto Formation

This unit stratigraphically overlies the Lonco Trapial and Garamilla formations. Within the portion of the government geologic map shown in Figure 7.2, the spatial distribution of this unit is restricted to the area immediately surrounding the Navidad Project and an area on strike to the southeast in the lower right hand corner of the map. The formation consists of lacustrine sedimentary rocks, which grade laterally and vertically from lower arkose basal conglomerates and sandstones to greywacke that give way to mudstones at higher stratigraphic levels. Interbedded with both the arkose, greywacke and shales are thin horizons of carbonaceous marls and limestone, some of which contain stromatolites.

Within the sedimentary sequence are three distinguishable volcanic lava flows. These appear conformable to the sedimentary stratigraphy and are believed to have been emplaced in sub-areal to sub-aqueous environments. Pyroclastic and phreatic-magmatic events precede the extrusion of the latter two lavas. Evidence of these events is preserved as pyroclastic horizons within the volcanic-sedimentary sequence and what is interpreted to be a maar – diatreme complex. The lavas consist of an intermediate composition rock referred to as andesite and two trachyandesite units referred to as the Lower and Upper latite units. The lower of these units is distinguishable from the upper by the ubiquitous presence of monolithic xenoliths in the former.

No obvious intrusive rocks are identified within the Project area with the exception of feeder dikes of the Lower Latite unit. The present

interpretation is that the latite units are the product of volcanic lava flows and flow breccias, though at Navidad Hill, the base of the latite has so far not been found by drilling, leaving open the possibility of a dome in this area.

7.2.3 Depositional setting

The rocks of the Lonco Trapial and Cañadón Asfalto formations were deposited into an actively subsiding tectonic basin. Sub-basins control the distribution of lacustrine sediments resulting in rapid facies changes. Source areas for the sediments appear to have changed over time. Early arkoses are believed to have been derived from highlands of the crystalline basement rocks to the southwest. The greywacke sediments of intermediate composition are believed to be sourced from the north. There is evidence the sedimentary cycles may have been interrupted by block faulting and tilting with erosion and re-sedimentation. The environment during the deposition of the volcanics of the Cañadón Asfalto Formation appears to have varied over time from

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place to place as exhibited by textures and characteristics for both sub-areal and submarine emplacement.

7.2.4 Structure and control of mineralisation

At the regional scale the main structural orientations within the Navidad District are northwest to southeast, east-northeast to west-southwest, and north-northwest to south-southeast. The depositional basin containing rocks of the Cañadón Asfalto Formation is approximately 55 km long and 10 km wide with the long axis trending northwest to southeast. Ground gravity surveys show a linear northwest to southeast boundary between high and low Bouguer anomalies, which are interpreted to represent structures affecting the crystalline basement rocks. The Navidad Project is located at the northwestern end of the basin. Mineralisation along the Navidad Trend from Marcasite Hill to Calcite NW exhibits a strongly linear northwest to southeast affinity. The Arco Iris Fault at Loma de La Plata is also orientated northwest to southeast.

The Navidad depositional basin is terminated to the northwest by an east-northeast to west-southwest trending structure that juxtaposes the volcanic-sedimentary sequences against rocks of the Lonco Trapial and Mamil Choique formations. To the southeast the Cañadón Asfalto facies are presumed buried beneath Quaternary cover in a large east-northeast to west-southwest trending depression.

The entire Navidad Project area is crossed by north-northwest to south-southeast structures that define the limits of many of the bedrock exposures and are believed to have offset stratigraphy with a dextral sense of relative movement. Observed displacements on these structures range from several metres to over a kilometre.

7.3 Property geology

7.3.1 Lithology

A simplified version of the Navidad Project geology is shown in Figure 7.3. The corresponding stratigraphic column for the Project area is shown in Figure 7.4. The oldest rocks are the crystalline basement rocks of the Mamil Choique Formation

located in the southwest corner of the map area. These basement rocks are overlain by a sequence of pyroclastics, volcanic agglomerates and lavas of the Lonco Trapial Formation. These rocks are exposed along a northwest to southeast trending strip in the southwest quadrant of the map area and in the valley northeast of the Sauzal Fault along the Navidad Trend. They are also exposed on the southeast projection of the Esperanza Trend at the Fold Zone.

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Figure 7.3 Property geology plan

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Figure 7.4 Simplified Navidad Project stratigraphic column

The welded pyroclastics of the Lonco Trapial Formation exposed to the southwest of the map area are also found directly north of Calcite Hill and in deep drilling along the Navidad Trend below the Sauzal Fault. Here they are interbedded with juvenile volcanoclastics derived from the same flows. A drill hole northeast of Navidad Hill crossed in excess of 500 m of this volcanoclastic/pyroclastic sequence without encountering the underlying agglomerates or basement rocks. This thick sequence of rock is generally oxidised as denoted by its characteristic red colour and in Section 8 of this report are likened to “Red Beds”.

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Stratigraphically above the Lonco Trapial volcanic sequence and forming the base of the Cañadón Asfalto Formation are coarse clastic sediments of arkosic composition. Basal conglomerates of the arkoses may contain boulders up to 2 m in diameter. They are composed almost exclusively of angular grains of quartz and feldspar derived from the Mamil Choique Formation. Locally the arkoses contain horizons of limestone, some with stromatolites. Coarser beds include pebble to cobble size clasts of granite and metamorphic rocks. These beds may locally exhibit cross-bedding sedimentary textures. These sediments extend from the valley floor southwest of the Argenta Trend to the Esperanza Trend. Intersections from drillholes southeast of Loma de La Plata and further south on the Argenta Trend indicate the arkoses are interbedded with thick sequences of argillaceous shales. At surface the coarser arkoses horizons are resistive and form extensive exposures. The shales are erosionally recessive and are rarely if ever exposed at surface.

At Loma de La Plata and between the Esperanza and Navidad trends there are no arkose sediments. In their place intercalated with the argillaceous black shales are mature greywackes of intermediate volcanic composition. These are deposited in rhythmic sequences consisting of pebble conglomerates that grade normally into coarse muddy sandstones. The greywackes locally contain thin carbonaceous horizons.

Above the greywackes from Loma de La Plata to Sector Z and between Esperanza and Navidad trends southeast of Calcite NW are argillaceous black shales. These sediments contain limestone horizons and zones with intercalations of coarser grained muddy sediments. They are rich in organic carbon and locally may contain thin coal seams. In the northwest to central portions of the Esperanza Valley the shales may also contain horizons of pyroclastics with varying degrees of re-working with thicknesses that range from 1 m up to 10 m. At Galena Hill the shales host massive sulphide replacement bodies at their lower contact with the latite lavas. At several of the Project deposits these shales contain Pb and Zn mineralisation distal to the higher grade silver zones.

Contemporaneous with the deposition of the sediments within the Project area, there were a minimum of three distinct extrusive lava and multiple pyroclastic volcanic events. The oldest of the lavas are fine-grained and of intermediate to mafic composition. These are referred to at the Project as andesite. These rocks are believed to be extruded sub-aerially as the auto-brecciated tops of the flows show the

effects of thermal oxidation. These lavas were either simultaneously deposited within two separate basins, one dominated by arkoses and the other by black argillaceous shales, or there were multiple andesite eruptive events. On the Argenta Trend the andesites are inter-bedded with arkoses and on the southern end of the Navidad Trend they are inter-bedded with black shales. At the northwestern end of the Navidad Trend and north of Provincial Route No. 4 they are overlain by pyroclastics and other latite lava flows with no intervening sediments. The andesite lavas are generally not mineralised; however, locally they can host Ag-Cu mineralisation. The best known mineralisation hosted in andesite is located at the southern limit of the Connector Zone. Here the tectonically brecciated and hydrothermally altered andesite return grades of up to 11 kg/t Ag in surface rock chip samples. There are also mineralised showings in andesites south of Loma de La Plata on the Argenta Trend and at the Fold Zone at the southeast end of the Esperanza Trend.

The next extrusive lava event produced what is referred to on the Project as the Lower Latite unit. It is actually a hybrid consisting of a trachyandesite contaminated by quartz, which appears as rounded 1 mm to 3 mm quartz phenocrysts with reaction rings in quantities ranging from 1% to 5%. The Lower Latite also contains cognate clasts 0.5 cm to 3 cm in size of fine-grained material of the same composition without quartz

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phenocrysts. On the Project these are referred to as “xenoliths”. The Lower Latite was preceded by a pyroclastic eruption that produced pumice bearing ash tuff. At Navidad Hill and Galena Hill the exposed volcanic sequence is andesite, pumice tuff followed by the Lower Latite with no intercalated sediments. The Lower Latite lava is restricted in distribution to the northern end of the Argenta Trend and the northern half of the Esperanza and Navidad trends. These lavas host high grade mineralisation at Calcite Hill, where the Upper Latite lavas are believed to have been removed by erosion prior to the deposition of the black shales. The Lower Latites also host mineralisation together with the Upper Latites at Galena Hill.

The last extrusive volcanic event produced the Upper Latite lava flows. These rocks are macroscopically identical to the Lower Latite except they do not contain cognate clasts. Potentially these autoclasts were completely reabsorbed by the magma before their extrusion. It is believed the initial eruption of the Upper Latite encountered sufficient ground water to create a maar – diatreme complex located at Calcite NW. Evidence supporting this hypothesis is a 2 km wide zone of milled matrix breccia containing rounded clasts of the welded pyroclastic flows and Lower Latite lavas. Horizons of reworked pyroclastics observed within the sediment sequences at the northern end of the Navidad Trend may represent surge deposits. Continued eruption of the Upper Latite lavas led to its distribution over an area minimally 60 km² in size including the entire length of the Argenta, Esperanza and Navidad trends and north of the Provincial Route No. 4. At the southeast end of the trend the groundmass of the lava is glassy and has devitrified to form spherulites. At the northwest end of the Argenta Trend and on the Esperanza and Navidad trends the lava is interbedded with greywackes and shales. The Upper Latite lava hosts practically all of the Ag-Cu mineralisation at the Loma de La Plata and Esperanza Valley deposits and a larger portion of the mineralisation at the Navidad Hill and Galena Hill deposits

7.3.2 Structure and control of mineralisation

Collectively the individual mineralised deposits along the Navidad Trend exhibit a strong northwest to southeast lineation. A few observed small mineralised veins and breccia dikes located along the trend also exhibit northwest to southeast to north-northwest to south-southeast orientations. No large potential feeder structure common to all the deposits has yet been discovered. If such a structure exists, it is likely that post-mineral movement on the Sauzal Fault laterally displaced it from beneath the known mineralised bodies.

At the individual deposit scale the mineralisation is clearly controlled by zones of primary or secondary porosity. Examples of this are the upper latite lavas at Esperanza Valley and Loma de La Plata and volcaniclastic horizons at the Connector Zone and Calcite NW. These zones are often capped by impermeable horizons. These aquitards effectively capped the ascending hydrothermal fluids and forced lateral migration outward from the plumes. The result was the formation of mineralised bodies with strataform geometries.

Almost all the Project mineralised deposits are contained within structural blocks separated from each other by three major structures. These structures are believed to be pre-mineralisation in some cases and are definitely post-mineralisation in others as evidenced by these structures truncating mineralisation. The most influential of these post-mineral structures are the Sauzal, Esperanza and Arco Iris faults. The Sauzal Fault is located along the northeast side of the Navidad Trend and dips shallowly to the southwest. This structure truncates the mineralisation at depth on the Galena Hill, Connector Zone, Navidad Hill and Calcite Hill deposits. The Esperanza Fault located

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along the Esperanza Trend has resulted in the drag folding of the host lithologies of the Valle Esperanza deposit. The Arco Iris Fault is located in the northern end of the Argenta Trend. This steeply northeast dipping fault limits the Loma de La Plata mineralised deposit to the southwest where it juxtaposes it against unmineralised andesite. The Barite Hill deposit is also interpreted to be affected by post-mineral low angle faulting, potentially analogous to the interpreted movement on the nearby and similarly orientated Sauzal Fault.

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8 Deposit types

Information in this section has been sourced from Snowden (2009), which incorporated contributions from Sillitoe (2007).

Navidad mineralisation is clearly epithermal in nature as demonstrated by widely observed open space filling by crustiform and cockade textures of the carbonate, barite and sulphide mineral assemblages. The abundance of base metals combined with gangue mineralogy of carbonate and barite dominate over silica, indicates the deposit should most appropriately be categorised as an intermediate – rather than a low sulphidation epithermal deposit. The alteration and sulphide mineral assemblages are incongruent with high sulphidation epithermal style of mineralisation, although late-stage kaolinite and reported minor hydrothermal alunite could imply the late ingress of a hypogene acidic fluid.

The Navidad deposits formed post-deposition and lithification of the containing greywacke and shale sedimentary sequences of the Cañadón Asfalto Formation. Evidence supporting this is open fractures filled by calcite and barite within the sediments overlaying zones of mineralisation. The depth of formation is believed to be moderately shallow, potentially on the order of 400 m to 500 m below the paleosurface. This is consistent with findings from calcite fluid inclusion studies by Lang (2003) that indicated the hydrothermal fluid was vapour dominated with a temperature of homogenisation below 200°C. Despite being formed near the paleosurface, no concrete evidence has ever been observed to indicate an exhalative facies to the mineralisation. The semi-massive sulphides at Galena Hill are clearly replacement in origin. The finely laminated carbonates postulated to represent exhalative products are in fact stromatolitic limestone. Hence, Navidad is not analogous to shallow-water volcanogenic massive sulphide (VMS) deposits like Eskay Creek in British Columbia as has been suggested by previous investigators.

The ore deposit model presented in Figure 8.1 is a schematic reconstruction at the time of emplacement for either Galena Hill or Navidad Hill. Vein and veinlet stockworks grade upwards into hydrothermal breccias believed to have been created by over pressuring of the ascending hydrothermal fluids within the latites. Breccia textures range from crackle to rotated and commonly contain a high component of fine sediments in their

matrix. The breccias locally contain displaced banded carbonate and mineralised clasts indicating multiple inter-mineralisation brecciation events. The breccias are cemented by carbonate and barite gangue and sulphide minerals. At Galena Hill, the breccia clasts become progressively more intensely replaced upwards by the sulphide cement, resulting in irregular bodies of semi-massive sulphide. The breccia and related semi-massive sulphide bodies at Galena Hill terminate abruptly upwards against a finely laminated limestone bed of stromatolitic origin. The overlying carbonaceous mudstone contains Zn mineralisation and can be massively silicified for up to 5 m above the upper limit of the high grade Ag-Pb mineralisation.

Figure 8.2 is a schematic drawing of lateral-flow style mineralisation away from the main ascending plume centres based upon observation made at the Loma de La Plata deposit. Here relatively thin horizons of latite lavas are interbedded with sediments. The silver plus minor copper mineralisation is preferentially localised along the top of the upper latite flow unit in either flow-top auto breccias or in crackle breccias. These breccias are likely to have resulted from even minor tectonic deformation due to the sharp rheology contrast between the brittle latite and the overlying sediments. Disseminated Zn

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mineralisation in the sediments forms halos both above and below the main Ag horizon of mineralisation.

The preferred hypothesis for the transport of the metals and their deposition is dependent upon the redox state of the underlying red bed and ignimbrite units and the reducing state of the overlying carbonaceous sediments. The transport mechanism further requires physical fluid-flow conditions of structural conduits and the primary or secondarily induced permeability of the breccias pipes and latite flow units. Ascending hydrothermal fluids passing through the underlying red beds would rapidly become buffered and oxidised, thus resulting in oxidation of sulphide sulphur in solution to sulphate. These fluids would be capable of precipitating carbonate, barite and specular hematite in the veins and veinlets within the red beds, but not Fe, Ag or base metal sulphides. The content of these metals could simply have been transported to higher levels within the hydrothermal system. Upon entry to the overlying relatively reduced rock package, the fluids became more reduced, allowing sulphide formation to commence, presumably as a result of admixture with sulphide-bearing groundwater from the organic carbon-rich, upper sedimentary unit. Interestingly, the Ag mineralisation in the basal grey sedimentary unit, immediately above the red beds, at Barite Hill is rich in native Ag, a mineral that could form after only relatively minor reduction of the ascendant fluids and without the need for reduced sulphur.

This model for Navidad, with mineralisation control by a district-wide redox interface, is reminiscent of red bed Cu and Ag deposits, where fluids ascending through thick red bed sequences leach Cu and/or Ag, along with other metals, and deposit them on contact with reduced horizons. The red bed silver deposits, such as Nacimiento in New Mexico in the United States, are also characterised by sulphur-poor mineral species, such as native Ag and acanthite. The difference is that at Navidad the mineralising fluid was epithermal in origin rather than being basinal brine as in the case of the red bed deposits.

The broadly strataform nature of the Navidad mineralisation is rather uncommon for an intermediate-sulphidation epithermal silver deposit, most of which tend to be of vein type (e.g. Fresnillo in Mexico, Arcata in Peru, Martha in Santa Cruz province, Argentina). Potential analogous deposits include the Jardin Cu-Ag deposit of northern Chile. Here strata-bound cupriferous sulphide mineralisation is associated with the upper brecciated and unwelded portion of a pyroclastic flow overlain by organic-rich tuffaceous lacustrine sedimentary rocks (Lortie, 1987). Another example of a broadly strataform deposit is San Cristóbal in Bolivia. Although the feeders for the San Cristóbal deposit are largely

confined to a dacite dome complex, the bulk of the silver-zinc-lead mineralisation is hosted by lacustrine sedimentary rocks rather than by lava as at Navidad.

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Figure 8.1 Schematic reconstruction of Galena Hill from Sillitoe (2007)

Figure 8.2 Schematic reconstruction of Loma de La Plata from Sillitoe (2007)

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9 Mineralisation

Information in this section has been sourced from Snowden (2009), which excerpted and updated from Kain (2007) and Allo, Paolini, and Williams (2009).

In all of the deposits and mineral showings the gangue minerals are principally calcite with or without barite and a much lower proportion of silica. Visibly recognisable ore minerals are native silver, grains and clots of black sulphides containing argentite, acanthite and discrete grains of sphalerite, galena, chalcopyrite, cuprite, bornite, native copper and copper carbonates. Distinct styles of mineralisation are reflected in the differences in ore minerals and proportion of gangue between the deposits. Various pulses of mineralisation are observed, principally at Galena Hill. With the exception of the latter, pyrite and sulphides in general are relatively scarce.

The principal mineral association of interest is Ag-Pb. Other associations of interest are Ag-Pb-Cu and Cu-Ag or more rarely Ag-Zn. Occasionally there is Ag only, or Cu-Pb-Zn or simply isolated occurrences of these base metals. This further suggests that deposition occurred through successive pulses of mineralisation. So far as it is known to date, gold is totally absent from the system.

Mineralisation is preferentially hosted in lavas with the upper latite containing the dominant proportion, followed by the lower latite and then rarely by the andesite. Deposits with the dominate portion of mineralisation within lavas include Loma de La Plata, Valle Esperanza, Calcite Hill, and Galena Hill. Sedimentary rocks and volcanoclastics can also contain significant mineralisation. Deposits where the mineralisation is dominantly hosted by these rock types include Calcite NW, Navidad Hill, Barite Hill, and the Connector Zone.

High grade mineralisation is nearly always correlative with either primary or induced secondary porosity of the host rocks. Examples of primary porosity include coarse volcanoclastic horizons and auto-brecciated lava flow tops. Secondary porosity occurs as crackle brecciation of the brittle lava flows, hydrothermal eruption breccias, and tectonic breccias. At both Valle Esperanza and Loma de La Plata the crackle brecciated upper latites are believed to have acted as aquifers bounded upward by what are interpreted as bedding plane faults with the

overlying sediments. The capping lutitic sediments created effective aquitards that would have greatly promoted the lateral migration of the ascending hydrothermal fluids. Mixing of the reduced formation waters within the aquifers with the oxidised and metal-laden hydrothermal fluids is hypothesised to have been a principal triggering mechanism for the precipitation of ore minerals. Locally the argillaceous mudstones above the upper latite are fractured and infilled by calcite. This indicates that the host rocks were buried and the sedimentary rocks lithified prior to the mineralising event.

To date the general Navidad Project is comprised of eight individual mineral deposits in three separate mineralised trends referred to as the Navidad Trend, the Esperanza Trend, and the Argenta Trend. The six deposits in the Navidad Trend are essentially contiguous and include, in a 5.8 km alignment from northwest to southeast, Calcite NW, Calcite Hill, Navidad, Connector Zone, Galena Hill, and Barite Hill. The Valle Esperanza deposit occurs on the east flank of the Esperanza Trend and is found approximately 370 m to the south-southwest of Galena Hill. The Loma de La Plata deposit occurs along the northern portion of the Argenta Trend and lies approximately 2.2 km southwest from the centre of Calcite Hill.

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9.1 Calcite NW

A plan of Calcite NW is shown in Figure 9.1. Calcite NW is located stratigraphically in the upper sedimentary package found directly above the latite unit. This package is comprised of mudstone, sandy volcanic tuffs, tuffaceous sandstones, lapilli tuffs, and volcanoclastic intervals. In general the layers with a significant tuffaceous component exhibit a strong argillic alteration.

Mineralisation occurs disseminated in the sediments where it is observed as galena with occasional scarce chalcopyrite. Facies with high permeability, such as the tuffaceous sandstones and volcanic tuffs, are preferentially mineralised. Towards the northwest the mineralisation is characterised by Pb with low Ag and is hosted mainly by tuffs and pyroclastic units. In the central to southwest area of Calcite NW, Ag and Pb mineralisation with low grade Cu and occasional Zn mineralisation are hosted by sandy mudstones and tuffaceous sandstones.

The main mass of mineralisation is located along the axis of the general Navidad Trend. There is a strong stratigraphic control. The wacke and tuffaceous units host the mineralisation within the inter-grain pore space. Mineralisation is interpreted to have been channelled through the migration of hydrothermal fluids between the nearly impermeable mudstone units.

There are two marker units within the deposit. One of these is a green lapilli tuff which is generally only weakly mineralised, and the second marker is generally taken as the base of mineralisation. The green lapilli tuff, between 5 m to 10 m thick, is found near the top of the deposit in a relatively lead-free zone. The second marker, known as the Galena Marker, is approximately 80 cm thick and is comprised of a type of massive dark mudstone with disseminated crystalline and irregular micro-veinlets of galena with high lead values and silver. Lead mineralisation with scarce to absent silver mineralisation is occasionally encountered up to 1 m below these units in a volcanoclastic layer or in a coarse detrital facies.

Mineralisation at Calcite NW takes the form of three long and tabular to slightly synformal bodies. The main body lies from the surface to a depth of 130 m below surface and has an average overburden thickness of approximately 60 m. It has a strike length of 1,825 m towards the northwest, a width between 350 m to 500 m, and a thickness between 10 m and 80 m. The mineralised body plunges gently to the northeast with a dip between 1° to 5°. The base of the main body is normally identified by the Galena Marker.

Towards the south-eastern end of the deposit, a smaller lens lies close to the surface parallel to the main body and about 80 m above it. It has a regular shape 275 m long, up to 250 m wide and between 20 m and 40 m thick.

Another elongated lens of mineralisation lies between 15 m to 50 m below and parallel to the northern end of the main body. The body is 1,000 m long, between 200 m and 350 m wide, and ranges between 10 m and 30 m in thickness.

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Figure 9.1 Plan of Calcite NW

9.2 Calcite Hill

A plan of Calcite Hill is shown in Error! Reference source not found.. The mineralisation is hosted principally in the latite with xenoliths unit (lower latite) and occurs upwards for a few metres above the contact with the overlying upper sedimentary or pyroclastic package depending on the sequence. The style of mineralisation is typically banded epithermal vein filling and stockworks in breccias developed in the brittle massive portions of the flow. Where present in the upper sedimentary package, mineralisation occurs as disseminations infilling the primary porosity as well as micro-veinlets that are comprised of argentiferous Pb and Zn sulphides along with interstratified galena.

Gangue mineralisation is comprised of calcite, minor silica, and barite either white in colour or as a caramel-coloured variety that occurs almost exclusively at Calcite Hill although it has been occasionally identified on nearby Navidad Hill. High grade mineralisation is comprised of galena, black sulphides, native silver, and occasional chalcopyrite. The overlying geochemical signature is Ag-Pb with minor Cu.

A zonation of the mineralisation hosted in the latite unit is exhibited in the sequence of the three principal zones which in descending depth order are:

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- An upper zone with principally Pb mineralisation with minor Ag, and minor to absent Cu
- An intermediate zone with high grade Ag mineralisation and proportionally less Pb and moderate Cu
- A lower zone with primarily silica fracture filling, low in sulphides and Ag mineralisation

Similar to the Galena Hill deposit, the mineralisation at Calcite Hill terminates abruptly at the lower contact of the latite unit with the reddish basal sedimentary unit, which exhibits poor to no permeability. An interpretation is that the latite, being confined as well on the upper contact with the mudstones which frequently act as fluid barriers, served as a unit with secondary permeability (in this case due to fracturing) which favoured the migration of mineralising fluids.

On the north flank of Calcite Hill the mineralisation is hosted in volcanoclastic rocks and in the lower portion of the overlying calcareous mudstone unit, and in the contact between the same volcanoclastic unit with the lower latite with xenoliths. The entire sequence exhibits structural disturbance. This is attributed to a possible low-angle fault at the base of the sequence which has underlying it the reddish-coloured volcanoclastic basal unit.

The mineralisation occurs principally as veinlets and as matrix filling in the breccia, at times with silica and iron oxides, with minor galena, copper oxides, and scarce pyrite. The upper sedimentary units as well as the volcanic and volcanoclastic units host Ag, Pb, and scarce Cu and Zn mineralisation.

Mineralisation at Calcite Hill forms an irregular body with a narrow upper portion outcropping towards the western end of Calcite Hill, which merges with a larger mineralised lens. Mineralisation outcrops and extends to a depth of around 250 m below surface. It forms a relatively flat surface 600 m long, ranging from 270 m to 600 m in width. The lower portion of the body has an irregular shape resulting from two nearly separate lenses that merge into one lens having a variable thickness between 150 m to 20 m. The body plunges to the southwest with a -5° dip.

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Figure 9.2 Plan of Calcite Hill

9.3 Navidad Hill

A plan of Navidad Hill is shown in Figure 9.3. The Navidad Hill deposit exhibits two different types of mineralisation and control. The first of these outcrops along the crest of the hill where mineralisation related to structural control is most evidently displayed compared to elsewhere on the Project. Here outcropping vein structures exhibit breccias comprised of finely banded crystalline calcite gangue, barite, and finely crystalline to chalcedonic silica. Visually identifiable ore grade minerals include galena, black sulphides, copper and manganese oxides, and lesser quantities of pyrite, chalcocopyrite, and rare native copper and silver.

The high grade brecciated vein structures occur in a belt approximately 100 m in width with discontinuous sub-vertical extensions, striking generally at an oblique angle to the main Navidad Trend in the range of 310° to 345°. Vein thicknesses are 1 m or less with Ag values in the 1,000 g/t to 10,000 g/t range. Vein development discontinuity is also evidenced by “rosario” outcrops along strike and by changes in mineralogical composition along strike as well as at depth. The latite wall rock adjacent to the breccia veins is also found mineralised with the development of veinlets, stockworks, and breccia zones. As indicated so far by drilling, the outcropping breccia veins do not

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extend to a depth exceeding 80 m where the vein integrity tends to break down into a zone of veinlets comprised principally of chalcedonic silica that increases at depth. To date the base of the latite has not been encountered by drilling at Navidad Hill which leaves open the possibility of a dome structure in this area.

The second main type of mineralisation at Navidad Hill is found emplaced on the southwest flank of the hill where it is hosted in and above the contact between the latite unit and an overlying volcanoclastic breccia. It has a well-developed stratigraphic control with a gentle southerly dip of some 20° to 30°. Moving away from the possible dome, the stratiform body changes its composition from a heterolithic latite breccia to a breccia with remobilised sedimentary clasts. This breccia exhibits gangue mineral matrix fillings of calcite, barite, and lesser silica, accompanied by black sulphides, minor galena, copper oxides, and relatively frequent native silver.

A third sub-set of mineralisation is found to the northwest of Navidad Hill where there is found a multi-phase heterolithic breccia with characteristics that indicate an explosive origin. The gangue is principally calcite and barite with ore minerals of galena, possible black sulphides, copper oxides, and contains moderate concentrations of Ag on the order of 100 g/t.

Mineralisation at Navidad Hill trends for 520 m towards the northwest and forms an irregular globular shape ranging from 270 m to 470 m wide and 10 m to 175 m thick. The mineralised zone has a shallow dip to the southwest and lies at the subsurface along the ridge crest to around 50 m depth along the southern flank.

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Figure 9.3 Plan of Navidad Hill

9.4 Connector Zone

A plan and cross section of the Connector Zone is shown in Figure 9.. The mineralisation occurs as disseminations and replacement of the matrix in the volcanoclastic rocks. Locally the volcanoclastic rock is crackle brecciated with a matrix of hydrothermal minerals, sulphides and rare native silver. The volcanoclastic rock can exhibit a wide range of textures ranging from conglomeratic horizons to thinly bedded strata. The volcanoclastic unit contains sub-rounded to very angular clasts of latite derived from the uplift and erosion of the latite lavas. Lesser, and generally lower grade mineralisation can also be hosted in the underlying greywacke and the overlying mudstones.

The Connector Zone is structurally complex. It shares some of the same structural trends found at Galena Hill located immediately to the southeast. At Connector the principal structural trends are:

- North-northeast to south-southwest trending steeply dipping structures that are responsible for radical changes in the stratigraphy across the generalised northwest trending strike of the mineralisation. It is interpreted that displacements along these structures are responsible for changes in thickness of the host volcanoclastic unit of up to 170 m in only 50 m along strike with

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similar changes in thickness in adjoining units. Synchronous erosion is a possible cause of the local removal of both the lower and upper latite lavas that allowed the volcanoclastic and mudstone units to be deposited directly on the lower andesites.

- Northwest to southeast to east-west oriented sub-vertical faulting is interpreted to have followed the deposition of the mudstones and produced a series of horst and graben structures by block faulting similar to those described at Galena Hill. Also similar to Galena Hill are the spatial coincidence of the higher grade values with these structures. It is believed movement on these northwest to southeast structures is synchronous to post-mineral in age.
- The post-mineral, northwest to southeast trending, southwest shallow dipping Sauzal Fault. This structure truncated the host lithologies and mineralisation at Connector Zone in a similar fashion as described at Galena Hill.
- Possible re-activated faulting on the north-northwest to south-southeast trend: Crossing the central portion of the Connector Zone there is some evidence to suggest the presence of a north-northwest to south-southeast trending structural corridor that may have cut and displaced the Sauzal Fault trace.

The mineralisation at Connector forms two intersecting, but distinct bodies, which combined, are 670 m in strike length, and between 240 m and 590 m wide. The mineralisation lies from the surface to a depth of 330 m. The deposits are hosted in a sedimentary sequence comprised of sandstones and fine conglomerates with minor mudstones, interbedded with volcanoclastic layers which are mostly formed by sub-rounded to angular latite fragments derived from the erosion of the latite lavas. Locally the host rocks exhibit micro-veinlets up to 1 cm thick and poorly developed stockwork texture. The intensity of the brecciation is weak to moderate and the gangue infilling is comprised of calcite and silica. Alteration is weak and is manifested by a moderate bleaching of the rock due to the presence of low-temperature illitic-smectitic clays.

Sulphide mineralisation occurs as galena, black and grey presumably Ag-bearing sulphides, as chalcopyrite and bornite disseminated in the sediments, in veinlets, and in replacements in the matrix of the volcanoclastic unit. Native silver is also present in trace amounts.

Of less importance and restricted to the east of the Connector Zone, the mineralisation is hosted by the brittle upper latite and andesite units. Disseminated sulphides occur in

hydrothermal crackle breccias with a matrix of calcite and barite with minor laumontite and silica.

In the upper portion of the volcanoclastic unit the geochemical signature is Ag-Pb with minor Cu, and in the lower portion of the sedimentary units Ag is present with practically no lead.

The geometry of the mineralisation suggests the north-northeast to south-southwest structures could be feeder zones for the ascending hydrothermal fluids. The fluids are postulated to have ascended the steep north-northeast structures, and then preceded up dip along the porous volcanoclastic unit where they are intersected by the west-northwest to east-southeast trending block faults.

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Figure 9.4 Plan and cross section of Connector Zone

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9.5 Galena Hill

A plan and cross section of Galena Hill is shown in Figure 9.. Mineralisation at Galena Hill is hosted in a variety of distinct fragmental rock types. These include hyaloclastites at the margins and ends of lava flows and crackle breccias within the massive cores of the flows. Also present are dikes and pipes of hydrothermal breccia. The predominant style of mineralisation is the selective replacement of breccia matrix, or as open space filling. Locally the mineralisation pervasively replaces the matrix of the host lithologies including the mudstones. Where the mudstones are mineralised, they can form massive sulphide-rich stratiform lenses containing galena and marcasite.

The lithology that hosts mineralisation varies within the different portions of the deposit. At the far northwest end of the deposit the mineralisation is primarily hosted within the lower latite with minor mineralisation in the overlying mudstones and underlying volcanoclastics. Towards the southeast end of the deposit the mineralisation is hosted in both the lower latite unit and the upper latite unit and locally in the overlying mudstones. To the far southeast end of the deposit all of the mineralisation is contained within the upper latite with only trace mineralisation contained in the overlying mudstones.

At Galena Hill both the upper and lower latite lavas are believed to have been emplaced as submarine flows. Evidence supporting this interpretation is the lack of thermal

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oxidation, which is common in other zones such as Loma de La Plata, and the abundance of very angular fragmental portions of the latite interpreted to represent in situ the reworked hyaloclastite. These fragmental portions of the lava flows are often the preferred location of mineral deposition.

Galena Hill is structurally complex. It is believed to be located at the vertices of several intersecting structural trends. From the reconstruction of the geology it appears that the earliest faults were syn- to post-mineralisation northwest to southeast block faults. Movement on these structures resulted in the formation of a horst and graben geometry. This movement is post-sedimentation, potentially in part syn-mineralisation and definitely part post-mineralisation. The continued movement of these structures post-mineralisation resulted in the uplift and erosion of part of the mineralisation and the preservation of those parts that were down-dropped.

The northwest to southeast trending block faults are truncated by the shallow dipping, northwest to southeast trending Sauzal Fault. The trace of this fault is coincident with the break in slope along the lower northeast flank of the Navidad Trend. The fault juxtaposes all the upper lithologies and mineralisation against the lower “red bed” volcanics. Movement on this structure is considered post-mineralisation. No evidence has been observed to indicate that this fault served in any way as a channel for the ascending hydrothermal fluids.

The last interpreted faulting at Galena Hill occurred along steeply dipping north-northwest to south-southeast trending structures. These structures form a structural corridor roughly 100 m to 150 m wide that crosses the central portion of the mineralisation. These structures are interpreted from surface mapping, ground magnetic and construction of drill sections. These structures are believed to have off-set the Sauzal Fault plane in places.

Alteration is variable from trace to locally strongly argillic. In general alteration is limited to bleaching of the host volcanic rock in close proximity to the mineralisation.

Sulphide minerals are galena, marcasite, lesser pyrite, scarce chalcopyrite, and occasional bornite. According to a preliminary report by Xstrata Process Support (2007), 85% of the Ag is contained in solid solution within a combination of marcasite and pyrite with 15% in acanthite (Ag₂S). The lead occurs as galena (PbS). The mineralisation appears to all occur as sulphides with little oxidation observed as evidenced by fresh galena occurrences found at surface. Gangue

mineralogy consists chiefly of calcite and barite with lesser silica.

The extent of mineralisation is long and wide with a strike length of roughly 900 m and a width of between 250 m and 700 m. In section views orientated at 030° to 210°, the mineralised body as defined by values approaching 50 g/t AgEQ forms a roughly strataform body with a slight dip to the southwest. This body resembles an inverted shield with a flat top and a thicker central portion that thins to the margins. On nearly every section the mineralisation is affected by post-mineralisation movement on the northwest to southeast trending block faults resulting in displacements of roughly 10 m to 50 m. Those portions of the mineralisation located above the horst are partly eroded whilst those portions to either side are preserved in their entirety. The mineralised zone ranges from a few metres thick at the extreme margins to over 200 m thick in the central portions of the deposit.

Mineralisation outcrops in several locations including the upper northwest flank and within the window through the mudstones in the area of the structural horst. The top

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of mineralisation ranges from surface to 200 m below surface with an average depth less than 40 m.

There are 12 drill holes in the Galena Hill sector of the Project that are being monitored on a regular basis for determining the level of the water table. Across the area the top of the water table is at approximately 1,137 m elevation, and is indicated on the cross section in Figure 9.. The majority of the Mineral Resource at Galena Hill lies beneath this level.

Figure 9.5 Plan and cross section of Galena Hill

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Galena Hill cross section on local coordinate 51000E view to 300°

9.6 Barite