Geology and Metalogenetic features of La Bodega Concesion, California Mining District, Santander, Colombia

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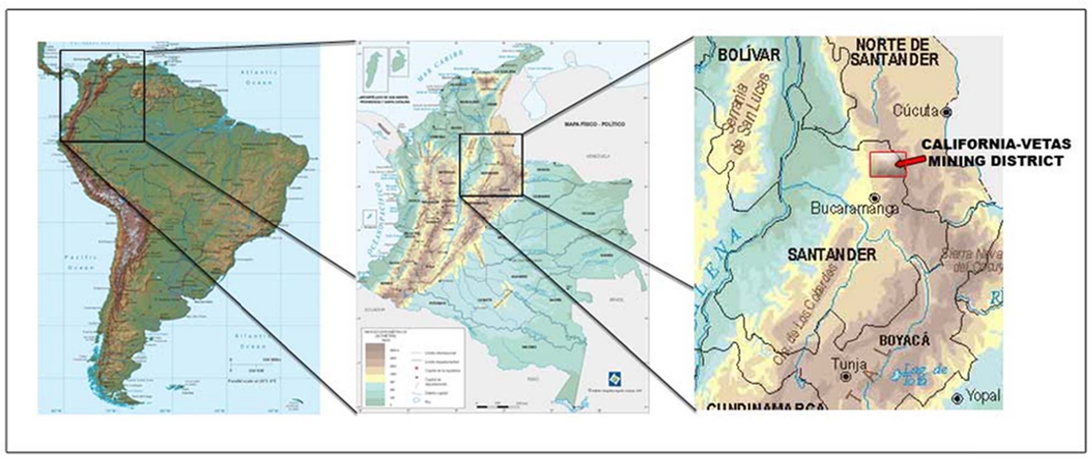
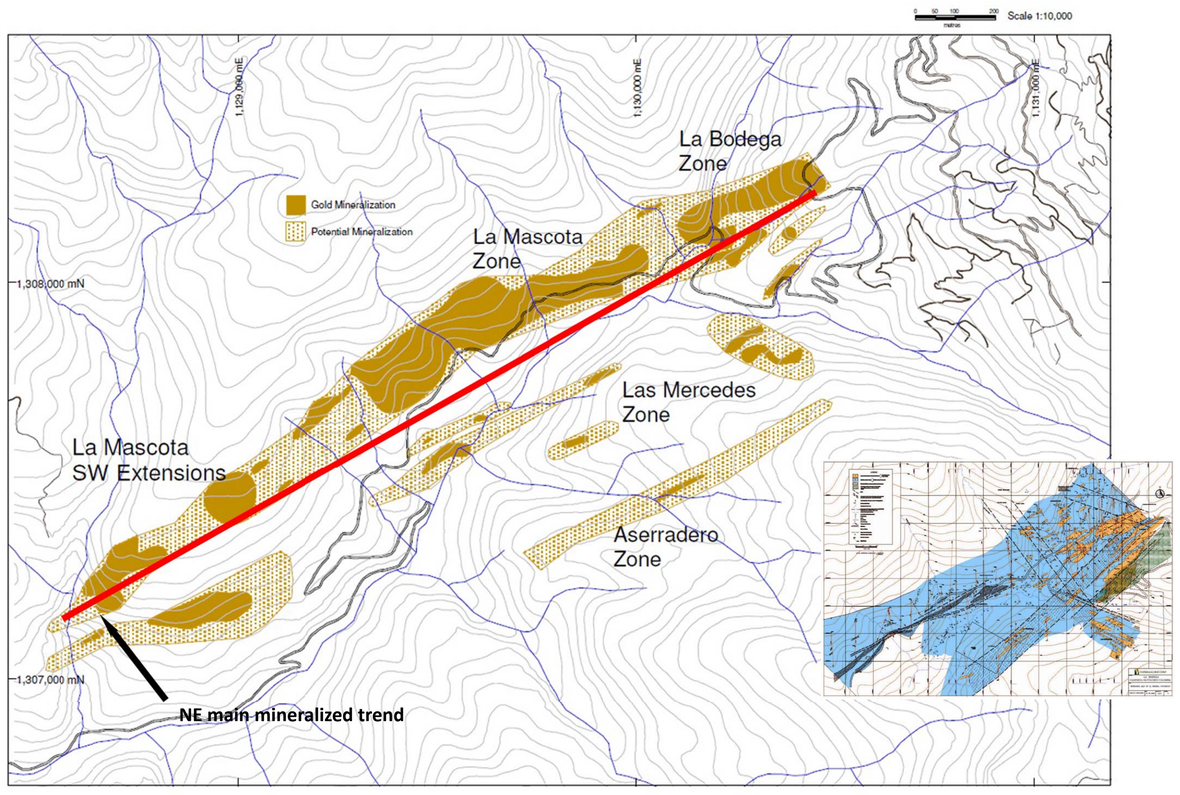
INTRODUCTION

La Bodega project has a total of infered resources of 3 milion ounces (Moz) of gold, 19.2 Moz of Silver and 84.4 pounds of Copper, with 2.0 g/ton of gold cut off. La Bodega project is located in the Eastern Cordillerain the Santander department within the California mining district, 60 Km to the North-east of Bucaramanga in Colombia. The main lithologies in the concesion are metamorphic rocks of the Bucaramanga Gneiss Formation (Middle Proterozoic) and felsic intrusives of Mesozoic age (Ward et al., 1973; Evans, 1977; Mendoza & Jaramillo, 1979; Royero & Clavijo, 2001).



Mineralization age is not well defined yet:a Re-Os radiometric age of 57 +/- 10 of the mineralization was determined by means of pyrite concentrates (Mathur et al., 2002), while K-Ar data of hydrothermal alteration minerals in the intrusives showed ages between 60 and 66 Ma (Nippon Mining Company, 1967 in Mathur et al., 2002). Nevertheless, porphyritic rocks outcropping at less than 7 km of the project have been dated giving ages between 9 and 8 Ma. (Mantilla et al, 2009).

Most mineralized bodies show a strong structural control on the NE trend steeply dipping to the NW (Bernasconi, 2006) speccially in the zones of main interest La Bodega and La Mascota which are the main objective in this study.



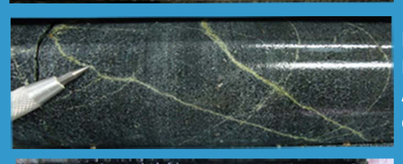
La Bodega Project mineralization targets map (Altman et al., 2010), and geological map of La Bodega North-east zone (Right, small) (Bernasconi et al., 2009)

MAIN ROCK TYPES AT LA BODEGA PROJECT

Gneiss: Bucaramanga Gneiss Formation (Middle proterozoic)

LB260 108.80 m LR (0100) Feldspar-Quartz Gneiss (granitic gneiss)

LB V9 185.70 m. Banded gneiss with mesosomes and leucosomes



LB178 278.50m. LM (9950) Amphibolite, epidote veinlets

LB260 206.60 m. LR (0100) Biotite Augen Gneiss

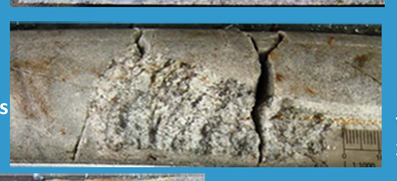
LB282 131.30 m. EC (8400) Quartz monzonite porphyry (Post Jurassic?)

Felsic Intrusives (Triassic to Jurassic?)

LB001 94.80 m. LB (0425) Felsic Intrusive (monzogranite?)

LB112 347.70 m. LM (9350) Felsic Intrusive (monzogranite dike?)

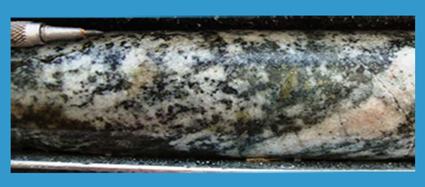
LB267 280.90 m. EC (8700-2) Felsic Intrusive. Minor Illite altered phenocrysts



LB280 228.0m. Aserradero (0075-1) Fine grained felsic intrusive with gneiss xenolith

HYDROTHERMAL ALTERATION

Hydrothermal systems alteration assemblages are typical in the area:
1. Propylitic alteration: epidote+ chlorite+pyrite+chalcopyrite1;
2. Illite-sericite alteration: Quartz+illite(o sericita)+pyrita;
3. Silicification: found mainly in the core of main mineralized zones: Quartz occurs mainly as cement of breccias, replacing matriz, alteration halos in the host rock and replacing clasts in brecias.
4. Alunite alteration is minor and is manily accompanied by quartz alteration.



LB262 444.18 m chlorite+epidote+pyrite+ chalcopyrite1

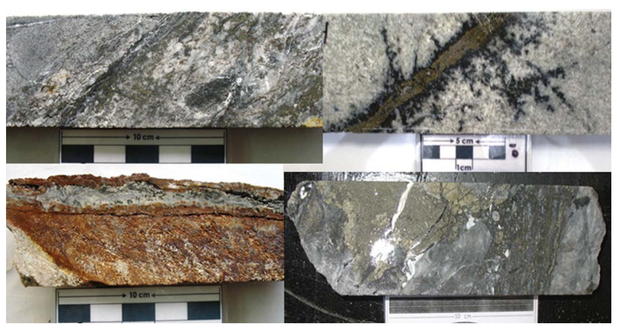
LB112 336.70 m quartz+Illite-(or sericite?)+ pyrite

LB112 295.60 m. Alunite,+Quartz+Pyrite (?)

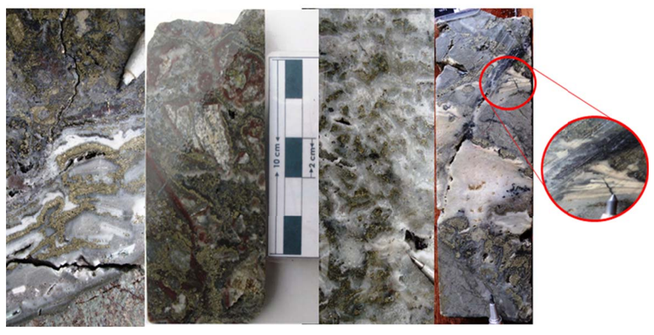
LB112 281.55 m. Quartz-silica filling-cementing, replacing matrix of HyBx.

LB187 554.60 m. (EC) Vuggy Silica (?)

MINERALIZATION STYLES

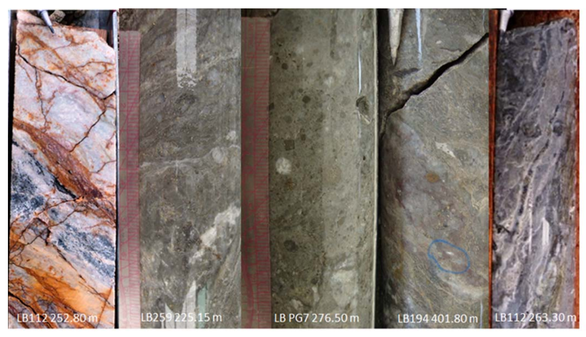


LA BODEGA ZONE: Predominantly vein disseminated systems. Minor discontinuous Hydrothermal breccias



LA MASCOTA ZONE: Hydrothermal breccias with multiple phases of brecciation. Complex paragenesis. Strong structural control.

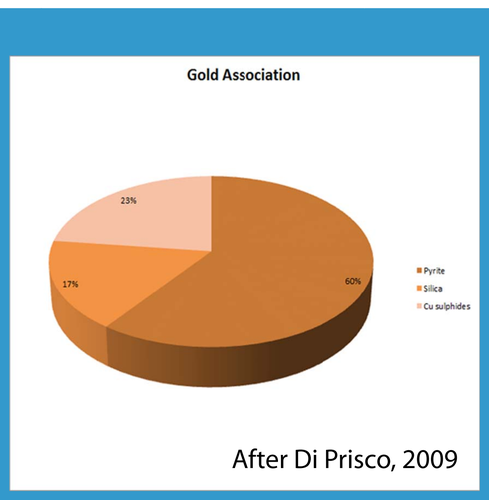
EL CUATRO ZONE: Black hydrothermal breccias. More Zn and U rich. Breccias delopped in Int. Vuggy or pseudo-vuggy silica.



TECTONIC BRECCIAS DURING MINERALIZATION EVENTS: cataclastites with tectonic foliation. Silicified.

POST MINERALIZATION EVENTS

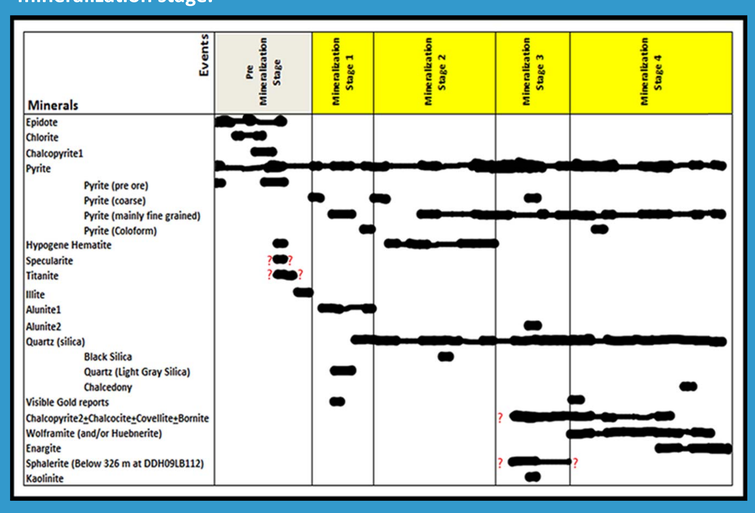
FAULT BRECCIAS: Clay supported breccias. Polimictic. Subrounded subangular clasts.

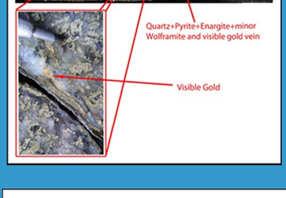


After Di Prisco, 2009

Preliminar paragenetic sequence at La Mascota based on DDH09LB112 log.

The preliminar paragenetic sequence was determined based on hand sample description of vein cross-cutting relationships. Premineralization stages are related to propylitic alteration assemblages (epidote, chlorite, pyrite and in this case chalcopyrite1. Pyrite and quartz occur throughout almost the whole sequence of events and is related to gold deposition in the mineralization stages. Quartz and alunite alteration (alunite1) characterize the alteration assemblage of mineralization stage 1. Quartz (difuse light gray silica) with fine pyrite (and visible gold) cutting quartz+coarse Pyrite was noticed but whether or not is part of stage 1 is not clear yet. Mineralization stage 2 is defined mainly by hypogene (or specular?) hematite, pyrite and quartz deposition. Evidence for this is that a quartz+pyrite+hypogene hematite (specular?) vein was found cutting alunitizied-silicified clast. Mineralization stage 3a is characterized by the occurrence of sphalerite and alunite2, which was noticed below 326 m depth of the drill hole. Unambiguous cross cutting relationships between stage 3 sphalerite and stage 3b are still elusive. The latter contains chalcopyrite2+chalcocite+covellite+bornite with quartz as defining characteristic. Mineralization stage 4 is characterized by the first occurrence of wolframite (and/or huebnerite) and the first occurrence of enargite, which seems to represent the last events of ore deposition. Veins that contain wolframite and enargite are cutting features (veins, cement of breccias and clasts) that contain the copper sulphides or sphalerite. Visible gold was also documented in this mineralization stage.





LB112. 294.45 m. quartz+pyrite+enargite +minor wolframite (mineralization stage 4) and visible gold vein, hosted in silicified gneiss.

LB112. 264.15m. BX5. Polimictitc clasts supported breccia with clast of cataclasite. Coarse pyrite (Py) with quartz cuts cataclasite and it is cut by quartz+wolframite+enargite+bornite? Vein (Mineralization stage 4) . This vein is cut by quartz-enargite (possibly luzonite) vein (end of mineralization stage 4). Banded silica precipitates in open space (part of mineralization stage 4). It is also cut by quartz-enargite vein.

OUTLINE, OBJECTIVES AND AIMS OF THE PROJECT

The project aims to make a characterization of the geology and the hydrothermal features of the La Mascota and La Bodega zones, determining similitudes and differences among classic hydrothermal deposits, as well as defining the paragenetic sequences of these two zones. Microscopy, SEM, electron microprobe analysis will be necessary for defining the paragenesis and elements distribution in sulphide phases and wolframite. X-ray diffraction and Terraspeck analysis will be done in order to characterize properly the alteration in the zones as well as to properly choose alunite samples for stable isotope analysis and dating. Mineralizing fluids fingerprint, oxidation state of the fluids and paleotemperature of mineralizing fluids precipitation are to be determined by means of the use of stable isotopes of Sulfur, Oxygen and Hydrogen mainly in alunites and pyrite . This may give clues for possible source and paths for the mineralizing fluids, which will probably help to develop an exploration tool for the project.
In order to properly constraint the ages of the mineralization, K-Ar dating on alunites will be done, as well as U-Pb dating of the intrusives within the concession.
Sampling within at least two sections in La Mascota and two sections in La Bodega will be necessary in order to achieve these objectives.

Ackknowledgments

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