# New Observations on the Bolivar district

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## Executive Summary

The Bolivar district has excellent potential for delineation and expansion of reserves beyond what is currently being mined. Production grades from the Bolivar Mine are higher than average Zn and Cu grades from comparable deposits due to high grading massive sulfide zones at the skarn-marble contact. Larger tonnages of 1% Cu and 5% Zn could be produced by mining wider intervals that include disseminated mineralization in skarn. High-grading the massive sulfide zones runs the risk of making uneconomic the surrounding zones of mineralized skarn.

Skarn mineralization in the Bolivar district is strongly zoned and predictable. Based upon the skarn mineralogy, the southern part of the district near El Val is the distal fringe of the system. In contrast, the drill core intercepts in the northernmost area, North Bolivar, still contain zones of proximal red-brown garnet indicating that there should be additional mineralization to the north, if not removed by erosion or structural offset. The center of the system appears to be just south of South Bolivar in the area referred to as the “Mo-core” in past reports.

There are two distinctive lithologies, a dolomitic protolith and a lower shaley siltstone unit(s), that can be used to locate and project mineralization under cover, i.e. to the east towards La Increible. The extent of skarn mineralization down dip to the east is still untested. It appears that the favorable units continue down dip and should be intersected by the La Increible breccia pipe. As previously recommended, this should be drill tested.

It is estimated that about 50% of the mineralized skarn in the Bolivar, La Montura, and El Val areas has been eroded away, although obviously much remains. This is highly prospective for the down dip extensions of skarn mineralization to the east because in these zones there will be almost no erosional loss, and this may partly offset the higher mining costs with depth.

## Introduction

The following report of observations and recommendations is based upon a three day field visit, June 13-15, to the Bolivar project which included examination of underground and surface exposures along with logging of 6 core holes drilled on the property. As required by Canadian Investment Regulations, Dia Bras has my permission to use this report for their own purposes, for their website, and for release to the public. Features described in this report are illustrated in a PowerPoint presentation (Fig. 1) that can be downloaded at:

http://www.science.smith.edu/~lmeinert/MeinertPubs/MeinertBolivarPhotos3.ppt

This PowerPoint presentation will be removed from the server once Dia Bras has downloaded it for their purposes.

# Observations based upon underground visit to Bolivar Mine

**Stop 1** Level 2 – zonation from hornfels through garnet colors (red-brown (Fig. 2) to brown to green-brown (Fig. 3)) to massive sphalerite>chalcopyrite at marble front.

**Stop 2** Level 1 – Breccia Linda East, massive sphalerite = chalcopyrite at marble front next to brown garnet (Fig. 4).

**Stop 3** Level 6 – La Rampa, massive sphalerite> chalcopyrite at marble front (Fig. 5) with red-brown garnet (Fig. 6) in the middle of skarn “vein” zoning outward to green-brown garnet-sphalerite (Fig. 7) and massive sulfide. From both drill core and underground exposures, it is clear that mining is targeting the massive ore such as this at the marble front to produce grades of 2-3% Cu and >10% Zn. This is higher than what would be expected from typical Cu-Zn skarns and larger tonnages of 1% Cu and 5% Zn could be produced by mining larger intervals with disseminated mineralization in skarn. High-grading the massive sulfide zones runs the risk of making uneconomic the surrounding zones of mineralized skarn.

**Stop 4** La Cava surface workings and karst – contact of skarn and massive sulfide with marble. Distal exposure of the hydrothermal system.

## Observations of surface walk from El Gallo to La Montura to El Val

**Stop 1** The main alteration of the andesitic volcanic rocks in the El Gallo area (Fig. 8) is planar veining by quartz-epidote veins, locally with quartz-albite envelopes. Rocks break and naturally weather to expose the epidote from these veins as covering planar surfaces (Figs. 9-10). The abundance of such veins should vary with proximity to hydrothermal centers and thus a map documenting their distribution could pinpoint buried hydrothermal centers. A view to the northwest shows the surface exposure of the interpreted core of the hydrothermal system – termed the Mo core based upon a surface Mo geochemical anomaly (Fig. 11).

**Stop 2** The lower andesitic volcanic rocks are mostly massive, fine-grained flows. An upper unit exposed in a slope outcrop consists of andesitic agglomerates with rounded clasts cemented by a mud/andesite matrix. This is a primary volcanic texture and not the result of later hydrothermal alteration.

**Stop 3** There are numerous felsic dikes in the Bolivar District. Several are exposed on the ridge east of the Central Skarn area (Fig. 12). The felsic dikes have a well developed flow foliation, especially near margins and contain both quartz and feldspar phenocrysts, the latter of which typically are weathered out from surface exposures leaving rectangular pits.

**Stop 4** La Montura area - Quartz-epidote veins (Fig. 13) cutting andesite in this location have 1-5 mm white envelopes (Fig. 14) on weathered surfaces. These are caused by quartz and/or albite envelopes on the quartz-epidote veins. In contrast, fresh surfaces are a plain dark hornfels texture (Fig. 15) even where the weathered surface shows the alteration minerals. Looking north at La Montura from El Val the low relief rubble-crop of the andesitic volcanic rocks overlies the skarn cliffs (Fig. 16).

**Stop 5** El Val cliff exposures (Fig. 17) with abundant planar felsic dikes (Fig. 18). The outcropping green garnet skarn is well mineralized. Supergene weathering results in white Zn oxide (Fig. 19) being more abundant than green malachite (Figs. 20-21), probably reflecting the primary Zn>Cu of the mineralization in this distal location.

**Stop 6** Road cuts created by drill pad construction? exposed several soft, white argillic altered felsic dikes (Fig. 22). The argillic alteration contrasts with the chlorite-epidote alteration of the adjacent andesite volcanic rocks.

# Observations based upon drill core in North to South order

## Bolivar Norte

**DDH 26** Section 2-N, drilled -62°W

| | |
|---|---|
| 0-5 | Porphyritic andesite with endoskarn patches (Fig. 23). |
| 6-13 | Skarn-altered brecciated volcanic hornfels (Fig. 24). |
| 13-18 | Pale green and brown garnet-pyroxene skarn – no sulfide. |
| 18-20 | Brown garnet-chalcopyrite-magnetite (Fig. 25). |
| 20-22 | Green-brown garnet-chalcopyrite-sphalerite (Fig. 26). |
| 22-31 | Green garnet-sphalerite>chalcopyrite (Fig. 27). |
| 31-33 | Tan garnet-wollastonite. |
| 33-34 | Yellow-green garnet-bornite (Fig. 28). |
| 34-53 | Pale garnet-wollastonite (Fig. 29). |
| 53-62 | Dark green pyroxene-red-brown garnet after shale (Fig. 30). |
| 62-65 | Porphyritic granodiorite dike with endoskarn & actinolite-chlorite veinlets (Fig. 31). |
| 65-108 | Green and brown garnet skarn, locally mineralized. |
| 108-116 | Light red-brown garnet-chalcopyrite (Fig. 32)-bornite (Fig. 33). |
| 116-145 | Green garnet skarn, local chalcopyrite-bornite. |
| 145-164 | Pale garnet-wollastonite skarn. |
| 164-204 | Dark green pyroxene-red-brown garnet after shale. |
| 204-208 | Green-brown garnet |
| 208-211 | Green-yellow garnet=pyroxene skarn |
| 211-215 | Red-brown and green garnet skarn with magnetite-chalcopyrite |
| 215-262 | Faulted multi-color garnet skarn |
| 262-269 | Red-brown garnet (Fig. 34). |
| 269-277 | Fine-grained mafic granodiorite with internal igneous contacts (Fig. 35).<br>XRF sample 272m |

**DDH 18** Section 0-N, drilled -80°W

| | |
|---|---|
| 0-7 | Andesite with skarn nodules and veins (Fig. 36-37). |
| 7-29 | Yellow-green garnet-sphalerite>chalcopyrite (Fig. 38). |
| 29-45 | Green-brown to brown garnet with chalcopyrite ± bornite (Fig. 39). |
| 45-49 | Red-brown garnet with bornite>chalcopyrite (Cu up to 9%) (Fig. 40). |
| 49-50 | Brown garnet-chalcopyrite |
| 50-238 | Dark green pyroxene-red-brown garnet after shale (Fig. 41). |
| 238-259 | Granodiorite XRF sample 253m. |

**DDH 41** Section 17-S, drilled -54° W.

| | |
|---|---|
| 0-32 | Marble with bands, swirls, and nodules of pale green pyroxene-yellow-green garnet skarnoid (Fig. 42). Tan garnet skarnoid at 30.5 m. |
| 32-34 | Mafic dike with bleached, argillized zone near contacts. |
| 34-41 | Green garnet-sphalerite (up to 3.9% Zn) and marble (Fig. 43). |
| 41-48 | Green-brown garnet-chalcopyrite (Fig. 44) with magnetite-chlorite-calcite patches. |

| | |
|---|---|
| 48-58 | Brown-red garnet-chalcopyrite-bornite (Fig. 45) with magnetite-chalcopyrite patches. |
| 58-60 | Brown garnet-chalcopyrite (41-60m has 1-3% Cu with <0.1 Zn) |
| 60-112 | Pyroxene-garnet hornfels alteration of shale protolith, minor chalcopyrite. |
| 102 | 1-2 cm igneous dikelet with planar contacts cutting pyroxene-garnet hornfels. Igneous rock is quartz-rich and has patches and margins of pink orthoclase. Contact with red-brown garnet nodule has some garnet in dikelet indicating possible contemporaneity of dikelet and garnet alteration. |
| 105 | Sharp contact of igneous dike cutting pyroxene veins in pyroxene-garnet hornfels. Igneous rock is quartz-rich and has abundant pink orthoclase (Fig. 46). |

**DDH 44** Section 19-S, drilled -55° W.

| | |
|---|---|
| 0-31 | Marble with bands, swirls, and nodules of pale green pyroxene-yellow-green garnet skarnoid. |
| 31-34 | Tan argillized pyroxene-garnet distal skarn |
| 34-37 | Green garnet-sphalerite (Fig. 47) (31-44m has 2-4% Zn with <0.3 Cu) |
| 37-44 | Green garnet-magnetite-sphalerite |
| 44-47 | Brown garnet-chalcopyrite (Fig. 48) (44-55m has 1-5% Cu with <0.1 Zn) |
| 47-51 | Red-brown garnet-chalcopyrite-magnetite |
| 51-52 | Pyroxene-garnet hornfels alteration of shale protolith, minor chalcopyrite. |
| 52-55 | Red-brown garnet-chalcopyrite-bornite (Fig. 49) |
| 55-58 | Pyroxene-garnet hornfels alteration of shale protolith, minor chalcopyrite. |
| 58-63 | Green-brown garnet-chalcopyrite |
| 63-104 | Pyroxene-garnet hornfels alteration of shale protolith, minor chalcopyrite (Fig.50). |
| 104-109 | Bolivar Granodiorite with pyroxene-chlorite endoskarn (Fig. 51) within 1 m of contact and magnetite-chalcopyrite-biotite planar veins (Fig 52). |

## Bolivar Sur

**DDH 167** Vertical hole drilled ~300m west of the La Increible breccia pipe

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|---|---|
| 0-298 | Log says subeconomic skarn and skarnoid. |
| 298-301 | Green pyroxene-magnetite-phlogopite-sphalerite-chalcopyrite (Figs. 53, 54). |
| 301-308 | Banded skarn and skarnoid |
| 308-326 | Magnesian skarn – black serpentine-magnetite-phlogopite (Fig.55 ). |
| 326-341 | Siltstone converted to biotite hornfels (Fig. 56) and cut by biotite-hornblende-chalcopyrite veins (Fig. 57). |
| 341-358 | Granodiorite contact with pyroxene hornfels (Fig. 58), XRF sample at 357m |

## La Montura

**DDH 38** Drilled -80°W

| | |
|---|---|
| 0-16 | Hornblende-chlorite veined andesite with metasomatic fronts of pale brown garnet alteration (Fig. 59). |
| 16-22 | Dark brown garnet alteration of volcanic rock with no sulfides (Fig. 60). |
| 22-25 | Green garnet and brown garnet-sphalerite>chalcopyrite |
| 25-26 | Massive sphalerite at marble contact (Fig. 25). |
| 26-30 | White marble |
| 30-38 | Yellow-green garnet to green garnet to yellow-green garnet-sphalerite (Fig. 62). |
| 38-88 | Marble and skarnoid |
| 88-108 | Green garnet-sphalerite (Fig. 102). |
| 108-114 | Brown garnet and green pyroxene |
| 114 to EOH | Pyroxene-garnet hornfels alteration of shale protolith |

## Discussion of Observations

Due to a water shortage and other production problems there has been relatively little new drilling since my last visit in December, 2005. Underground production continues to produce a positive cash flow due to the combination of high grades and high metal prices. Production grades from the Bolivar Mine are higher than average Zn and Cu grades from comparable deposits. This is driven at least in part by the need to mine high grade material to offset relatively high transportation costs. In particular, production has focused on the high grade massive sulfide zones at the skarn-marble contact, such as observed on Levels 2 and 6. These typically are the highest grade parts of skarn systems. From both drill core and underground exposures, it is clear that mining is targeting massive ore such as this at the marble front to produce grades of 2-3% Cu and >10% Zn. Larger tonnages of 1% Cu and 5% Zn could be produced by mining larger intervals that include disseminated mineralization in skarn. High-grading the massive sulfide zones runs the risk of making uneconomic the surrounding zones of mineralized skarn.

As documented in previous reports and in the photos accompanying this report, skarn mineralization in the Bolivar district is strongly zoned and predictable. In particular, high Zn zones are associated with green garnet in distal regions near the marble front. In contrast, high Cu zones are more proximal and associated with brown garnet or, in magnesian skarn zones, with bornite and yellow-green garnet or Mg-silicate minerals such as olivine, phlogopite, and serpentine. This predictability can be used in planning future exploration and mining. The general sequence from proximal to distal is: red-brown garnet to brown garnet to green garnet±pyroxene to massive sulfide to marble. Most skarn has disseminated Cu-Zn mineralization whereas massive (>50%) sulfide is localized near skarn-marble contacts.

There are two distinctive lithologies which can be recognized in drill core and underground. The first is magnesian skarn developed from a dolomitic protolith. This is most easily recognized by the abundant magnetite as well as the Mg silicate minerals. The other distinctive lithology is a lower shaley siltstone unit(s). This alters to blue-green pyroxene hornfels with dark reddish brown garnet nodules and layers. Although locally mineralized this unit almost never is ore grade and is useful mainly as a stratigraphic marker. Given the strong stratigraphic control on skarn mineralization, these two units can be used to locate and project mineralization under cover, i.e. to the east towards La Increible.

Based upon the skarn mineralogy and apparent abundance of supergene Zn and Cu, the southern part of the district near El Val is the distal fringe of the system. In contrast, the drill core intercepts in the northernmost area, North Bolivar, still contain zones of proximal red-brown garnet indicating that there should be additional mineralization to the north, if not removed by erosion or structural offset. The center of the system appears to be just south of South Bolivar in the area referred to as the “Mo-core” in past reports.

The extent of skarn mineralization down dip to the east is still untested. It appears that the favorable units continue down dip and should be intersected by the La Increible breccia pipe. As previously recommended, this should be drill tested.

A final observation concerns the amount of skarn mineralization removed by erosion along the east-west drainages separating the ridges of Bolivar, La Montura, and El Val. From walking along the ridges, it is estimated about 50% of the mineralized skarn in these areas has been eroded away, although obviously much remains. This is highly prospective for the down dip extensions of skarn mineralization to the east because in these zones there will be almost no erosional loss, and this may partly offset the higher mining costs with depth.