

Observations on the Bolivar district

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20 April, 2005

Executive Summary

The Bolivar district has significant exploration potential. High grade material in the existing Bolivar mine allows immediate production on a small scale although future reserves have not been blocked out. An essential step in near-term ore reserve definition is underground diamond drilling. This is necessary to establish continuity of known ore zones and to explore for new extensions. This cannot be done reliably with surface drilling although district exploration will continue to require surface drilling.

The Bolivar system is a Cu skarn system with high Zn in distal regions, as opposed to a Zn skarn system. This has several implications for exploration and development in that Cu skarns can be much bigger than Zn skarn systems and have greater lateral continuity. K-silicate alteration in igneous rocks is present although not extensive, and the brittle fracture and collapse brecciation cemented by quartz, epidote, and sulfides in the La Increible mine is similar to some porphyry Cu deposits in Sonora. Prospects for further exploration success are high. The following steps are recommended:

- 1) Given the uncertain association of the various dikes and main stock with mineralization and the certainty that mineralization is ultimately related to some igneous system, it is important to have a better understanding of igneous systematics in the district. To help with this zircons should be dated from the various igneous rocks, including the main Bolivar stock, an andesite dike, the andesitic volcanic rocks, and the overlying rhyolitic rocks.
- 2) The stratigraphic section for the Bolivar District is not well known. None of the rock units exposed in the district have formal names or stratigraphic descriptions. A type section for each rock type should be identified and described. In particular, the sedimentary rocks need to be carefully described and a stratigraphic section created. Siltstone marker beds and variations in calcite/dolomite have both stratigraphic and exploration significance.
- 3) Great expense and effort is invested in drilling and the resulting core is one of the mine's greatest assets. At least in the early stages of exploration and mining, core should not be skeletonized or discarded. More care should be taken in storing and utilizing drill core.
- 4) Skarn mineralogy is the foundation for understanding a skarn system such as Bolivar. To assist the geologists in doing their job, petrographic analysis should be used periodically to support their drill core logging and mapping. A small research project is proposed to identify the main minerals and compositions that will be useful in exploration. The resulting report identifying specific applications to exploration can be completed within three months of authorization.
- 5) There is a large existing database of assay information available from drill core and underground production. These data should be contoured on maps and cross sections for metal ratios including Pb/Zn, Pb/Cu, Zn/Cu, Ag/Pb, Ag/Zn, and Ag/Cu. This is a very low cost exploration tool using existing data with potentially important results.
- 6) Existing maps and sections are incomplete. This makes it difficult to visualize where untested ground could host new ore bodies. This can be remedied by the ongoing construction of a 3D mine model that incorporates all known geological and assay information.

Introduction

Dia Bras (DIB) acquired the Bolivar mine and surrounding land package in October 2004. Previously, the mine was operated by a private Mexican company, Sr. Fernandez, for about 20 years and for the last eight years Dia Bras' project geologist, Roberto Banda, was the mine geologist. During those eight years the mine shipped 60,000 tonnes at 30% Zn and 6% Cu. The open stopes indicate that 200,000-300,000 tonnes was mined by Fernandez. Such grades are significantly higher than comparable mining in other parts of the world and it is clear that larger tonnages of lower grade could be developed. A cost/production model should be evaluated to determine optimally profitable levels of operation. Dia Bras is now developing the mine to produce 300 tonnes per day and has started milling development ore. They are expanding the Level 1 and Level 6 adits to take mechanized equipment.

The following report of observations and recommendations is based upon a three day field visit, April 17-19, 2005, which included examination of underground and surface exposures along with examination of 9 of the approximately 125 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/MeinertBolivarPhotos.ppt>

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

Geologic Setting

Most of the area surrounding the Bolivar mine, and indeed for more than 100 kms along the line of flight from Chihuahua City (Fig. 2), is covered by a thick volcanic sequence consisting of a lower dominantly andesite unit and an upper dominantly rhyolitic unit. The contact between the two likely is an unconformity although it is unknown how much time is represented by this unconformity. It is likely to be considerable given that there is such a strong contrast in abundance of mineralization in the two units. The rhyolite sequence appears to be barren whereas the andesite sequence hosts numerous epithermal Au (mainly high sulfidation) and lesser base and precious metal vein, skarn, and breccia deposits. In the Bolivar mine area the rhyolite unit is a prominent cliff former (Fig. 3). Unconformably underlying the volcanic units is a sedimentary sequence consisting of limestone, argillaceous limestone, dolomitic limestone, dolostone, and siltstone (possibly tuffaceous). Based upon very limited inspection of drill core it appears that calcic horizons (limestone and argillaceous limestone) are more abundant in the upper part of the section and magnesian horizons (dolomitic limestone and dolostone) are more abundant in the lower part of the section. In addition, siltstone beds ranging from 10cm to several meters in thickness appear to be more abundant in the lower part of the section. In the mine area all these units dip approximately 20° NE. Little is known about the age of these units although the volcanic rocks presumably are Tertiary and the sedimentary units might be Mesozoic.

The above volcanic and sedimentary units have been intruded by a variety of igneous rocks. Two large plutons are shown in Figure 4 and both are well-defined by airborne radiometric maps (Fig. 5) but less so by magnetic maps (Fig. 6). The pluton adjacent to the Bolivar mine is henceforth called

the Bolivar Granodiorite. It is medium grained, equigranular, and consists of 70-80% feldspar with plagioclase greatly in excess of orthoclase, 10-15% quartz, 5-10% hornblende, and 5-10% biotite. At the Level 6 portal, the intrusion is magnetite bearing although in the South Bolivar region the magnetite has been sulfidized to pyrite, probably related to K-silicate alteration as observed in DDH 125. According to Tom Robyn this pyritic area corresponds to a mag low on the regional magnetic map (Fig. 6). The pluton to the west of Bolivar has only been identified in a reconnaissance fashion by Dia Bras geologist Jacques Marchand. It appears to be broadly similar to the Bolivar Granodiorite. Both of these plutons appear to be crosscut by andesite dikes. The dikes have sharp planar contacts and are younger than the granodiorite plutons but their age relationship to the bedded andesitic volcanic units is unknown. Both the stocks and dikes are cut by skarn alteration and mineralization and thus are coeval or older than skarn alteration and mineralization. In addition, there is an East-West trending anomaly on the radiometric map (Fig. 5) that may represent a buried intrusion. This possibility should be explored.

Given this complex igneous history and the apparent spatial association of dikes with some skarn alteration, it would be useful to obtain a clearer understanding of the geochronological relations of igneous rocks in the Bolivar district. This is feasible with modern single zircon dating techniques. Such dating can be done through commercial labs or by contract with university geochronology labs. Zircons are preferable over techniques such as Ar-Ar which date alteration events. We know that alteration postdates most or all of the exposed igneous rocks and it is the chronology of the dikes and igneous events in general that needs to be understood. In addition, it would be useful to date a mineral associated with mineralization. The most likely candidates would be amphibole or mica in the skarn assemblage, and both are amenable to Ar-Ar dating.

Observations based upon underground visit to Bolivar Mine, level 6

- Stop 1** ~8 m from portal is contact of Bolivar Granodiorite with siliceous pyroxene hornfels, with a patch of purple-brown biotite at the contact (Fig. 7). ~1 m to brown garnet skarn alteration of limestone which is then zoned to green garnet and then soft green pyroxene-wollastonite near marble (Fig. 8). At the contact is a zone of vuggy euhedral quartz.
- Stop 2** Pillar at crosscut contains green garnet and bladed vesuvianite with massive chalcopryrite-sphalerite at marble contact (Fig. 9). Beyond skarn in marble, massive sphalerite appears to follow a fault and andesite dike. Also in marble is a 10 m zone of very coarse grained white calcite with 10-20cm crystals and pods of massive chalcopryrite (Fig. 10) and pods of brown garnet (Fig. 11). Also disseminated in calcite are large 1-2 cm crystals of chalcopryrite (Fig. 12).
- Stop 3** Fernandez structural zone with coarse grained brown to red brown garnet (Fig. 13, 14) in coarse grained white calcite matrix. Pods of massive chalcopryrite and sphalerite in calcite (Fig. 15) and vuggy quartz with chlorite and hematite (Fig. 16).
- Stop 4** Andesite dike and faults channel fluids along Rosario Extension. Red-brown garnet veins mark fluid conduits through hornfels (Fig. 17) and fine grained

pyroxene>garnet skarn. Massive chalcopyrite occurs discordantly at marble contact (Fig. 18).

Observations based upon surface exposures near Bolivar Mine

- Stop 1** Outcrop near level 6 adit (Fig. 19) is equigranular Bolivar Granodiorite with 10% quartz, 5% biotite, and plagioclase>>Kspar. Planar fractures have pink Kspar envelopes.
- Stop 2** Outcrop near level 1 adit is massive granular green garnet (Fig. 20).
- Stop 3** Granodiorite sill contact with dolomitic marble. Pink-brown garnet-Kspar endoskarn of sill (Fig. 21) and bright green garnet-vesuvianite-phlogopite skarn in marble (Fig. 22).
- Stop 4** Calcic skarnoid in marble along Fernandez structure shows nodular net texture of garnet-wollastonite after argillaceous patches (Fig. 23). Intensity of alteration along this structure shows channeling of fluids in "metamorphic aureole" that forms skarnoid.
- Stop 5** La Increible breccia pipe. Planar quartz-chalcopyrite veins in andesite, 1-2 cm euhedral quartz in vugs (Fig. 24). Breccia collapse of bedding with chalcopyrite-quartz infill like Pilares breccia pipe in porphyry Cu deposits such as Cananea and La Caridad.
- Stop 6** La Montura area has oxidized green granular garnet at contact with andesitic volcanic rocks. Zoned to pale tan garnet skarnoid replacing argillaceous layers and nodules in marble (Fig. 25), to pale garnet-wollastonite replacement, and finally just wollastonite replacing and surrounding argillaceous and cherty nodules (Fig. 26). View from this area to El Val in distance shows continuity of skarn alteration (Fig. 27).

Observations based upon drill core

Section 0 North

- DDH 77** This hole was drilled -70° through the main Bolivar mine area.
- 0-6 oxidized green garnet>pyroxene skarn
6-9 gray marble
9-12 oxidized pyroxene>green garnet skarn
12-17 white marble with 1 cm patches of chalcopyrite rimmed by chlorite
17-18 honey brown garnet with chalcopyrite (Fig. 28)
18-21 pale brown-green garnet = green pyroxene-sphalerite (Fig. 29)
21-23 very coarse grained calcite with patches of green garnet, sphalerite, & chlorite (Fig. 30)
23-35 marble

- 35-36 dark brown garnet (Fig. 31)
- 36-38 pale green diopsidic pyroxene in Mg skarn (Fig. 31)
- 38-42 dark brown garnet > pyroxene
- 42-44 siltstone altered to pyroxene and biotite hornfels, cut by brown garnet veins
- 44-231 interbedded marble, mottled dolostone, and Mg skarn (Fig. 32)

Section 7 South

DDH 67 This hole was drilled -60° through the andesitic volcanic-marble contact

71-75 pale green grossularitic garnet-wollastonite skarnoid that preserves the original nodular texture. The texture is similar to the magnesian skarnoid of DDH77 but the matrix is calcic garnet-wollastonite (Fig. 33, 34).

DDH 68 This hole was drilled -60° through skarn into the Bolivar Granodiorite

- 0-4 oxidized green garnet skarn with chrysacola and malachite
- 4-7 green garnet > green pyroxene with epidote and 5-10% sphalerite (Fig. 35)
- 7-9 green garnet = green pyroxene with epidote and specular hematite (Fig. 36)
- 9-18 green garnet < green pyroxene with epidote and hornblende
- 18-22 punky white pyroxene-wollastonite
- 22-25 dark granodiorite
- 25-39 skeleton skarn
- 39-48 granodiorite
- 48-52 epidote-garnet endoskarn
- 52-70 skeleton granodiorite
- 70-82 epidote endoskarn (Fig. 37)
- 199-242 skeleton fresh granodiorite (Fig. 38)

Section 9 South

DDH 70 This hole was drilled -50° through the andesitic volcanic rock-marble contact

- 0-72 skeleton andesite
- 72-111 skeleton calcic skarnoid with tan garnet-wollastonite that preserves the original nodular texture and fragments (Fig. 39, 40)

DDH 96 This hole was drilled -X° through skarn into the Bolivar Granodiorite

- 59-66 pale punky green pyroxene >> garnet, cut by green-brown garnet-sphalerite-chalcopryrite veins (Fig. 41) and late quartz-garnet-sphalerite-chalcopryrite (Fig. 42).
- 66-68 green pyroxene > red-brown garnet
- 68-88 brown garnet > pyroxene-specular hematite, pods of very coarse grained white calcite with clots and rims of chalcopryrite-sphalerite-brown garnet (Fig. 43)
- 88-98 fine grained pale green pyroxene at marble contact (88) (Fig. 44)
- 98-101.5 andesite dike with intrusive contact with marble at 101.5 (Fig. 45)

101.5-117 marble
 117-123 zoned sequence from yellow to green to brown to red-brown garnet (Fig. 46)
 123-140 pale brown garnet, skarnoid, and banded siltstone
 140-141 andesite dike
 141-149 brown garnet with clots of chalcopyrite
 149-154 andesite dike
 154-155 granodiorite but by long planar quartz-chalcopyrite-chlorite veins with white
 feldspar envelopes (Fig. 47)

Section 15 South

DDH 93 This hole was drilled -80° through skarn into the Bolivar Granodiorite

0-12 pyroxene > green-tan garnet
 12-14 tan garnet > pyroxene
 14-22 andesite dike
 22-24 green-brown garnet
 24-32 andesite dike cut by 2 cm tan-green garnet vein with pyroxene vein and stockwork envelope (Fig. 48)
 32-34 green-brown garnet-sphalerite
 34-36 brown garnet >> blue-green pyroxene-epidote-chalcopyrite (Fig. 49)
 36-41 andesite dike with small skarn-sphalerite pendent
 41-47 green garnet-sphalerite > chalcopyrite
 47-56 calcite flood with actinolite-chlorite
 56-62 green pyroxene > garnet
 62-66 calcite-chlorite-hornblende flood (Fig. 50)
 66-72 green garnet-epidote
 72-87 pyroxene hornfels but by garnet vein
 87-91 granodiorite dike with pyroxene hornfels pendent & brown garnet at margin (Fig. 51)

South Bolivar

DDH 125 This hole was drilled through magnetite-rich Mg skarn

164-167 magnetite-olivine Mg skarn (Fig. 52)
 167-169 brown garnet > pyroxene-chalcopyrite (Fig. 53)
 169-169.5 banded siltstone
 169.5-171 pyroxene > red brown garnet-magnetite
 171-171.1 banded siltstone
 171.1-173 pyroxene-olivine (Fig. 54)
 173-174 magnetite and siltstone
 174-176 pyroxene > garnet
 176-177 banded siltstone with biotite hornfels alteration cut by pyroxene veins (Fig. 55)
 177-180 green pyroxene-pyrite skarn
 180-184 andesite dike cut by hornblende-chalcopyrite vein (Fig. 56)

184-185 magnetite-serpentine breccia

DDH 124 This hole was drilled through skarnoid and Mg skarn into Bolivar Granodiorite

198-211 tan garnet-pyroxene skarnoid preserves original nodular texture

211-215 banded siltstone

215-220 brown garnet-quartz and green Mg skarn

220-238 magnetite-chalcopryrite-serpentine (after olivine) (Fig. 57) and red-brown garnet

238-247 hornfels and andesite dike

247-264 granodiorite with quartz-pyrite±chalcopryrite veins with Kspar envelopes (Fig. 58)

La Increible

DDH 28 This hole was drilled through the La Increible breccia pipe in andesitic volcanic rocks and into the underlying brecciated marble and skarn

34-63 skeleton andesite volcanic rocks intruded by granodiorite dike with stockwork chlorite-actinolite veins in volcanic rock near contact

63-131 skeleton veined andesite

131-135 vuggy euhedral quartz-epidote-chalcopryrite with patches of very coarse grained white calcite with feathery clots of pink-tan bustamite (Fig. 59)

135-155 andesite veined (Fig. 60) and brecciated by white quartz with euhedral green epidote margins and rare patches of calcite-bustamite (Fig. 61)

155-198 mottled and brecciated marble with pale brown garnet-wollastonite in matrix (Fig. 62, 63), rare fragments of epidote-altered andesite rimmed by epidote (Fig. 64,65)

198-212 epidote-rimmed volcanic fragments in quartz

212-231 brecciated marble, some dolomitic with gray serpentine veins (Fig. 66), some pink bustamite (Fig. 67) and patches of coarse grained euhedral vuggy quartz (Fig. 68)

Discussion of Observations

The underground, surface, and drill core exposures paint a consistent story of high grade Cu-Zn mineralization in carbonate rocks near the contact with the Bolivar Granodiorite and to a lesser extent with the overlying andesitic volcanic rocks. In all cases, the skarn is zoned relative to fluid flow channels and in most cases these channels are centered on igneous contacts. This does not mean that the skarn is genetically related to the immediately adjacent igneous rocks but it does mean that fluids flowed up along those contacts.

Relative to the timing of skarn formation several observations provide some constraints. The Bolivar Granodiorite is a medium grained equigranular rock that had to have formed several km and more likely 5-7 km beneath the surface. Given the size of the surface exposure (15-20 km²) this pluton would have to have had at least 2 km of roof rocks to prevent catastrophic eruption. However, the depth is almost certainly greater than 2 km due to the medium grained and equigranular texture of the rock. The 5-7 km depth of formation estimate is supported by the size

and mineralogy of the metamorphic aureole. Limestone is converted to marble for 100s of meters away from the contact and garnet-wollastonite skarnoid is developed in rocks of impure composition for significant distances away from the main igneous contact. Locally, such as along the Fernandez structural trend, skarnoid is developed even further from the contact. The lack of higher temperature mineral assemblages such as anorthite-wollastonite makes it unlikely that the pluton depth was more than 7 km. The 5-7 km depth range also is supported by the medium grained, equigranular texture and the lack of chilled margins or porphyritic texture.

In contrast, the andesite dikes have planar, chilled contacts and are generally fine grained and/or porphyritic. The dikes apparently cut the granodiorite although I did not see an example of such a crosscutting relationship. Both the texture and crosscutting relations suggest that the andesite dikes are younger and shallower than the granodiorite. Both granodiorite and andesite dikes have alteration, locally skarn, along their contacts. In addition endoskarn affects both the granodiorite and andesite dikes. Thus these rocks are older than or at best coeval with alteration/mineralization. The presence of skarn veins cutting an andesite dike (DDH96-101.5) is clear evidence that at least some skarn is later than at least some of the andesite dikes. And since the andesite dikes apparently cut the granodiorite, this indicates that skarn mineralization is younger than the granodiorite and perhaps coeval with some generation of andesite dike.

A closer association of granodiorite with skarn alteration and mineralization is suggested by local K-silicate veining of the granodiorite (DDH124-264) and the zonation of skarn relative to this contact. In particular the presence of chalcopyrite-dominant skarn (lacking sphalerite) in the South Bolivar area, along with K-silicate veins suggests that this is close to a center of hydrothermal fluid activity. In contrast, the main Bolivar mine is characterized by Zn>Cu and more distal skarn mineralogy such as pyroxene>garnet and pale green and brown garnets.

Since the andesite and rhyolite volcanic rocks in the district dip ~20° NE and assuming that these rocks are younger than the Bolivar Granodiorite, then this stock must also be tilted ~20° to the NE. This means that the NE corner, near the Bolivar Mine is the shallowest part of the pluton and the logical focal point of fluid flow. Along the same line of reasoning, the southern part of the pluton represents the deepest part of the system. These structural relations should be confirmed as they have direct implications for future exploration.

The abundant, but not quite massive, magnetite in the South Bolivar region is due to dolomitic wall rocks rather than solely a proximal location. If the South Bolivar region is a center of hydrothermal fluid activity this suggests that the type of mineralization present in the Bolivar mine could occur at a similar distance south of South Bolivar, assuming receptive lithologies are present. Although the stratigraphy of the carbonate section is not known, it appears that dolomite and siltstone occur together and that both are more abundant at depth and to the south. This has important implications for the style and mineralogy of mineralization. In addition, impure mottled and argillaceous carbonate rocks are present in the stratigraphic section and these rocks have been converted to skarnoid. Although these rocks are not mineralized they are a positive indication of the size of the mineralized system. Their distribution should be mapped and barren skarnoid needs to be distinguished from mineralized skarn in terms of district zonation and exploration.

The overall mineralogy of the Bolivar system is typical of a major Cu skarn system and has few of the characteristics of a Zn skarn system. The high Zn grades in the Bolivar mine are due to the

distal location of this alteration zone within the overall district zonation pattern. This is confirmed by the relative absence of sphalerite in the South Bolivar region. Specifically, no evidence was seen for manganese-rich pyroxene in the district, as is present in most Zn skarn systems. Minor bustamite (Mn pyroxenoid) appears to be present in the La Increible area but this could simply reflect the distal portion of a Cu skarn system.

The identification of the Bolivar system as a Cu skarn system with high Zn in distal regions, as opposed to a Zn skarn system, has several implications for exploration and development. The most positive aspect is that Cu skarns can be much bigger than Zn skarn systems with many known examples ≥ 100 Mt. In contrast the largest known Zn skarns are about 50 Mt and most Zn skarns are significantly smaller than that, with a few million tons being a median size. Cu skarns associated with porphyritic intrusions can be even larger with several known examples such as Bingham, Morenci, and Santa Rita in the 500 Mt range. However, there is no evidence of a porphyritic intrusion in the Bolivar region and the amount of K-silicate alteration, although present, is small. Nevertheless, exploration personal should be watchful for signs of porphyry style mineralization. The strongest indication of this style of mineralization is the breccia pipe at La Increible. The brittle fracture and collapse brecciation cemented by quartz, epidote, and sulfides is similar to the Cananea and La Caridad districts in Sonora. Other evidence of surface brecciation should be watched for as the shallow expression of underlying magmatic activity. Given the 20° NE dip of the stratigraphic section and if this tilting postdates intrusion and mineralization, then the most prospective ground for shallow porphyry-style mineralization is to the northeast under the volcanic rocks.

In terms of current mining, it appears that the very high grades being extracted are limiting tonnage potential and it is not clear that this is an optimal economic model. It is reported that over eight years the mine shipped 60,000 tonnes at 30% Zn and 6% Cu. The open stopes indicate that 200,000-300,000 tonnes were mined by the previous operator. Such grades are significantly higher than comparable mining in other parts of the world and it is clear that larger tonnages of lower grade could be developed. A grade/tonnage model should be evaluated to determine optimally profitable levels of operation. It is likely that such an optimum will be about half the current mining grades.

Recommendations for future work

- 1) Given the uncertain association of the various dikes and main stock with mineralization and the certainty that mineralization is ultimately related to some igneous system, it is important to have a better understanding of igneous systematics in the district. To help with this zircons should be dated from the various igneous rocks, including the main Bolivar stock, an andesite dike, the andesitic volcanic rocks, and the overlying rhyolitic rocks. Such dating can be done through commercial labs or by contract with university geochronology labs. Zircons are preferable over techniques such as Ar-Ar which date alteration events. We know that alteration postdates most or all of the dikes and it is the chronology of the dikes and igneous events in general that needs to be understood.
- 2) The stratigraphic section for the Bolivar District is not well known. None of the rock units exposed in the district have formal names or stratigraphic descriptions. A type section for each rock

type should be identified and described. In particular, the sedimentary rocks need to be carefully described and a stratigraphic section created. Based upon the preliminary observations described above, there are siltstone units which may serve as marker beds that will allow correlation between drill holes. There are both impure calcic and dolomitic carbonate units that have different alteration and mineralization styles. For example, the magnetite mineralization in drill holes 124 and 125 is due to the presence of magnesian skarn which in turn reflects a dolomitic protolith. A limestone in this same position would not develop magnetite. One approach to establishing a stratigraphic section is to examine drill hole intersections that are not strongly altered. Once marker horizons such as siltstones or tuffs are recognized then the thickness of intervening carbonate units can be measured. Correlation from drill hole to drill hole allows development of average thicknesses and allows stratigraphic interpretation of more intensely altered sections. Since most drill holes have been skeletonized, such stratigraphic studies will have to be done on recent and new drilling.

3) Great expense and effort is invested in drilling and the resulting core is one of the mine's greatest assets. At least in the early stages of exploration and mining, core should not be skeletonized or discarded. Present practices inhibit full understanding and use of the core, such as the stratigraphic study described above. Current core storage practices can be improved. Drill core sheds should not be used as "temporary" storage for unrelated equipment such as construction materials, shop equipment, and furniture such as mattresses! Core racks should be bolted to the floor for stability and designed to allow easy access to core boxes. The current racks seem both expensive and inefficient relative to others I have seen. If an earthquake should occur (not unheard of in Mexico) the present system would be a mess. Logging tables should be constructed in each core shed. The goal is to facilitate proper use of core to aid exploration and mining, not to inhibit it.

4) Skarn mineralogy is the foundation for understanding a skarn system such as Bolivar. To assist the geologists in doing their job, petrographic analysis should be used periodically to support their drill core logging and mapping. This is a small expense relative to drilling and assaying and greatly increases the accuracy and confidence of geological work. Geologists should be encouraged to send a sample out for petrographic analysis when they encounter new or unusual mineralogy. A simple report that the major minerals present are X, Y, and Z is sufficient and is relatively inexpensive. After the first few times, the need for petrographic analysis will decline as the geologists gain confidence in their mineral identifications. To build a foundation for this mineralogical understanding a small research project is proposed. I collected a suite of representative samples during my examination of the core. I will have thin sections made of these samples and identify the main minerals and compositions that will be useful in exploration. The resulting report identifying specific applications to exploration can be completed within three months of authorization.

5) Most skarn systems are zoned in terms of mineralogy and metal ratios. There is a large existing database of assay information available from drill core and underground production. These data should be contoured on maps and cross sections for metal ratios including Pb/Zn, Pb/Cu, Zn/Cu, Ag/Pb, Ag/Zn, and Ag/Cu. This is a very low cost exploration tool using existing data with potentially very important results.

6) Exploration should be carried out on two fronts simultaneously. The first priority given the reality of ongoing mining is to define new and existing reserves in the mine using underground drilling. This can be capably led by Roberto Banda who is familiar with the geology and past

production of the mine. The second priority is exploration outside of the mine, both in nearby zones such as South Bolivar and in regional trends throughout the district. This should be led by someone such as Jacques Marchand, without direct day to day mine responsibilities. It is a fact of life that the mine geologist will necessarily be involved in daily mine activities whereas the exploration geologist needs to be free to work away from the mine on drilling and sampling projects.