

# Igneous Rocks in the Bolivar district

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## Executive Summary

The igneous rocks in the Bolivar district formed from normal calc-alkaline subduction-related magmas. Major elements and oxidation state are similar to plutons associated with Cu skarns worldwide. REE plots show that the various textural variants of the Bolivar pluton are all genetically related. There is no evidence for unusual magma compositions or alteration processes and one conclusion to be drawn from this is that other plutons in the region should be capable of generating similar Cu mineralization. Given that there are other plutons mapped in the region (Fig. 2), they should all be examined for potential Cu skarn mineralization.

## Introduction

The following report on igneous rocks in the Bolivar district is based upon samples collected during a three day field visit, June 13-15. These samples were analyzed by Chemex Labs in Vancouver, British Columbia for major, minor, and rare earth elements in order to better understand the petrogenesis of the igneous rocks. 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 an attached PowerPoint presentation (Fig. 1).

## Sample Description

The five igneous rock samples are all granodiorite and range from mafic to felsic (Table 1). The igneous rocks are mostly porphyritic although few are true porphyries with a fine-grained to aphanetic groundmass. The lack of a fine-grained to aphanetic groundmass suggests that these rocks are not emplaced at very shallow depths, e.g. <2 km. On the other hand the porphyritic texture suggests that they also are not deeply emplaced, e.g. >5 km. Thus, the most likely depth of emplacement of the Bolivar plutonic rocks is 2-5 km, a range that is consistent with the large areal extent of the Bolivar pluton, which is about 7 km<sup>2</sup> (Fig. 2).

### **Table 1** **Sample #**      **Description**

|   |          |                     |
|---|----------|---------------------|
| 1 | 26-272m  | mafic granodiorite  |
| 2 | 18-253m  | granodiorite        |
| 3 | 44-109m  | granodiorite        |
| 4 | 135-213m | granodiorite        |
| 5 | 167-357m | felsic granodiorite |

**DDH 26**      Section 2-N, drilled -62°W

269-277      Fine-grained mafic granodiorite (Fig. 3) with internal igneous contacts (Fig. 4).  
XRF sample 272m

**DDH 18**      Section 0-N, drilled -80°W

238-259      Granodiorite XRF sample 253m (Fig. 5).

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

- 104-109 Bolivar Granodiorite (Fig. 6) XRF sample 109m
- DDH 135** South Bolivar zone, Bolivar Granodiorite (Fig. 7) variable pink Kspar (Fig. 8) XRF sample 213m
- DDH 167** Vertical hole drilled ~300m west of the La Increible breccia pipe
- 341-358 Felsic granodiorite (Fig. 9), XRF sample at 357m

## Whole Rock Compositions

After normal sample preparation by Chemex Labs in Vancouver, B.C., samples were analyzed for major and minor elements by XRF. REE were analyzed by ICP-MS and ferrous Fe was analyzed by wet chemistry (titration). The results are summarized in Table 2 and average values for plutons related to various skarn types are listed for comparison purposes.

As expected, the various textural variants of the Bolivar Granodiorite span a considerable range but the average of the five samples (Column H of Table 2) shows a fairly consistent match with the average composition of plutons related to Cu skarns. Furthermore, the freshest appearing Bolivar sample, 44-109, is almost an exact match for the average composition of plutons related to Cu skarns. This is further support for the previous suggestion that the Bolivar system is fundamentally a Cu skarn system and that the potential for porphyry Cu style mineralization remains high in the district.

In terms of oxidation state, the Bolivar system is fairly close to typical Cu skarn plutons and there is no indication of a Au association. Plutons associated with Au skarns tend to be significantly more reduced (average  $\text{Fe}_2\text{O}_3/(\text{Fe}_2\text{O}_3+\text{FeO}) = 0.27$ ) and thus there is no expectation that further exploration will encounter high Au values related to the Bolivar pluton.

In terms of petrogenesis, rare earth elements (REE) provide one way of interpreting the origin of igneous rocks. Bolivar REE concentration data have been ratioed against standard chondritic meteorites. This allows easier interpretation of the data by smoothing out fluctuations due to natural abundance variations and exposing those anomalies due to geological processes. The Chondrite reference values used in these plots are based on Nakamura (1974) in *Geochimica et Cosmochimica Acta*, Volume 38, p. 757-775). A spidergram of normalized REE is illustrated in Figure 10. The overall pattern is typical of subduction-related magmas and the slight Eu anomaly is consistent with normal fractionation of plagioclase. The REE plots of the individual igneous samples show that the various textural variants of the Bolivar pluton are all genetically related.

## Summary

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