Research applied to mineral exploration

Observations on the Tolita prospect, Region III, Chile

Looking NNE to Zone A (center) and B (right) from southern structure; two hills constitute silicified dacite intrusions, with variable sheeted veinlets; Zone A has the best surface grades, and in two RC holes

Report for:

Mariana Resources

January, 2011

Prepared by:

Jeffrey W. Hedenquist

Hedenquist Consulting, Inc.

99 Fifth Avenue, Suite 260
Ottawa, Ontario K1S 5P5 Canada
Tel: 1(613) 230-9191

Contents *pg*

Summary and recommendations

The Tolita prospect consists of three relatively small areas of silicification associated with weak potassic alteration that includes magnetite. Fine veinlets of quartz and sulfide, with pyrite > chalcopyrite, are typically sheeted, mainly have a steep dip, and are largely limited to the areas of silicification; the orientation of the veinlets in Zone A vary depending on location, suggesting a possible radial distribution. The main area of anomalous gold (and minor copper) is in Zone A, with the area of silicification and anomalous gold being ~250-300 m in diameter, up to ~3800 m elevation; the gold anomaly is 150-400 ppb Au, locally 400-600 ppb, with one value >1 g/t; Cu is 400-800 ppm, locally >1000 ppm. The best RC results, from TL97-03, have an average of 0.22 g/t Au from 28 to 192 m, including 28 m from 142 m depth of 0.33 g/t, and 12 m of 0.46 g/t from 180 m dept, at ~3650 m elevation; the bottom 30 m of this hole decreases to 20-50 ppb Au.

These small intrusion may be apophyses from larger bodies at depth; they are clearly the focus of sheeted veinlet development and the anomalous gold and copper values. Based on the existing surface results, there are geological targets to test, to determine the depth potential of the prospect, i.e., whether the present erosion level is the shallow manifestation of a deeper and more strongly altered, veined and mineralized system at depth, or the apophyses and associated hydrothermal systems are inherently small, with no potential.

Recommendations

- Map the areas of silicification (Zones A, B and C), focusing initially on Zone A. Record the veinlet density (number per meter) and orientation(s). Collect check samples (50-100, focused on Zone A) in areas of high vein density, and other areas of variable degree of silicification with few or no veinlets.
- After confirmation of grades and the relation to vein density, consider to test Zone A with one or more RC holes, oriented to cut veinlet direction(s) associated with the better grades. Collar the hole at the lowest elevation possible that combined with angle (60 degrees preferred) allows the central part of Zone A to be tested; drill to at least 400 m depth. Log the hole, including vein density and sulfide abundance (plus the ratio of pyrite:chalcopyrite), and compare with assay results.
- If the results of the deeper RC drilling are positive, consider an Induced Polarization survey to identify zones of higher sulfide concentration; target these areas with diamond drill holes to at least 400 m depth (at 60 degrees angle).

Introduction

John Sutcliffe requested the author to examine the Tolita prospect in Region III, 100 southeast of Copiapo and 30 km southwest of Cerro Casale. The concession is being offered by Enrique Viteri. One day was spent on site, 3.5 hour travel from Copiapo. Luis Ignacios Silva, Javier Fuentes, and Ximena Piñana, Mariana Resources, and Andrew Shaw, Catalina Resources, joined the visit. I thank these individuals for their contributions to this report, including observations, discussion, and comments.

Background

The first known work was conducted in 1995 by Minera Santa Fe Pacific Chile Ltda, during which time fine quartz veinlets within a zone of silicification was identified, with anomalous gold and copper values. Road cuts and trenches of 2500 m allowed rock samples to be collected and the area to be mapped. A core of magnetite-bearing potassic alteration of dacite was identified (Fig. 1), which hosts the silicification and quartz-pyrite-(chalcopyrite) veinlets, surrounded by a zone of sericite-clay alteration of dacitic tuffs, out to distal propylitic aleration. A total of 291 samples were collected, with values of 50-510 ppb Au and 500-3600 ppm Cu returned (Keenan et al., March 1998).

The prospect was subsequently assessed by Minera Exploro Chile Ltda between 1996 to 1998 (Keenan et al., March 1998). The work included geological mapping, soil sampling, trenching and rock chip sampling, and an airborne magnetic survey. Nine trenches totalling 3600 m were cut, and 1810 2-m channels were sampled. The work culminated with the drilling of three reverse circulation holes totalling 240, 214 and 220 m at a 60 degree angle; a further five planned RC holes were not drilled due to a snowstorm in early June, 1997.

Three areas of silicification (Zone A, B and C) were identified by the soil sample results of Au and Cu, and the rock samples defined the extent of the core zones (250-300 m diameter, 500 m long by 200 to 70 m, and 150 x 300 m in extent, respectively; Fig. 2); the tops of the silicic hills are up to ~3800 m elevation. The anomalies are restricted to the areas of silicification, with the best grades in Zone A associated with the strongest silicification (Fig. 2); it is not clear if this is also the areas of best-developed quartz veinlets. The results (as summarized by Keenan et al., March 1998) include: A, 150-400 ppb Au, locally 400-600 ppb and with one value >1 g/t; Cu was 400-800 ppm, locally >1000 ppm. B, 100-200 ppb Au, 200-700 ppm Cu, locally >1000 ppm. C, 150-200 ppb Au, up to 400 ppb, and an average of 300 ppm Cu, locally >1000 ppm. A structure to the south with up to 15 m wide alteration, returned a 6-m channel across the structure with 0.44 g/t Au and 2160 ppm Cu; a grab sample of the narrow vein material reported 58 g/t Au and 6 wt% Cu.

The results for the three RC holes included: TL97-01 (B Zone) intersected a weakly silicified dacite with pyrite and magnetite and a low density of quartz veinlets. Only 14 samples returned >100 ppb Au, with two values >200 ppb, most at shallow depth; Cu maxima were 500 ppm. TL97-02 (A Zone) targeted the area of highest surface values; a zone of greater silicification was intersected below 64 m depth. From 64 m a 150-m interval (to boh) averaged 0.25 g/t Au, including 16 m from 118 m of 0.65 g/t and a high of 2.9 g/t. Copper was 500-800 ppm, with >1000 ppm from 76 to 88 m depth. TL97-03 (Zone A) was drilled to the north, at right angles to TL97-02; below 28 m depth silicification and quartz veinlet density increased. From 28 to 192 m the average was 0.22 g/t Au, including 28 m from 142 m depth of 0.33 g/t, and 12 m from 180 m depth at 0.46 g/t. Copper values were similar to TL97-02.

Indo Gold worked in the area at reported the results in 1999 (Van Treek, February 1999). They cut about 1500 m of trenches in areas of sericitic-clay alteration, extending only slightly into the silicified cores (traces shown as dark lines on Fig. 1). A total of 636 samples were collected with the following results: Of 530 samples adjacent to the silicified areas, 71 were above detection (10 ppb Au), ranging from 10 to 120 ppb, although all but three samples were <50 ppb; values above detection (10 ppm) for Cu were few. In the area of the structure to the south, four values returned 1 to 12.4 g/t Au, and Cu from 0.13 to 2.88 wt%.

The basement rocks consist of a sequence of Permian to Cretaceous sandstones and fine conglomerates, intruded by granites, and overlain by Oligocene to Miocene age volcanic products. The sedimentary sequence in the Tolita prospect is cut by dacite intrusions (Van Treek, February 1999); the areas on the margin include dacite tuff. Exploro mapping (Keenan et al., March 1998) had previously suggested that tuffs were more abundant, including through all three RC holes.

The Tolita prospect has been suggested to be a porphyry Au-Cu system, similar to some deposits in the Maricunga belt, including Cerro Casale.

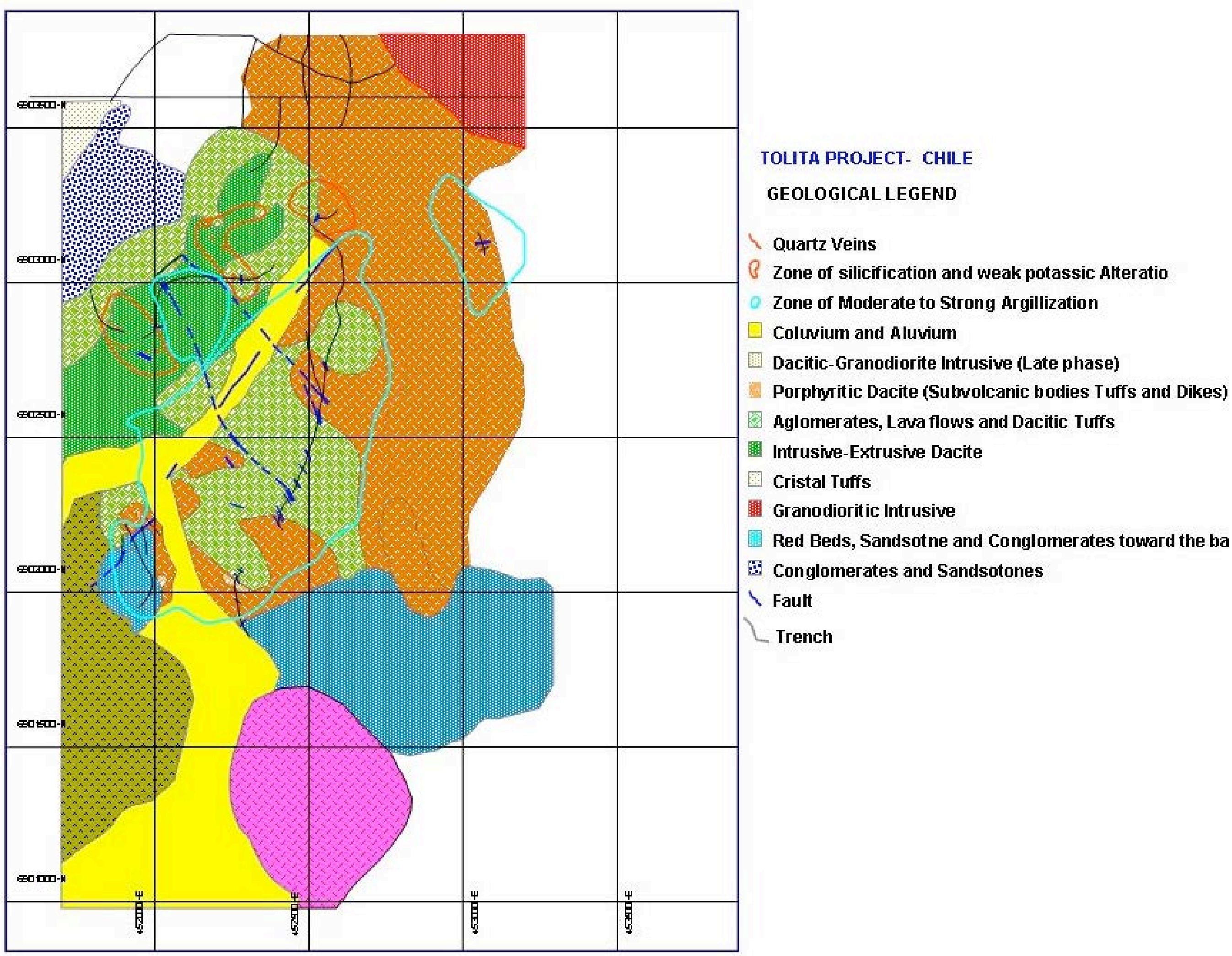

Fig. 1. a) Geological map of the Tolita prospect (Indo Gold; Van Treek, February 1999), areas of silicification in orange.

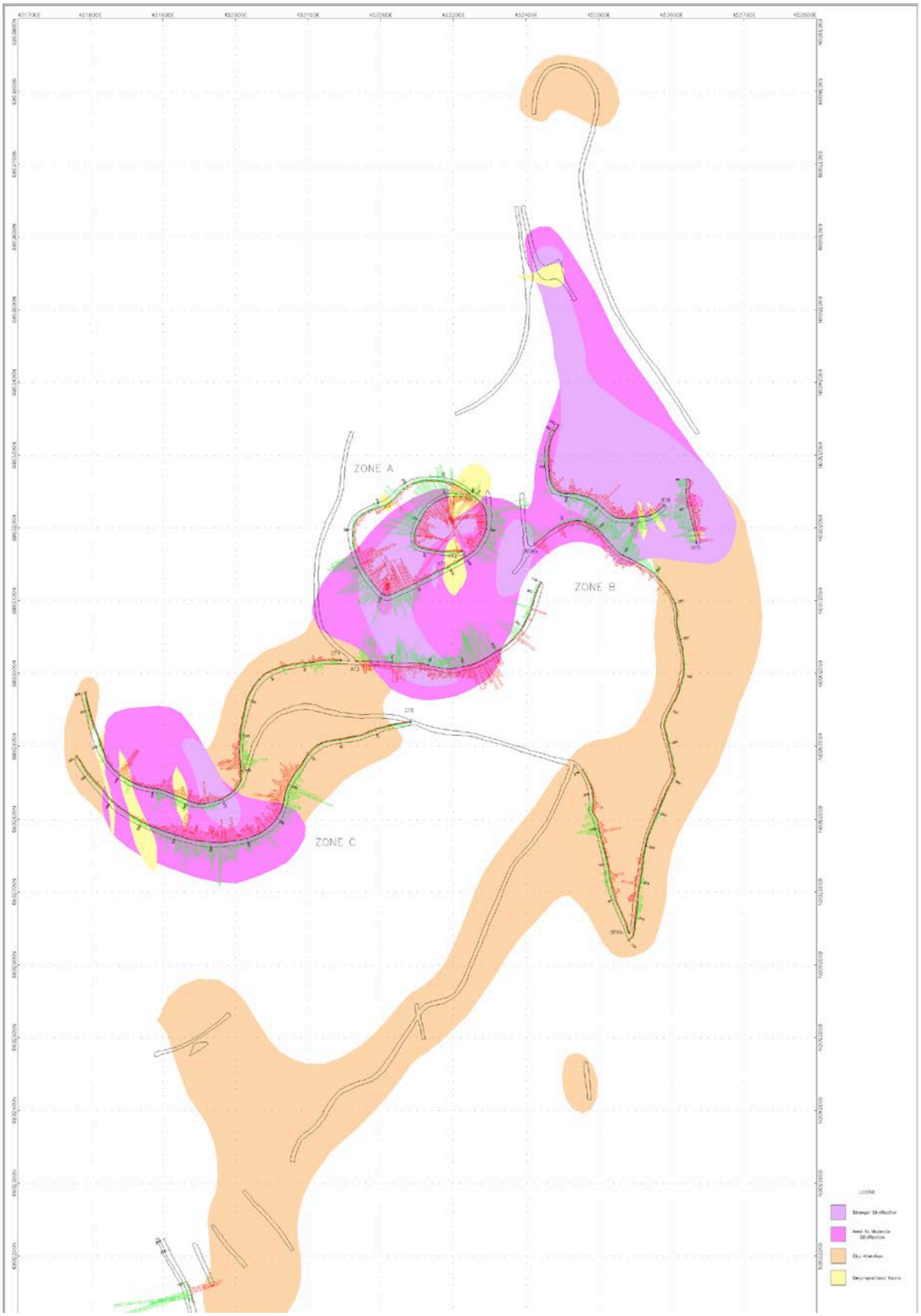

Fig. 2. Alteration map, with trace of Exploro trenches and assays (red, Au; green, Cu); silicification shown in purple (weak and strong, light and dark), clay, brown (Keenan et al., March 1998).

Observations

There are multiple felsic intrusions at Tolita, plus andesitic rocks on ridges on the margin of the prospect (J. Fuentes, pers. commun.). The stocks intrude dacitic tuff that has a lower phenocryst content than the intrusions, with a variable lithic content; in places it is lenticular. The areas of silicification consist of intrusive rocks of general dacitic composition, with variable phenocryst size and abundance; it is likely that the units cut by the RC holes are also dacite intrusion. On the margin of the intrusion the felsic tuffs are clay altered. The geologic map and sections by Keenan et al. (March 1998) indicated that the silicified rocks were dacitic tuffs, but their coherent nature and lack of lithic fragments and lenticularity point to their intrusive origin. The geologic map by Indo Gold (Fig. 1) identified the correct lithology. Numerous dikes have been mapped in the area. Despite the comparison of the magmatism to that of the Maricunga district, the age is much older; SERNAGEOMIN dating places it at ~35 Ma (J. Fuentes, pers. commun.).

The veinlets are variably banded, typically showing center lines (Fig. 3a); the quartz is granular, and in cuttings pyrite plus rare chalcopyrite are present. Locally the veinlets are sheeted (Fig. 3b), but they locally have two orientations (Fig. 3c). Although magnetite is common in the silicified zones, many of the veinlets have weak to no magnetism, and rock without veinlets can be strongly magnetic.

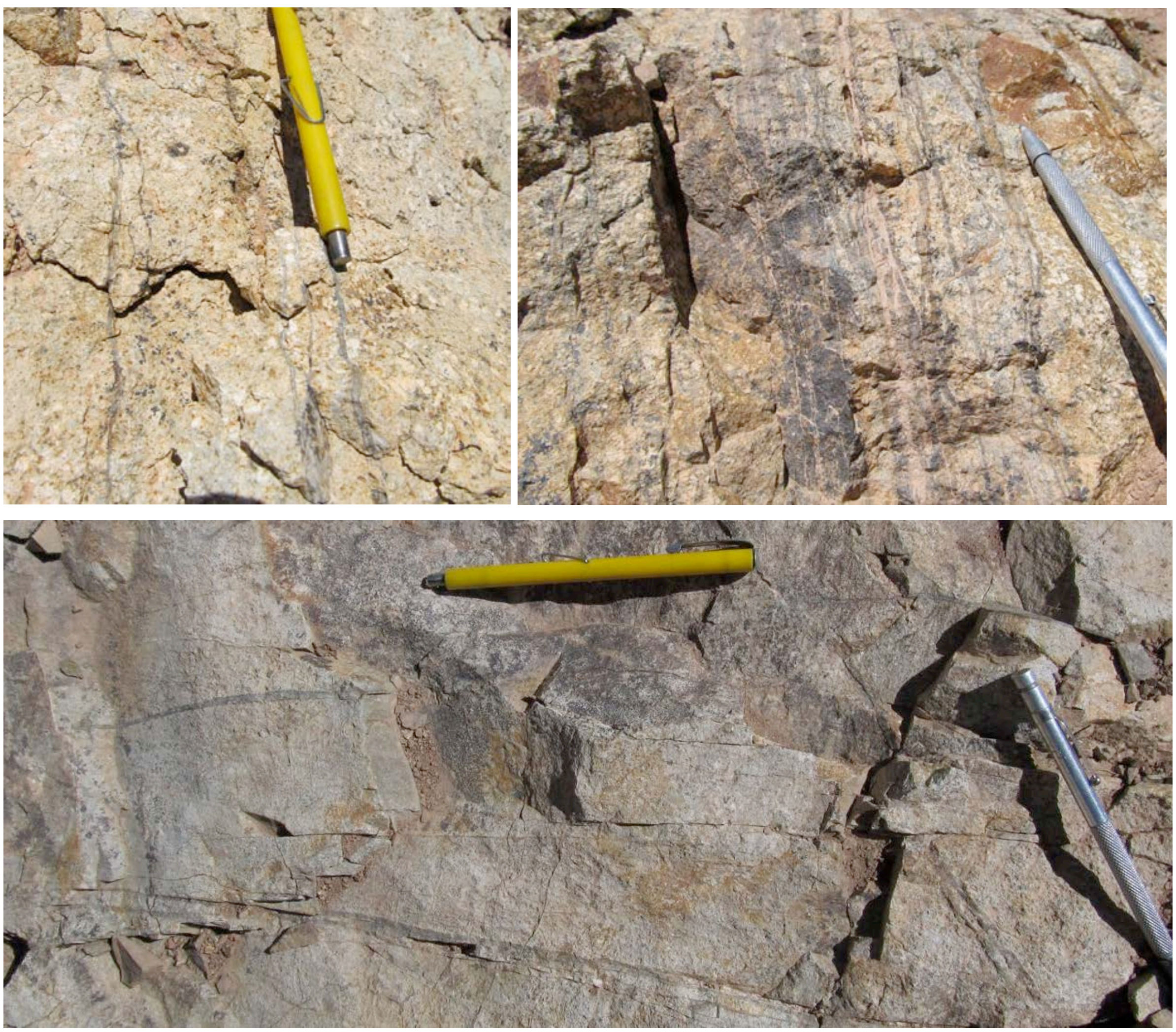

Fig. 3. a) Veinlets cutting dacite intrusion, Zone A; veinlets are finely banded. b) Concentrations of veinlets with a unidirectional sheeted appearance. c) Locally veinlets can have two orientations (here ~N-S and NE).

The best gold values are in Zone A, associated with the core of magnetite-bearing alteration that is silicified (Fig. 4). The grades decrease sharply at the contact of the silicified intrusion with the clay-altered rock, which occurs at lower elevations, below the summit of each hill.

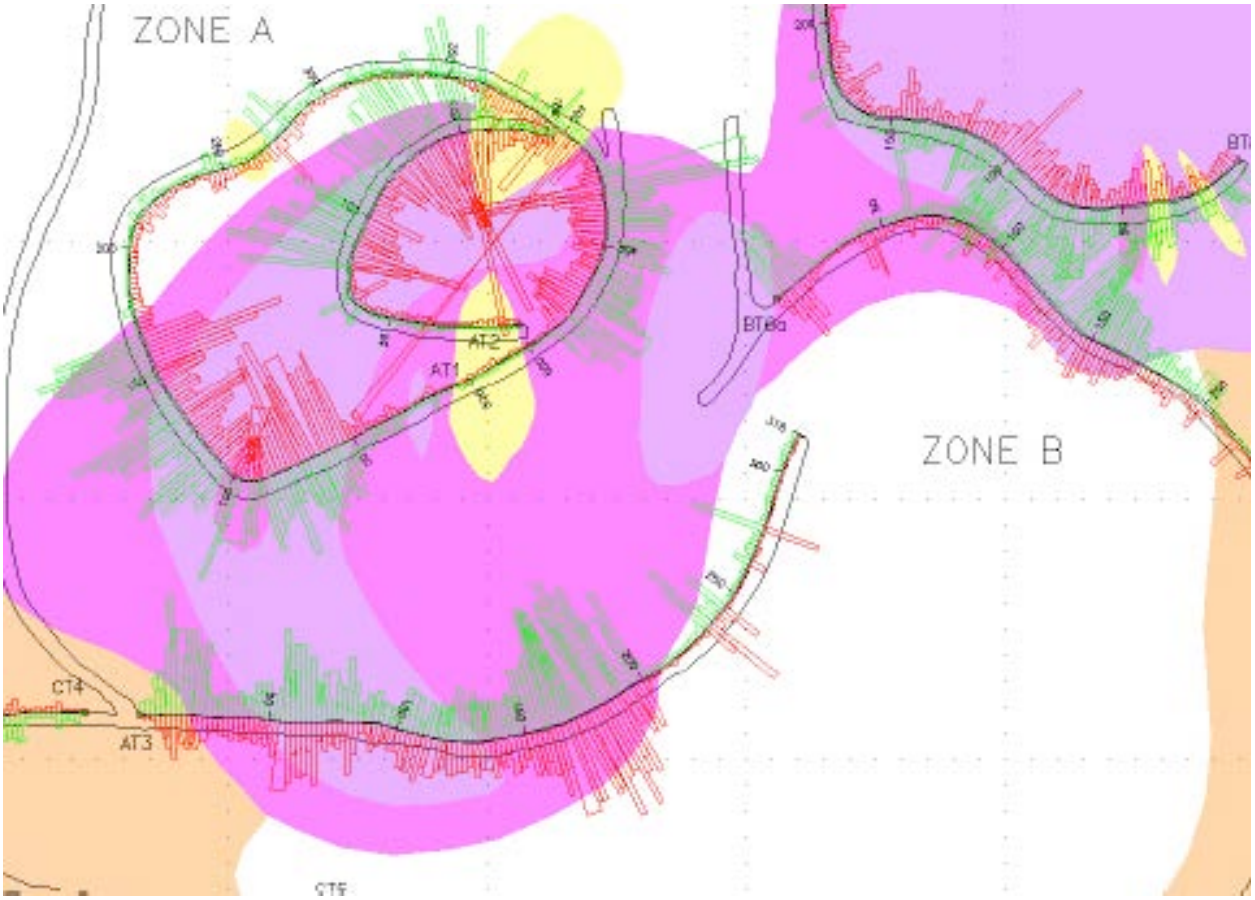

Fig. 4. a) Closeup of Zone A and the western half of Zone B (Fig. 2), showing the histogram portrayal of the gold and copper distribution (typical higher Au values, red, range from ~150 to 400 ppb, and higher Cu values range from ~400 to 800 ppm). Marginal clay alteration typically has much lower values, <40 ppb Au and <150 ppm Cu). b) Looking west across Zone A (central hill, ~3800 m elev.) and the western portion of Zone B (right). Silicification and sheeted fine veinlets extend as far as the lower road cut on the eastern slope of Zone A.

Fig. 5. a) Looking SW over area east of Area A and B; contact of dacitic intrusion (left) with clay-altered tuff; float of banded and sheeted quartz veinlet fragments (sampled, for assay) are present along the contact. b) SE from Zone A, ridge capped by propylitic altered andesite flows; beyond are the sedimentary sequences.

Away from the central silicified areas of Zone A and B, a dacitic tuff is present that is clay altered, except where it is cut by dikes (Fig. 5a); in one location, sheeted quartz veinlets occur near the intrusive contact. To the SE, the alteration is reportedly propylitic, hosted by andesite flows (Fig. 5b; J. Fuentes, pers. commun.).

One km to the SSW of the middle of Zone A there is a discontinuous structure with a trend ~E-W (Fig. 6) that reports the highest grades on the property, albeit largely associated with a narrow vein zone (Fig. 6b). There are reports of grades from the clay-altered halo, which suggests that the anomalous values in this zone may be largely the result of supergene remobilization.

To the NE ~7 km (Fig. 7), there is another prospect at higher elevation called Toro, reportedly of epithermal nature. Indo Gold also assessed this area and conducted RC drilling; the results of this work is not known to the author.


Fig. 6. a) SSW from Zone A to the high-grade (1-10 g/t Au) structure that has been trenched up the slope. b) Clay alteration halo to the narrow (~30 cm wide) structure that consists of narrow quartz veinlets plus barite.

Fig. 7. Looking NE to higher elevation in the area of the Toro prospect (small hills just to the right of center on the horizon).

Discussion

The veinlets, with a weak banded and locally sheeted nature (Fig. 3), can appear similar to some of the narrow veinlets in Maricunga-type porphyry gold deposits. However, the intrusions in the Tolita area are older (at 35 Ma) than the magmatism associated with the Maricunga porphyry Au systems (23 to 13.5 Ma; Sillitoe et al., 1991, *Economic Geology*), which have distinct coarsely banded grey and white sheeted quartz veins, with local radial distribution (e.g., Verde).

The RC holes TL97-02 and 03, which cut Zone A to the west and north, respectively, reportedly returned the best values in the more strongly silicified dacite; like at the surface, the density of veinlets was not discussed. The best values were returned in TL97-03, with the highest grade interval, 12 m of 0.46 g/t from 180 m depth, to an elevation of ~4650 m; however, the grades in the bottom 30 m of the hole ranged between 20 and 50 ppb Au.

An Induced Polarization survey would help to define the areas of sulfide at depth, although the RC holes TL97-02 and 03 have already identified sulfides and anomalous gold up to ~150 m depth below the summit of Zone A. Therefore, if the check assays confirm the surface mineralization, and mapping defines the relationship of grade to the sheeted veinlets, the next step would be to test the depth potential of the system in this area with the best geological indications of mineralization, perhaps with an RC hole from the outer road, from the south or east of Zone A (Fig. 8) to the north or west, as appropriate to cut the mapped veinlets.

Fig. 8. Looking NNW to Zone A; the area of silicification and veining, as well as gold anomalies (Fig. 2 and 4a) extend below the road cut at the base of outcrops. A deep RC drillhole from the road, ~50 to 60 m below the collars of holes TL97-02 and 03 and drilled to at least 400 m depth, would test the system at least 150 m deeper.

Conclusions

The Tolita prospect consists of three relatively small areas of silicification associated with weak potassic alteration that includes magnetite. Fine veinlets of quartz and sulfide, with pyrite > chalcopyrite, are typically sheeted, mainly have a steep dip, and are largely limited to the areas of silicification; the orientation of the veinlets in Zone A vary depending on location, suggesting a possible radial distribution. The main area of anomalous gold (and minor copper) is in Zone A, with the area of silicification and anomalous gold being ~250-300 m in diameter, up to ~3800 m elevation; the gold anomaly is 150-400 ppb Au, locally 400-600 ppb, with one value >1 g/t; Cu is 400-800 ppm, locally >1000 ppm. The best RC results, from TL97-03, have an average of 0.22 g/t Au from 28 to 192 m, including 28 m from 142 m depth of 0.33 g/t, and 12 m of 0.46 g/t from 180 m dept, at ~3650 m elevation; the bottom 30 m of this hole decreases to 20-50 ppb Au.

These small intrusion may be apophyses from larger bodies at depth; they are clearly the focus of sheeted veinlet development and the anomalous gold and copper values. Based on the existing surface results, there are geological targets to test, to determine the depth potential of the prospect, i.e., whether the present erosion level is the shallow manifestation of a deeper and more strongly altered, veined and mineralized system at depth, or the apophyses and associated hydrothermal systems are inherently small, with no potential.

Recommendations

- Map the areas of silicification (Zones A, B and C), focusing initially on Zone A. Record the veinlet density (number per meter) and orientation(s). Collect check samples (50-100, focused on Zone A) in areas of high vein density, and other areas of variable degree of silicification with few or no veinlets.
- After confirmation of grades and the relation to vein density, consider to test Zone A with one or more RC holes, oriented to cut veinlet direction(s) associated with the better grades. Collar the hole at the lowest elevation possible that combined with angle (60 degrees preferred) allows the central part of Zone A to be tested; drill to at least 400 m depth. Log the hole, including vein density and sulfide abundance (plus the ratio of pyrite:chalcopyrite), and compare with assay results.
- If the results of the deeper RC drilling are positive, consider an Induced Polarization survey to identify zones of higher sulfide concentration; target these areas with diamond drill holes to at least 400 m depth (at 60 degrees angle).

Qualifications

I, Jeffrey W. Hedenquist, of Ottawa, Canada, hearby certify that:

- I am President of Hedenquist Consulting, Inc., incorporated within the province of Ontario. I am an independent consulting geologist with an office at 74 Greenfield Avenue, Ottawa, Ontario, K1S 0X7, Canada; telephone 1-613-230-9191.
- I am a graduate of Macalester College, St. Paul, Minnesota, USA (B.A, Geology, 1975), The Johns Hopkins University, Baltimore, Maryland, USA (M.A., Geology, 1978), and the University of Auckland, Auckland, New Zealand (Ph.D, Geology, 1983).
- I have practiced my profession as a geologist continuously since 1975, working as a researcher for the U.S. Geological Survey, the New Zealand Department of Scientific and Industrial Research – Chemistry Division, and the Geological Survey of Japan until the end of 1998. I have published widely in international refereed journals on subjects related to epithermal and porphyry ore-deposit formation and active hydrothermal systems. I consulted to the mineral industry and various governments as a New Zealand government scientist from 1985 to 1989, and I have been an independent consultant since January, 1999.
- I am a Fellow of the Society of Economic Geologists, have served as an executive officer, and am now the Past-President. I am also a member of the Geological Association of Canada (Mineral Deposits Division), Society of Resource Geology of Japan and the Geochemical Society. I was Editor of the 100th Anniversary Publications of Economic Geology, am Associate Editor of Economic Geology, and am an editorial board member of Resource Geology; I have previously served as editorial board member of Geology, Geothermics, Journal of Exploration Geochemistry, Geochemical Journal and Mineralium Deposita.
- This report is based on information provided to me by Mariana Resources, Catalina Resources, previous independent reports, and personal observations in the field.
- I have no direct or indirect interest in Mariana Resources, Catalina Resources, or in the properties described in this report, or in any other properties in the region.
- I hearby grant permission for the use of this report in its full and unedited form in a Statement of Material Facts or for similar purpose. Written permission must be obtained from me before publication or distribution of any excerpt or summary.

Hedenquist Consulting, Inc.

Jeffrey W. Hedenquist

____

Jeffrey W. Hedenquist, Ph.D.
President

Date: January, 2011
Copiapo and Cariquima, Chile