Geophysical Research Abstracts, Vol. 8, 01173, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01173

Application of Spontaneous Potential profiles for exploration of gold-rich epithermal low sulfidation veins in a tropical region

A. Lobo-Guerrero S.

LOGEMIN S.A., Cll. 126ª No. 43-76, off. 309, Bogotá, Colombia (ageo@logemin.com/Tel: +57-1-6435364)

Introduction

Spontaneous Potential (S.P.) profiling was used to evaluate strike-slip duplex structures and locate gold-rich veins in extensional zones of a vein system in low mountain, humid environments of the Colombian Andes. Six days of total field work helped to model the deposit, and guided further exploration. Similar techniques may be applied to mesothermal shear zones and some epithermal base-metal deposits.

Spontaneous Potential

S.P. exploration techniques have been known for over a century, but are commonly underestimated in modern exploration activities. In the author's experience, S.P. profiling produces excellent results with small investment in equipment and qualified personnel. Natural oxidation-reduction processes generate small electrical potentials that can be measured and mapped. Oxidation of a mineral such as pyrite, transforms iron sulfide into iron oxide; that liberates electrons, which produce a negatively charged electrical current that is normally under one volt. To measure small currents on the ground one needs special electrodes that do not polarize as they are introduced in the soil.

Sulfide oxidation in sulfide-bearing fractures (hopefully carrying economic base or precious metals) generates small currents. Vein host rocks generally do not contain as high a concentration of oxidizing sulfides, and their S.P. values offer a strong contrast with zones of mineralized veins. S.P. methods take advantage of that contrast: zones with higher concentration of sulfides in oxidation produce negative potential anomalies that stand out well below the local base level. The presence of metals in the structures cannot be detected by measuring potentials. It must be defined by traditional geochemical means.

To measure S.P. profiles, one must begin by measuring the regional base level or “noise” produced by interaction of soil, organic material and active weathering. Zones with higher concentration of oxidizing sulfides produce negative potential anomalies that stand out well below the local base level. Measurements are recorded after one to two minutes, when the voltmeter reaches a stabilization plateau.

Exploration Site Generalized Geology

The project is located on the Colombian Central Cordillera, in a region of soft slopes covered by vegetation and thick, black organic soil, with 2500 mm of average rainfall per year. Welded tuff sequences and various pyroclastic deposits with sub-horizontal stratification outcrop sparsely (Fig. 1). Alligned quartz ridges intersect the volcanic rocks and contain incipient chalcedonic banding in multiple brecciation events, low metallic mineralization and some pyrite relicts. Further inspection to the south of the quartz ridges revealed milky quartz float cut by dark gray quartz veinlets, druzes and abundant goethite in some angular vugs (Fig. 1). Local people indicated the campsite of an old miner along a dry creek that runs SW of the quartz float (marked by star). Locals state that the miner spent several rainy seasons panning coarse gold, and found nuggets “3 cm wide”. Colluvial deposits a few meters thick cover most of the mapped area.

Exploration Procedure and Interpretation

Evidence indicated the presence of a gold mineralized system, but outcrops offered little information on where to focus further exploration. A few S.P. profiles helped to refine the geological model and identify exploration targets.

Profiles 1, 2 and 3 (Fig. 2) were obtained after the first two field work days. Complete results were compiled and processed at the end of each day and helped to program the next day’s activities. A potential anomaly produced by the quartz ridges was effectively proven. Several branches of the main structure were detected up slope and down slope from the goethite-rich quartz float.

Fig. 1. Exploration site generalized geology. Fig. 2. First round of S.P. profiles.

The next two field days produced four more infill profiles (4, 5, 6 and 7, Fig. 3). A set of structures that seemed to spread from the main allignment with the quartz ridges was progressively defined. Fig. 4 shows data obtained in Profiles 1 to 7. Dark dots are detected anomalies and thick gray lines are zones without anomalies; probable lineaments stand out when joining the dots. Profile 6 showed anomalies near the larger fragments of goethite-rich quartz float. Another set of aligned anomalies seemed to lie to the south. It could be due to a fault, another vein un-related to the first, or a strike-slip duplex. These possible alternatives required further investigation. The best way to test components of duplexes was to intersect them perpendicularly; the next set of profiles was planned with that in mind.

Two more days of work were used to produce profiles 8, 9, 10 and 11 (Fig. 5). Several sets of anomalies could be drawn based on the new profiles; they could be grouped in sets of two and three. Information from gray lines (Fig. 6) was valuable; it defined zones without anomalies. Data obtained from the profiles was drawn on Fig. 6, and structures were now easy to identify.

Exploration targets could be defined. A deformation strike-slip ellipsoid helped to better define extensional zones and locate potential mineralization sites. Coarse gold seemed to come from the five NW-SE-trending structures. Other structures seemed not to carry economic quantities of gold. Rich ore shoots seemed to occur at the intersection of corners of duplexes.

These hypotheses were tested by trenching and sampling. The complete structure, as finally defined was very similar to that of Fig. 6. Five mineralized veins, each 400 meters long were discovered. The project is currently under evaluation.

Conclusion

Spontaneous potential profiles served their purpose. Six days of total field work helped to define the structural model of the deposit, and guided further exploration. The development of the prospect no longer went blindfolded. Profile orientation was important; better results were obtained when profiles intersected potential mineralized structures at right angles.

Fig. 3. Second round of fill-in S.P. profiles. Fig. 4. Interpretation of the first two sets of profiles.

Fig. 5. Diagonal profiles to test connecting structures. Fig. 6. Final interpretation, S.P. profiles.