THREE-DAY SHORT COURSE ON A METALLOGENIC EXPLORATION MODEL FOR ECUADOR AND COLOMBIA

Geotarget Solutions Inc. (GTS Inc.) has developed a detailed metallogenic model for the following regions in Ecuador and Colombia:

ECUADOR	COLOMBIA
Western Cordillera	Western Cordillera
Eastern Cordillera	Central Cordillera
Sub-Andean Zone (Napo and Cutucu regions)	

The metallogenic model is an excellent resource of information for first order greenfields mineral exploration at the regional and local scale in Ecuador and Colombia. The model includes detailed predictions of i) the location, timing and nature (classification and metal inventory) of primary ore formation, and ii) the preservation potential of those ore deposits. An extensive geochronological, thermochronological, sedimentological, paleomagnetic and geochemical database has been combined with up-to-date field relationships and maps to derive a tectonic and metallogenic history of the cordilleras of Ecuador and Colombia during the Early Triassic – Late Miocene. This period saw the formation of porphyry, high-sulphidation, low-sulphidation, epithermal, metamorphic shear zone-type, exhalative-type, sedimentary hosted and placer deposits, all of which are incorporated into the metallogenic model. The database used to construct the model is extensive, and has been collected over a period of thirteen years by geologists who are recognized as international experts on the geology of the Northern Andes. GTS Inc. offers to deliver the metallogenic model to a potential customer on an **exclusive** basis, providing the client with an important first order exploration advantage. The metallogenic model will be offered as a three day short-course, the content of which is summarized in the following pages. The credentials of the GTS Inc. staff who worked on the metallogenic model can be viewed at www.geotargets.ca. Please contact Dr. Richard Spikings for further information (+41 76 580 6383; spikings@geotargets.ca).

A 3-day Short Course on the Tectonic History and Metallogenic Potential in Ecuador and Colombia.

Day 1. Data Presentation

An extensive quantitative database has been acquired from crystalline and sedimentary rocks of the cordilleras, foreland basins and flat forearc regions of Ecuador and Colombia, by staff members of GTS Inc., and other geological teams. A majority of those data are geochronological (igneous and metamorphic crystallization ages), thermochronological (time-Temperature/exhumation histories), geochemical (tectonic origin and process), sedimentological (e.g. provenance and depositional information) and paleomagnetic (paleogeographic information) in nature, and some are published in various national and international academic journals. Day 1 will be used to present a detailed compilation of the following data sets, along with tuition on how to determine which data is accurate, and importantly, which data can be used to understand the geology of the region and generate an exploration plan:

1. **Geochronological data** (U-Pb, $^{40}Ar/^{39}Ar$, Rb-Sr; *Ecuador and Colombia*).
2. **Geochemical data** (major oxides, trace elements, rare earth elements, Sr, Nd and Pb isotopic data; *Ecuador and Colombia*).
3. **Sedimentological data** (heavy mineral content, stratigraphic age, depositional environment; *Ecuador and Colombia*).
4. **Paleomagnetic data** (Inclination and declination data; *Ecuador and Colombia*).
5. **Thermochronological data** (U-Pb, $^{40}Ar/^{39}Ar$, fission track and (U-Th)/He; *Ecuador and Colombia*).

At the end of day 1, the participants will have been presented with i) a complete database of quantitative data that is available from the flat forearc regions, foreland basins, Western and Eastern cordilleras of Ecuador, and the Western and Central cordilleras of Colombia, ii) a detailed appreciation of how to filter that data, and be able to determine which is accurate and can be used to improve an exploration plan, and which data is not useful.

Day 2. The Tectonic and Metallogenic Model

The second day is divided into two sections:

i) *Construction of a **tectonic model** for Ecuador and Colombia*, by combining all of the quantitative data that is presented in day 1, with field relationships and maps. The model will identify specific terranes within the forearcs, foreland basins and cordilleras of Ecuador and Colombia, and will constrain the tectonic origin of those terranes. Established links between tectonic setting (e.g. magmatic arcs, sedimentary basins and zones of shearing and orogenesis) and mineralization style will be discussed, leading towards a predictive model for the location of ore formation in Ecuador and Colombia. All lines of reasoning will be discussed in detail, so the participants are tutored on how to interpret the various types of data to constrain the most likely tectonic origins of various rock sequences. Once the terranes and their tectonic origins have been established, we will proceed to show how and when those terranes were juxtaposed by collisional and extensional events. Finally, the model provides a detailed explanation of the post-collisional geological history of the rocks of Ecuador and Colombia, including the timing, location and magnitude of fault displacement, sedimentation patterns and the erosional history of the rocks of the cordilleras.

ii) *Construction of the **metallogenic model** for Ecuador and Colombia*, using the tectonic model (see point i, above) of those regions as a starting point. We will present, and explain how the metallogenic model of the forearcs, foreland basins and cordilleras of Ecuador and Colombia has been constructed. The model will be clearly presented using cross sections and maps, and will show the i) timing of formation, ii) type of mineralization, iii) metal inventory and iv) the preservation potential (e.g. has it been eroded away? How deep is it today? Has it been displaced by strike-slip faulting?). The model includes porphyry, high-sulphidation, low-sulphidation, epithermal, shear-zone hosted, exhalative-type, sedimentary-hosted and paleo-placer deposits, and predicts which rock units are the most prospective for any given type of deposit. The model will be tested against known metal occurrences in Ecuador and Colombia, as a quality control check on its accuracy.

At the end of day 2, the participants will have been presented with a state-of-the-art tectonic and metallogenic model for forearcs, foreland basins and cordilleras of Ecuador and Colombia, and they will have learnt how those models were constructed, in a pedagogic, step-wise manner, from raw data to final product.

Day 3. Application of the Metallogenic Model

The metallogenic model is tightly constrained by sophisticated quantitative data, and therefore the optimal and most efficient application of the model to an exploration plan requires the use of modern earth science methods. Day three is used to explain those methods, including i) which rocks to sample, ii) which analyses should be performed, iii) where particular analyses can be performed, iv) how to interpret the data, and v) how to apply the data and use the metallogenic model. Two examples are provided to explain the necessity of day three:

i) The metallogenic model precisely predicts the *timing* (to within ± 1 million years or less) of erosion of large porphyry deposits from the cordilleras of Ecuador and Colombia, and therefore the timing of their deposition as placer deposits in the bordering continental margin and foreland basins. Paleo-placer deposits are usually hosted in gravel-conglomerate beds, where fossil preservation is sparse to non-existent, rendering it problematic to identify the prospective strata. Consequently, the application of the model to paleo-placer exploration requires the use of geochronological methods to target the prospective strata. Various useful methods (e.g. laser ablation inductively coupled plasma mass spectrometry) that can determine the stratigraphic ages of sedimentary rocks will be explained, in detail.

ii) The metallogenic model shows that mineralized porphyry deposits were forming throughout the Eastern Cordillera of Ecuador, and the Central Cordillera of Colombia throughout the Tertiary period (during the previous 65 million years). However, the model also indicates that the amount of exhumation (erosion) along those cordilleras has been extremely variable, depending on location, during the Tertiary. Therefore, the preservation potential of Tertiary porphyry deposits is also

highly variable. Fortunately, the preservation potential of any given location within the cordillera can be determined by applying a thermochronological tool, which provides the exploration geologist with an accurate value of the amount of erosion that has occurred, since the porphyry deposit formed. A complete suit of geochronological and thermochronological methods will be presented on day three, providing the participants with the tools required to determine the preservation potential of any faulted block, within a concession.

At the end of the third day, the participants will have been tutored on various modern earth science methods that are required to incorporate the metallogenic model into an exploration plan, with numerous examples that are specific for Ecuador and Colombia.