6th International Symposium on Andean Geodynamics (ISAG 2005, Barcelona), Extended Abstracts: 752-755

New insights into the timing of gold systems in the Tertiary metallogenic belt of San Luis, Argentina

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KEYWORDS: Tertiary, Metallogeny, Gold, Hydrothermal Chronology, Illite dating

INTRODUCTION

The formation of epithermal gold-silver deposits and porphyry-type gold-copper deposits in the San Luis metallogenic belt (32° 45'-33° 14' S) is related to Late Miocene-Late Pliocene volcanic activity which took place immediately prior to, and during the final stages of the slab flattening between 27° and 33° S. The San Luis belt magmatism occurred in two discrete magmatic episodes. During the first Late Miocene (10/11-6.3 Ma) event, volcanic complexes erupted in the western part of the belt (La Carolina and Cañada Honda districts). During the second episode from Late Miocene to Late Pliocene (6.4-1.9 Ma), the volcanic activity became concentrated in the eastern part of the belt (Cerros del Rosario and El Morro districts).

New K-Ar ages from illite from different deposits and K-Ar ages of samples previously dated provide information on the timing of mineralization for La Carolina and Cañada Honda districts.

GEOLOGIC BACKGROUND

The San Luis Tertiary metallogenic belt is located in the Sierras Pampeanas of San Luis Province, Argentina, in the southeastern extreme of the Pampean flat-slab segment (Fig. 1A). The volcanic rocks and associated mineralization occur within a west-northwest-trending magmatic belt. Four main volcanic centers may be distinguished along the belt. These include La Carolina, Cañada Honda, Cerros del Rosario, and El Morro (Fig. 1B). Tertiary igneous rocks cropping out from La Carolina in the west to El Morro in the east are represented mainly by volcanic rocks such as andesites, dacites, latites and trachytes; only small outcrops of high-level stocks are exposed at the present level of erosion. On the whole, the Tertiary volcanic belt of andesitic to trachytic composition, comprises a maar-diatreme system later disturbed by dome emplacement at the La Carolina district; a stratovolcano with associated flows and volcaniclastic rocks, preceding the extrusion of domes at the Cañada Honda district; and domes and volcaniclastic deposits related to the development of calderas in Cerros del Rosario and El Morro districts (Urbina et al., 1997). Starting about 10 to 11 Ma, volcanism swept southeastward across 80 Km reaching the eastern end of the belt at about 6.4 Ma. The mesosilicic igneous rocks are classified as normal to high-K calc-alkaline and shoshonitic types and exhibit a K enrichment with decreasing ages. Geochemical features of these magmas such as LILE and LREE enrichments, Ti and Ta depletion, and Ba/La and La/Ta ratios higher than 20 and 25, respectively, indicate an arc-like signature consistent with rocks related to subduction environment worldwide (Urbina et al., 1997).

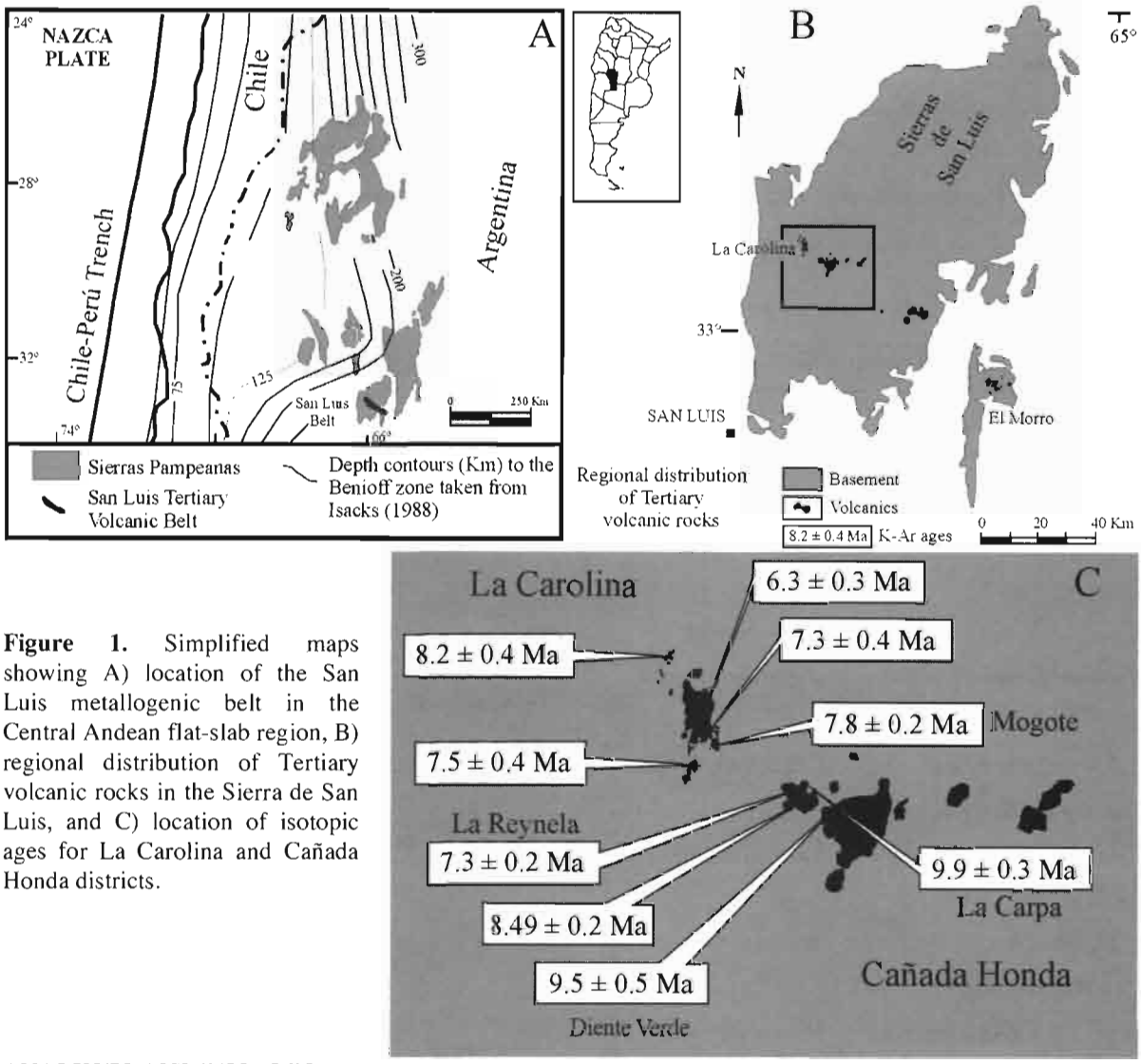

Figure 1. Simplified maps showing A) location of the San Luis metallogenic belt in the Central Andean flat-slab region, B) regional distribution of Tertiary volcanic rocks in the Sierra de San Luis, and C) location of isotopic ages for La Carolina and Cañada Honda districts.

ANALYSES AND RESULTS

The San Luis belt contains several mineral deposits and large hydrothermal alteration zones hosted by Tertiary volcanic rocks, high-level stocks which intruded them, and Precambrian to Paleozoic igneous metamorphic basement rocks. Mineralization styles present include epithermal sulfide-rich base-metal deposits, gold and gold-silver deposits of low-sulfidation type and porphyry-type gold-copper deposits. The two most important mineralized districts in the belt are La Carolina and Cañada Honda. Two new K-Ar ages were obtained for these districts. K-Ar determination for altered stock at La Carolina district has been made on illite. Likewise, an illite from hydrothermal alteration at La Carpa deposit, Cañada Honda district, was dated by the same method. The newly obtained ages together with previous K-Ar ages are presented in Table 1 with locations shown in Figure 1 C. At La Carolina, immediately next to Cerro Mogote, one illite sample was collected after fractional settling from altered high-level subvolcanic intrusion located in the southeastern sector of the district. Sericitic alteration is related to a multidirectional stockwork and disseminated mineralization of pyrite. The 7.8 ± 0.2 Ma age provided by illite confirms that the ore formation was related with the development of the maar-diatreme system and in general preceded the barren domes emplacement. The age of 7.3 Ma for altered latite from Cerro Pan de Azucar probably reflects the hydrothermal/mineralization event superposed on pre-existing

lithology, rather than the original age of the dome. Nevertheless, with the exception of the age obtained for the latest trachytic dyke (6.3 Ma), all ages from different sectors of the district are comparable. Thus, although the number of radiometric ages for La Carolina alteration-mineralization center is limited, it permits to estimate the hydrothermal system lifespan. The overlaps between the illite age and the ages for prealteration-mineralization dome at Tres Cerritos and later Cerro Tomolasta and Pan de Azucar domes, suggest that the hydrothermal system was probably short-lived and appear to be restricted in time to ~ 7.8 - 7 Ma.

Table 1. K-Ar data for samples from La Carolina and Cañada Honda districts, San Luis Metallogenic Belt

Sample n° and locality	Sample description	Material dated	K-Ar age	Reference
C 41, Tres Cerritos, La Carolina district	Andesite from the dome	Whole-rock	8.2 ± 0.4 Ma	Sruoga et al. (1996)
Mgte. 1, next Cerro Mogote, southeastern sector of La Carolina district	Hydrothermal alteration	Illite	7.8 ± 0.2 Ma	This report [1]
C 3, Cerro Tomolasta, La Carolina district	Latite from the dome	Sanidine	7.5 ± 0.4 Ma	Urbina et al. (1995)
C 4, Cerro Pan de Azucar, La Carolina district	Latite from the dome	Whole-rock	7.3 ± 0.4 Ma	Urbina et al. (1995)
C 46, latest dyke, La Carolina district	Trachyte from dyke	Sanidine	6.3 ± 0.3 Ma	Sruoga et al. (1996)
Lcpa. 1, La Carpa deposit, Cañada Honda district	Hydrothermal alteration	Illite	9.9 ± 0.3 Ma	This report [1]
DV5, Cerro Diente Verde, Cañada Honda district	Andesite from the wall of the volcanic edifice	Whole-rock	9.5 ± 0.5 Ma	Urbina et al. (1995)
CVM7, Cerro del Valle, Cañada Honda district	Andesite from the dome	Whole-rock	8.49 ± 0.2 Ma	Urbina and Oggier (2001)
LR 1-4, La Reynela deposit, Cañada Honda district	Hydrothermal alteration	Illite	7.3 ± 0.2 Ma	Urbina and Oggier (2001)

[1] K-Ar dating was done in the Activation Laboratories Ltd., Ontario, Canada (Actlabs). The K-Ar concentration was performed by ICP. The argon analysis was performed using isotope dilution procedure on noble gas mass spectrometer.

A different situation is present in Cañada Honda district, where an age of 9.9 ± 0.3 Ma was provided by illite accompanying the mineralization at La Carpa epithermal vein located 800 m northwestward from Diente Verde. The 9.9 Ma age of La Carpa deposit confirms that Cañada Honda is the oldest volcanic field in the belt and, taking into account that hydrothermal activity occurs about 0.5 Ma after the initiation of volcanism in the migrating volcanic centers elsewhere (Hedenquist et al., 1996), it further suggests that volcanic activity in the

Sierras Pampeanas of San Luis began, at least, at 10 to 11 Ma. Previous illite K-Ar dating at La Reynela epithermal vein which cuts Cerro del Valle dome (8.49 Ma) yielded an age of 7.3 Ma. Therefore, the ages from La Reynela and La Carpa veins indicate that hydrothermal activity at Cañada Honda district range from 9.9 to 7.3 Ma. An intrusion centered district was suggested by Urbina et al. (1997) for Cañada Honda based on spatial distribution of different mineralizations with regard to the high-level porphyry subvolcanic intrusion at Diente Verde. The age of Diente Verde deposit remains unknown since neither mineralization nor host stock have been yet dated, but the age of the deposit formation could be interpreted to be close to those of the walls of Diente Verde volcanic edifice (9.5 Ma) and La Carpa vein (9.9 Ma). Therefore, temporal and genetic linkage between La Reynela, La Carpa and Diente Verde deposits may be reasonably inferred. At the same time, the maximum that has been suggested for major magmatic hydrothermal systems is 2-m.y. (Silberman, 1985), then the 2.6 Ma period of time between La Carpa and La Reynela formation could reflect different hydrothermal pulses at the Cañada Honda district. On the other hand, the overlapping ages of Cañada Honda and La Carolina mineralizations indicate that the hydrothermal systems were simultaneously active at both districts. The latest emplacement of a trachytic dyke in La Carolina district at 6.3 Ma is coeval with Sierra del Morro pre-caldera andesite (6.4 Ma). Therefore, the volcanic activity at La Carolina and Cañada Honda districts ceased when the eruptions began in the eastern side of the belt, where the ages of volcanism range from 6.4 to 1.9 Ma (Ramos et al., 1991). Although metal deposits are lacking in the eastern part of the belt, carbonate epithermal deposits as well as large hydrothermal alteration zones are considered to be related with this second volcanic event.

In summary, two magmatic episodes and associated periods of mineralization accompanying the W to E migration of the volcanic front can be distinguished in the San Luis metallogenic belt. During the first Late Miocene event (10/11-6.3 Ma), volcanic complexes and associated mineralization were formed in the western part of the belt, where the hydrothermal activity range from 9.9 to 7.3 Ma. Throughout this 2.6 Ma period, the mineralizations appear to have been formed by superposed hydrothermal pulses. Hydrothermal overprinting would be an important factor in the formation of major deposits and is thought to enhance the exploration potential at La Carolina and Cañada Honda districts.

References

Isacks B. L. 1988. Uplift of the central Andean plateau and bending of the Bolivian Orocline. Journal of Geophysical Research, 93, 3211-3231.

Hedenquist, J.W., Izawa, E., Arribas, A., and White, N.C., 1996. Epithermal gold deposits: Styles, characteristics, and exploration: Society of Resource Geology of Japan, Special Publication Number 1, 16 p.

Ramos V., Munizaga F. and Kay S. M. 1991. El magmatismo Cenozoico a los 33 ° S de Latitud: Geocronología y Relaciones Tectónicas. 6 ° Congreso Geológico Chileno, 892-896.

Silberman, M. L., 1985. Geochronology of hydrothermal alteration and mineralization: Tertiary hydrothermal precious-metal deposits in the Great Basin. U. S. Geol. Survey Bull. 1646, 55-70.

Sruoga P., Urbina N. and Malvicini L. 1996. El Volcanismo Terciario y los depósitos hidrotermales (Au, Cu) asociados en La Carolina y Diente Verde, San Luis, Argentina. XIII Congreso Geológico Argentino, 3, 89-100.

Urbina N. and Oggier F. P. 2001. New K-Ar ages of volcanic rocks and associated mineralization in Cañada Honda district, San Luis, Argentina. III South American Symposium On Isotope Geology Volume (CD-ROM), Sociedad Geológica de Chile, Santiago, Chile: 539-542.

Urbina N., Sruoga P. and Malvicini L. 1995. El volcanismo Mioceno y la mineralización aurífera asociada en La Carolina y Diente Verde, provincia de San Luis, Argentina. IX Congreso Latinoamericano de Geología, Caracas, Venezuela (CD-ROM) TE M5-252, 1-13.

Urbina N., Sruoga P. and Malvicini L. 1997. Late Tertiary Gold-Bearing Volcanic Belt in the Sierras Pampeanas of San Luis, Argentina. International Geology Review, 39, 4, 287-306.