Report on the XXVI Curso Latinoamericano de Metalogenia UNESCO-SEG-SGA Universidad Nacional Autónoma de México (UNAM), Instituto de Geofísica, Ciudad de México (México), 25 June–7 July 2007

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The 2007 edition of the UNESCO-SEG-SGA Metallogeny course was held in Mexico City from 26 June to 7 July. For the first time since its establishment, the course was hosted by a Central Latin American country, at the prestigious Universidad Nacional Autónoma de Mexico (UNAM), recently proclaimed by UNESCO as cultural patrimony of the humanity. The course attracted 75 participants from 8 countries of Latin America (Chile, Argentina, Mexico, Peru, Brazil, Cuba, Ecuador, Colombia) from both the industry and the academy (Figure 1), thus becoming the largest ever edition of this course for number of participants. Of the 75 participants 17 were granted a scholarship thanks to the generous support of KFPE, SGA, SEG and UNESCO. The fellowship awardees gave a 15 minutes presentation about their current works and/or research, the quality of which was very good.

Following the well established philosophy of this course, fellowships were attributed to young graduates who have recently started to work in the mining industry or geological surveys (10 awardees) or who are finishing Masters or undertaking PhD studies (7 awardees) (Figure 1). Among the full paying participants the great majority consisted of representatives of the mining or geothermal industry (50 versus only 8 people from a pure academic environment: Figure 1). This shows that the course raises the interest of mining companies who are sending their geologists to the course for formational purposes.

As usual the Course was split into two parts: a theory part, which ran between 25 and 30 June, and a field part, which ran from 1 to 7 July. The theory part of the course was based on lectures given, both in Spanish and in English, by several international and Mexican instructors (Figure 2). The main theme of this year was "Active and fossil hydrothermal systems and associated mineralization" and featured instructors, expert in this field, coming from New Zealand (S. Simmons and P. Browne) who gave general introduction lectures about the geochemistry of the fluids and the mineralogy involved in active and fossil hydrothermal systems. M. Chiaradia (Geneva, Switzerland) gave a general introduction on the geodynamic setting and the chemistry of the magmas associated with these hydrothermal systems, whereas L. Fontboté (Geneva, Switzerland), V. Valencia and C. Canet presented general features of various types of fossil mineralization associated with hydrothermal systems, including carbonate-hosted cordilleran type deposits, iron oxide-copper gold deposits (IOCG), porphyry copper deposits and massive sul-

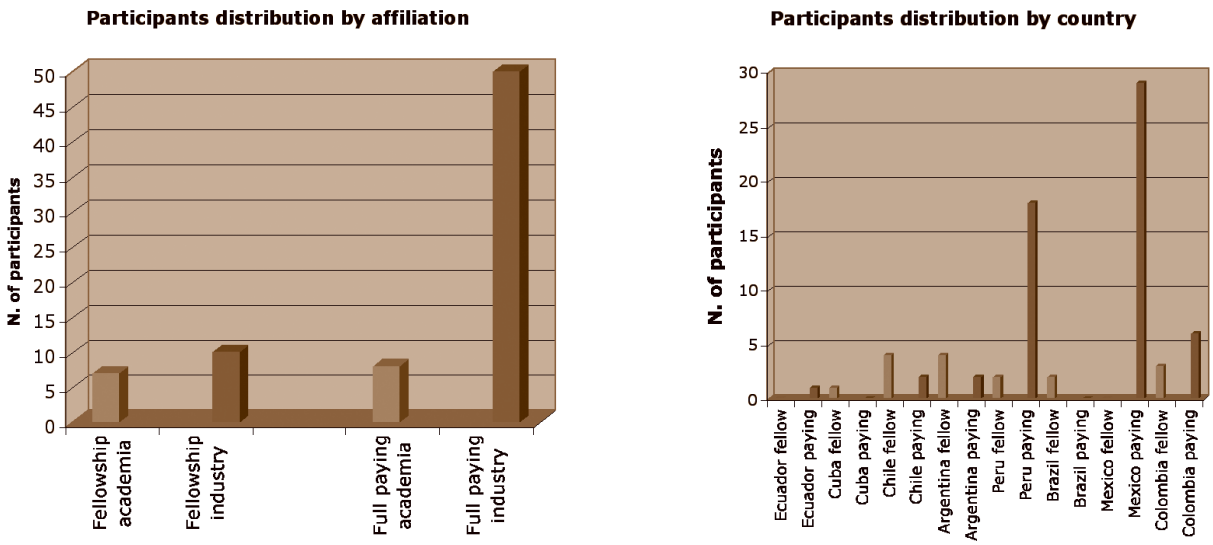

Figure 1: left: frequency histogram of the participants' distribution by affiliation to the industry or academia; right: frequency histogram of the participants' distribution by affiliation to country.

fide deposits. Various Mexican instructors (including A. Camprubí and E. González-Partida) presented general geological and metallogenic features of Mexico as well as description of various mineral deposits, also as part of preparation to the field trip. A lecture on remote sensing, given by R.-M. Prol-ledesma, and its applications to ore deposit exploration was also part of the menu. This year edition featured for the first time in the history of this course workshops in which the participants could become acquainted with laboratory tools useful for the study of hydrothermal systems. There were workshops on fluid inclusions and on geochemical modeling using thermodynamic softwares.

The field trip started on Sunday 1 July with a journey of about 350 km to the northwest of Mexico City to visit the Ag and Au mining district of Guanajuato (Figure 3). Guanajuato is a world-class mining district with estimates of historical production ranging up to 1,500 million ounces of silver and 7 million ounces of gold. The three principal mines (Valenciana, Cata and Rayas) are owned by Great Panther and occupy the heart of the 25 kilometre long Veta Madre (Mother Lode) structure that controls the majority of the silver-gold mineralization in the Guanajuato District (Silver Users Association, Washington Report, 2005). Silver was discovered in the area in 1548 and historic production for the district is estimated at 1.12 billion ounces of silver and 5.63 million ounces of gold. Low sulfidation epithermal silver-gold mineralization is found in quartz veins and large stockwork bodies within the Veta Madre structure, which can reach widths of 30 metres or more and locally exceed 100 metres in length. The mineralization is accompanied by spectacular boiling textures expressed by very large bladed calcite crystals (Figure 4). In some parts of the deposit, copper mineralization occurs in sufficient quantities to be recovered as a byproduct. During the visit to the mining district of Guanjuato we had an introductory lecture about the geology of the district, we visited the Museum of Mineralogy with a collection of some of the most beautiful mineral samples from the mining district (in particular the spectacular samples of a variety of adularia, called valencianite from the Valenciana mine, and bladed calcite), we could study the mineralization textures and alteration on outcrops, and entered a mine tunnel used for exploitation of a mineralized vein (Figure 5).

From Guanajuato we moved a few hundreds of kilometers southward to visit the active geothermal field of Los Azufres (Figure 3), one of several Pleistocene silicic volcanic centres with active geothermal systems in the Mexican Volcanic Belt. With an electricity production of 98 MW, it represents the second most important geothermal field in Mexico (Torres-Alvarado, 2000). Two main geologic units can be recognized at Los Azufres: (1) a silicic sequence of rhyodacites, rhyolites and dacites with ages between 1.0 and 0.15 m.y. and a thickness up to 1000 m (Dobson and Mahood, 1985); (2) a 2700 m thick interstratification of lava flows and pyroclastic rocks, of andesitic to basaltic composition, with ages between 18 and 1 m.y., forming the local basement. This unit provides the main aquifer with fluid flow through fractures and faults, sometimes reaching the surface. Three different fault systems, which confer secondary permeability to the geological units, can be distinguished in the field (Torres-Alvarado, 2000): NE-SW, E-W and N-S. The E-W system is the most important one for geothermal fluid circulation. Geothermal manifestations (fumaroles, solfataras, and mudpits), geophysical anomalies and important energy production zones are related to this fault system. Hydrothermal alteration has affected most rocks in the geothermal field to varying extent. The most important alteration assemblages with increasing depth are: argillitization/silicification, zeolite/calcite formation, sericitization/chloritization, and chloritization/epidotization (Torres-Alvarado, 2000).

During the visit to Los Azufres we received introductory explanations about the geothermal plant as well as the geology of the system and then we visited different working geothermal plants andsome surface manifestation of the geothermal system (Figure 6).

The last visit was to the Au-skarn deposit of Nukay. The Nukay district (property of Luismin) is hosted by upper Cretaceous carbonate platform rocks of the northern Sierra Madre del Sur of central Guerrero state. Mineralization is centered on two early Tertiary granodioritic stocks that are part of a NW-trending porphyry belt (~65-62 Ma) that extends across central Guerrero and is associated with variable but regionally persistent Au-Cu mineralization (Jones, 2003). Mineralization at Nukay lies along the margins of two porphyritic granodio-

Figure 2: International and local instructors of the 2007 edition of the course. From left to right: L. Fontboté (Geneva, Switzerland), S. Simmons (Auckland, New Zealand), V. Valencia (Tucson, USA), P. Browne (Auckland, New Zealand). A. Camprubi (Mexico City, Mexico), M. Chiaradia (Geneva, Switzerland).

Figure 3: Sites visited during the field trip.

rite-tonalite intrusions, termed the 'West' and 'East' stocks. Field evidence and 40Ar/39Ar ages indicate that the East stock was emplaced first (~64.99-64.67 Ma) (Jones, 2003). The West stock was subsequently emplaced as a relatively simple steep-sided pluton (~64.17-63.39 Ma). Gold mineralization occurs both in Fe-Au skarns developed along the margins of the stocks and disseminated within the hydrothermal potassic (orthoclase, scapolite, antigorite) alteration area of the intrusives (Levresse et al., 2004). The mineralization consists of pervasive botryoidal and massive hematite with disseminated gold (De la Garza et al. 1996). During the visit we were first instructed about the geology of the district and later we examined mineralized drill-cores, geological maps and we visited the open pit actively mined (Figure 7). On Saturday 7 July we made return to Mexico City.

Overall the course was a great success, both for the high number of participants (the highest so far for this course) and the vivid interest that the participants showed both during the theoretical part of the course and in the field. This was also a great opportunity to advertise SGA in Latin America and 15 participants applied for membership in this occasion.

The 2008 edition of the course will take place in Bolivia and I would like to wish it a successful outcome as it was the case for this Mexico edition.

References

De la Garza, V., Téllez, R., Díaz, R., Hernández, A. (1996) Geology of the Bermejal iron-gold deposit Mezcala, Guerrero, México. In: Coyner AR, Fahey PL (eds) Geology and ore deposits of the American Cordillera. Geol Soc Nevada Symp Proc, Reno/ Sparks, Nevada, April 1995, 111:1354–1368.

Dobson, P. F. and Mahood, G. A. (1985) Volcanic stratigraphy of the Los Azufres Geothermal Area, Mexico. Journal of Volcanology and Geothermal Research 25, 273-287.

Jones, D. M. (2003) Tectonic, petrologic, and hydrothermal dynamics of gold mineralization in the Nukay district of Guerrero, Mexico. Abstract GSA Meeting 2003, Paper No. 24-8.

Levresse, G., González-Partida, E., Carrillo-Chavez, A., Tritlla, J., Camprubí, A., Cheilletz, A., Gasquet, D., Deloule, E. (2004) Petrology, U/Pb dating and (C-O) stable isotope constraints on the source and evolution of the adakite-related Mezcala Fe-Au skarn district, Guerrero, Mexico. Mineralium Deposita 39: 301–312.

Silver Users Association, Washington Report (2005) Volume 2, Issue 10 October 31, 2005, p. 6-7.

Torres-Alvarado, I. S. (2000) Mineral Chemistry of hydrothermal silicates in Los Azufres geothermal field, Mexico. Proceedings World Geothermal Congress 2000, Kyushu - Tohoku, Japan, May 28 - June 10, 2000.

Figure 4: Spectacular bladed calcite from the Guanajuato district.

Figure 5: A group of participants to the field trip about to enter a tunnel of a mine in the Guanajuato district.

Figure 6: Some of the participants under a torrential rain, standing before a fumarole of the Los Azufres geothermal field.

Figure 7: Open pit of the Nukay Fe-Au-skarn mine.