

Late timing for high sulfidation cordilleran base metal lode and replacement deposits in porphyry-related districts: the case of Colquijirca, central Peru*

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Introduction

"Cordilleran base metal lode" deposits (Einaudi, 1977 and 1982) or "cordilleran veins" (Sawkins, 1972) depicted as parts of the upper construct of porphyry copper systems, have the following main characteristics (e.g., Einaudi, 1982): (i) high sulfidation state of the mineral assemblage with associated advanced argillic to sericitic alteration, (ii) strong zoning from Cu cores to external Zn-Pb(Ag) ores, (iii) massive texture and sulfide content of up to more than 50% in volume, considerably

higher than in other porphyry-related ore type, and (iv) basically a common suite of enriched metals, that is, Cu-Zn-Pb±(Ag-Au).

*Expanded version of the contribution presented at the SEG meeting "Global exploration 2002: Integrated methods for discovery", Denver April 2002 (Bendezi and Fontboté, 2002).

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IMPORTANT NOTICE

New address for the SGA homepage on Internet

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News on Mineralium Deposita

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We are pleased to announce that several changes are being made to *Mineralium Deposita*. These changes include:

Volume increase to 1000 pages per year

In order to maintain a relatively short time between acceptance of an article and final publication in *Mineralium Deposita*, Springer-Verlag and SGA Council agreed to increase the number of printed pages per year from 800 to 1000 pages. This change reflects the continued increase in the number of manuscripts submitted to *Mineralium Deposita* for possible publication. We now receive about 100 papers per year, of which about one third are accepted for publication. Each year we also publish one to three thematic issues that contain invited papers.

The current backlog of papers waiting to be printed is about eight months. These papers are available electronically and accessible via the Springer online service.

Color plates

Springer announced a new policy and pricing schedule for color plates. A flat rate of 485 EUR (approximately 440 USD) is now charged per article for as many color illustrations as necessary. Members of SGA can request that the charge for color plates be waived. However, the decision to waive these charges resides with the Chief Editors. It should be noted that only one article per issue can have free color illustrations.

Subsidized journal subscriptions

SGA Council will grant a limited number of free subscriptions of *Mineralium Deposita* to institutions and, under special circumstances, to individuals in an economically challenged position. The grant period is for two years. The informal written request for such free subscriptions should be addressed to the Executive Secretary (Dr. Jan Pasava, Czech Geological Survey, Klárov, 11800 Prague 1, Czech Republic) outlining the need for the free subscription and how the journal will be used. This letter must include the names of two SGA members who are willing to support this request.

Springer online

All journal subscribers have access to the Springer online system on which you can read all issues of *Mineralium Deposita* printed since 1997, plus the *Electronic supplementary material*, and the electronically published manuscripts currently in print. Access requires registration with the Springer LINK system at <<http://link.springer.de/helpdesk/helporder.htm>> using your subscription number which is written on the mailing label of the Journal. The subscription number consists of seven digits, a slash, followed by two digits, such as 0123456/05. If the first number has less than seven digits, add the corresponding number of zeros in front. You will receive a personal access code and password by e-mail within two days.

Missing issues/address change

Address changes and all inquiries regarding problems with the delivery of *Mineralium Deposita* should be addressed to <sga@mineral.tu-freiberg.de> with a copy to <tiks@springer.de>.

Bernd Lehmann/Rich Goldfarb ♦

SGA News

N.° 13 June 2002

Editor

Massimo Chiaradia

Département de Minéralogie, Université de Genève, Rue des Maraîchers 13, CH-1211 Genève 4 SWITZERLAND

Collaborators

J. Berthoud

SGA News is a publication of SGA (Society of Geology Applied to Mineral Deposits) and appears twice a year. SGA News can be also read in the SGA homepage on Internet:

<http://www.min.tu-clausthal.de/sga.html> maintained by Bernd Lehmann and Jan Heinrich, Institut für Mineralogie, TU Clausthal, Adolph-Roemer str. 2a, D-38678 Clausthal-Zellerfeld; Fax: +49 5423 72 2321; e-mail: heinrich@imr.tu-clausthal.de

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Information for contributors

Items for publication may be sent to: SGA News (see address below). Manuscripts should be sent in computer diskette in Macintosh or DOS formats using Microsoft Word or WordPerfect. Please always send a paper copy and indicate the format you are using.

Deadline for SGA News

N.° 14:

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SGA News - Mailbox:

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NEWS OF THE SOCIETY

News of the Council

Report of the President

P. Fenoll Hach-Alf reported on the period from January 1, 2002 (when she became the SGA President) to April 27, 2002. She welcomed all newly elected officers and thanked officers whose term expired at the end of 2001.

Report of the Treasurer

The SEG Treasurer apologies for any inconvenience which has resulted from problems with the former SEG Treasurer's secretary. As of May 1, Sabine Lange, M.Sc., has replaced Dr. Judith Vogtmann in the Treasurer's Office.

In order to improve the process of membership to SGA, the Treasurer's Office, in agreement with the Council, has designed some new strategies. The Treasurer's Office will inform all new applicants, either through e-mail or fax, when the application process has been completed. Springer-Verlag will assign an ID number to the new member for electronic access to MD, and will begin sending MD.

The SGA Treasurer's Office will also check the possibility of paying membership fees through INTERNET with a printout of receipt (or email which confirms payment).

Report of the Chief Editors, MD

R. Goldfarb will retire from his position with the end of 2002. The Council approved that Larry Meinert from the Washington State University, who joined the Editorial Board in 2001, will replace him. The Editors will discuss positions on the Editorial Board with suitable candidates (9 vacancies for 2003) and will inform the Council on the status of these negotiations at the next Council Meeting. The Council approved an increase of the number of pages of MD from 800 to 1000 effective from 2003.

Report of the SGA Promotion Manager

G. Borg presented new developments for the public promotion of SGA.

SGA Student Chapters

The SGA Council is open to Student Members to form Student Chapters. The Council approved the creation of a joint Prague-Freiberg SGA Student Chapter. Participation in SGA Student

Chapter activities does not necessarily entitle the member to SGA Student fees.

Proposal for creation of SGA Awards

The Council approved the creation of the SGA Young Scientist Award. The award will be given biannually to a young scientist for research in economic geology published before his 35th birthday. The award consists of a citation, 1500 EURO and travel to the Biennial meeting for the presentation.

Sponsoring of SGA membership in less economically developed countries

The Council approved a special subsidized subscription program for institutions, and under special circumstances, also for individuals in an economically challenged situation.

7th SGA Biennial Meeting

The progress report was given by D. Eliopoulos. The 7th Biennial SGA Meeting "Mineral Exploration and Sustainable Development" will be organized by Society for Geology Applied to Mineral Deposits in Athens (Greece), August 24-28, 2003. The meeting will be co-organized by the Institute of Geology and Mineral Exploration, Athens Technical University, Geological Society of Greece, Society of Economic Geologists and others.

SGA NEWS MAILBOX

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*We expect your letters with comments, news,
criticisms, ...*

CHANGE OF ADDRESS FORM

If you have changed (or will change in the near future) your address please fill in this form and send it to:

Peter M. Herzig, SGA Treasurer - Institut für Mineralogie, TU Bergakademie Freiberg, Brennhausgasse 14 - D-09596 Freiberg, Germany; phone: +49 3731 39-2662/2626; fax: +49 3731 39-2610; e-mail: herzig@mineral.tu-freiberg.de

Name:

Old address:

Complete new address (including phone, fax and e-mail)

!!! IMPORTANT NOTICE !!!

Applications to SGA for meeting sponsorship have to be submitted to Jan Pasava, SGA Executive Secretary, on appropriate forms developed and approved by the SGA Council which are available at the SGA home page on Internet:

<http://www.min.tu-clausthal.de/sga.html>

Other requests will be not considered.

The SGA Council thanked D. Eliopoulos for the excellent organization of both the SGA Executive Committee and Ordinary Council Meetings in Athens and the great hospitality provided by IGME. A personal welcome by Director General, IGME, and Head, Mineral Deposit Department, were highly appreciated. The Council approved that D. Leach will act as a technical liaison within the Organizing Committee. The registration fees for the congress have been fixed as follows:

registration	early	late
Member SGA/SEG	EUR 250	EUR 350
Non-member	EUR 350	EUR 450
Student member SGA/SEG	EUR 100	EUR 150
Student non-member	EUR 150	EUR 200

The second circular will be sent to only those people who responded to the 1st call or will make a request for a copy.

Status of SGA-SEG collaboration

The Council approved the organization of the SGA module-session on "Cutting edge advancements in economic geology" for the 2004 SEG meeting in Perth, Australia (already approved by SEG Council).

Status of SGA-IAGOD collaboration

The Council approved that SGA should take a larger role in the organization of the 12th IAGOD Quadrennial Meeting (St. Petersburg – August 2006) and recommended to discuss more on SGA-IAGOD collaboration during a possible joint IAGOD-SGA Council meeting in Windhoek, Namibia.

Meeting sponsorship

The Council approved the following requests for meeting sponsorship by SGA:

- 4th Fennoscandian Exploration and Mining (FEM), December 3-5, 2003, Rovaniemi, Finland. H. Papunen will act as SGA keynote speaker.
- 12th IAGOD Quadrennial Symposium, August 2006, St. Petersburg, Russia.
- 16th Australian Geological Convention, June 30 -July 5, 2002, Adelaide, Australia.
- World class mineral deposits and earth evolution, August 19-21 2003, Cardiff, UK. Ch. Heinrich will act as SGA keynote speaker.

Various

J. Cabello (Regional Vice-President for South America) will launch a promotion campaign of economic geology in South America.

Jingwen Mao offered to organize the next SGA Biennial Meeting (2005) in Beijing (China).

Your suggestions and ideas for any topic of interest to SGA are welcome! They can be addressed to any Council member or to

Dr. Jan Pasava
SGA Executive Secretary

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CZECH REPUBLIC

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SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS**SGA COUNCIL 2002****Executive Committee**

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SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS

Report of the Executive Secretary about membership

42 Regular Members, 44 Student Members, 1 Senior Member and 2 Corporate Members applied for membership from August 23, 2001 to April 24, 2002

LIST OF NEW SGA MEMBERS
(August 23, 2001-April 24, 2002)

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Pierrette TREMBLAY, St-Rédempteur, Quebec, CANADA
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Yi-Tian WANG, Institute of Mineral Resources, Beijing, P.R. CHINA
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Friedrich SPEIDEL, Lima, PERU
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Michael BUXTON, Johannesburg, Marshalltown 2107, SOUTH AFRICA
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Zbigniew SAWLOWICZ, Krakow, POLAND
Bernhard DOLD, Université de Lausanne, Lausanne, SWITZERLAND
Jean VALLANCE, Université de Genève, Genève, SWITZERLAND
Howard DAVIES, Spital, Wirral, Merseyside, U.K.
Kip JEFFREY, University of Leicester, Leicester, U.K.
Charles MOON, University of Leicester, Leicester, U.K.
Cameron ALLEN, Cominco American Inc., Spokane, WA, U.S.A.
William W. ATKINSON, Jr., University of Colorado, Boulder, U.S.A.
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Jeff DOEBRICH, USGS, Reno, NV, U.S.A.
Lawrence DREW, Reston VA, U.S.A.
Brian HOAL, Society of Economic Geologists, Littleton, CO, U.S.A.

Erik MELCHIORRE, DePauw University, Greencastle, IN, U.S.A.

Student Members

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Sebastian GONZALEZ CHIOZZA, FCEN-UBA, Pabellon, ARGENTINA
Pilar MOREIRA, La Plata BS AS, ARGENTINA
Karina MYKIETIUK, La Plata, Buenos Aires, ARGENTINA
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Please send a letter of justification for the need and specify how the journal will be used. The written request including contact details of two SGA members supporting this request should be sent to the SGA Executive Secretary, Czech Geological Survey, Klárov 131/3, 118 21 Praha 1, Czech Republic, EUROPE.



Report on SGA Booth at the SEG 2002 Meeting

The SGA was extremely visible and active at the international SEG 2002 Global Exploration Conference in Denver this April. SGA was a co-sponsor of this highly successful meeting that included more than 750 attendees from dozens of countries.

Among the more noteworthy presentations at the meeting, was an outstanding overview of recent developments regarding the exceptional and still controversial Witwatersrand goldfields by Hartwig Frimmel, the SGA distinguished lecturer for this meeting. The SGA certainly appreciated the effort by Hartwig, who flew from Cape Town to Denver to deliver this important talk just 24 hours after becoming a new father and we congratulate Hartwig on both successes.

The SGA also had a highly visible exhibit booth that highlighted to many attendees the benefits of joining the society. Important activities, including the biennial meetings, were highlighted and there was extreme interest in many recent issues of *Mineralium Deposita*, particularly the thematic issues on China, Brazil, alkalic gold, and intrusion-related gold. As a result, almost 50 new members joined the society at this one meeting. (Actually, it would have been exactly 50, but Neil Phillips gave us a wrong credit card type, so if you read this Neil, we need you to try again!). There was also a great deal of interest in the upcoming 2003 SGA meeting in Athens from old and new SGA members alike, and it clearly seems like we can look forward to a well-attended meeting next year. The booth also continually served as a meeting place for many SGA members from around the globe and for dissemination of information regarding the latest society and journal news. We were helped out with the running of the SGA booth over the three days by Craig Hart, Erin Marsh, David Leach, Ken Puchnik, Craig McClung, and Cameron Rombach. In summary, we all agreed that this was indeed a very beneficial venue for SGA's presence and perhaps our most successful membership registration activity to date.

Eric Anderson
Rich Goldfarb



New databases on European Metallogeny A GEODE initiative

Derek Blundell, Chair, GEODE Steering Committee (e-mail: d.blundell@gl.rhul.ac.uk)

Want to find information about one of the largest ore deposits in Europe, quickly and easily? Then go to the GEODE database web-site <http://www.gl.rhul.ac.uk/geode/register.html> and consult its new ore deposit database LODE (Largest Ore Deposits in Europe). Here you will find reports on each of 58 ore deposits or districts that describe the geology, mineralogy and ore deposit type, together with metal contents and economic information, supported by a short bibliography. Many of the reports contain illustrations (photographs, maps, cross-sections).

The database is on open access and the individual ore deposit reports are accessed via a basemap of Europe showing the locations of all the ore deposits or via a list of ore deposits relating to one of the five main projects undertaken by GEODE: the Alpine-Balkan-Carpathian-Dinaride belt (ABCD), basin-hosted deposits, Fennoscandian and Ukrainian Shield, SW Variscides and Uralides.

LODE was put together to underpin the research activities of GEODE but we hope that it will be of much wider use, since it is

the first time that basic information on the largest ore deposits of Europe has been assembled in an easily accessible way. The format for the reports is based on a GIS developed at BRGM (French Geological Survey) that has been used to compile detailed information about metallogenic provinces in various parts of the world. The main compilation of LODE was undertaken by Miss Leena Rajavuori during a month-long visit to BRGM in Orléans, supervised by Dr. Jean-Pierre Milesi and his colleagues. LODE uses the terminology of the BRGM lexicon and the BRGM classification scheme so that the ore deposits and economic information are described in a systematic and universal manner. We are extremely grateful to BRGM for all their help. Additionally for GEODE, BRGM is currently developing a more detailed GIS database of all the mineral occurrences of central Europe, which will not only underpin research in the ABCD project but will also provide a database of real potential in exploration.

Having established the five main projects three years ago, GEODE researchers have been collaborating in a number of well-focused, multidisciplinary, multinational research projects across Europe. Their efforts are beginning to come to fruition and already groups of related papers have been submitted for publication in *Mineralium Deposita*, *Economic Geology* and a volume in the Geological Society Special Publications series. More are to follow. With all this research activity, GEODE

needed to build a database of people and research institutions working in relevant areas, so the GEODE database website includes a second database, called RESOURCES. This is subdivided into two interlinked files set up on Filemaker Pro 5 (© Filemaker Inc.) called "people" and "institutions". The "people" file holds a set of records about individuals giving address, e-mail and phone number, their area of expertise, research interests, collaboration and a list of recent publications. The "institutions" file includes an internet site, a list of research facilities and a list of the people in the institution who are included in the "people" file. The RESOURCES database can be viewed interactively so that, for example, you can search for everyone working on a particular ore deposit or for every institution that has facilities for fluid inclusion analysis. Because of its interactive nature, the RESOURCES database is not on open access but is password protected. However, if you have *bona fide* reasons for gaining access you can do so easily by contacting me by e-mail and I will give you a password. Of course, I may try to persuade you to allow me to include you in the database! At present, 89 people from 46 institutions are listed and we still have a long way to go to complete the database. But we hope that it is already sufficient to be of real value in finding out who is doing what and where, and how to contact them.

7th Annual European Short Course on Metallogeny

L'Aber W'rach, Brest, France, October 1st to 5th 2001

The most recent edition of the European short course on metallogeny took place from October 1st to 5th 2001. Speakers and students were welcomed *à la Breton* by course organizers Thierry Juteau (UBO), Yves Fouquet (IFREMER), Nick Arndt (University of Grenoble) and Steve Scott (University of Toronto/UBO). The course attracts an increasingly international range of participants and this year was no exception. Delegates arrived from Portugal, France, Germany, United States, United Kingdom, Canada, Russia, Morocco and Mexico. Talks were held at the *Centre de la mer* in the picturesque coastal town of L'Aber W'rach (Landeda) near Brest, France.

Course instructors included: Yves Fouquet (IFREMER), Steven D. Scott (Univ. Toronto/UBO), Thierry Juteau (UBO/IUEM), Roger Hekinian (Kiel University), Mary Ohnenstetter (CRPG), Harold Gibson (Laurentian Univ.), Kim Juniper (UQUAM), David Leach (USGS Denver), Eric Marcoux (Univ. Orleans), Fernando Barriga (Univ. Lisbon) and Christian Mustion (CRPG). The course was separated into two main portions. Firstly, two days were dedicated to ancient ore deposits and ore depositional processes. Secondly, the last two days focused on modern seafloor processes from hydrothermalism to biomineralization. Laboratory sessions took place each day after the talks. Samples from various worldwide ore deposits (ancient and modern) were put on display as hand samples and thin sections. These sessions also provided a forum for further discussion with course instructors. Several unsolicited talks were given in the late afternoons and introduced participants to current research being done in various international institutions. Day 3 was a field trip that included several geological stops on the Crozon peninsula. Some of the best preserved volcanic and sedimentary sequences in France were examined and discussed as the group made their way along the spectacular Brittany coast.

The 8th annual European short course on metallogeny will mark a change of venue as Lisbon, Portugal, was announced as the next host city. With ever increasing international collaboration related to both ancient and modern ore depositional processes, the 2002 edition of the course promises to be an exceptional opportunity for various scientific communities to come together in a setting that promotes discussion and learning.

Yannick Beaudoin (University of Toronto)

The SGA Young Scientist Award

The SGA Young Scientist Award is offered biannually to a young scientist who contributed significantly to the understanding of mineral deposits. The award which consists of a citation, price money of EUR 1500, and travel to the Biennial meeting for the presentation, is not restricted to the candidate's nationality, place of employment, or membership in the Society. The award is given for contributions to economic geology. The SGA Young Scientist Award is awarded for research in economic geology published before the author's 35th birthday. The awardee must be less than 37 years of age on January 1 of the year in which the award is presented.

Any Society member in good standing may nominate candidates for the award. Nominees who are not selected in their first year of nomination, but are still eligible, will be considered for awards in following years.

How to Nominate

A brief biographical summary in the style of American Men and Women of Science or other similar biographical listing should be submitted by the person making the nomination to the SGA Executive Secretary by January 1 of the year of Biennial Meeting (1993, 1995, 1997...). The following information should be included:

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Understanding Mineral Deposits

by
Kula C. Misra
Dept. of Geological Sciences, The University of
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The challenge of finding new orebodies to satisfy the ever increasing demands for mineral commodities has to be met, in addition to improved techniques of exploration, mining, extraction, and management, by a better understanding of the geologic setting and genesis of the various classes of mineral deposits. A substantial part of the book is devoted to a discussion, with appropriate examples, of principles that govern the formation of mineral deposits and the various kinds of field and laboratory data that can be used to interpret their genesis. The rest of the book discusses the characteristics of selected classes of deposits, their relationship with the crustal evolution in space and time, and on the application of available data to the formulation of viable genetic models that provide the basis for exploration strategies.

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1: LATE TIMING FOR HIGH SULFIDATION CORDILLERAN BASE METAL LODGE AND REPLACEMENT DEPOSITS...

It is documented from different parts of the world that numerous sulfide-rich veins, some of them that can be classified as "cordilleran base metal lodes", are superimposed on the upper parts of porphyry copper deposits and cut earlier veins of the potassic and phyllic alteration assemblages (e.g., Meyer and Hemley, 1967; Brimhall, 1979; Fréaut et al., 1997; Brathwaite et al., 2001). Einaudi (1977, 1982, 1994) points out the late stage character of the fluids that form this type of base metal-rich deposit within the moderately deep porphyry-skarn environment. At shallower environments, these fluids can also generate different styles of high sulfidation cordilleran base metal lodes and replacement bodies. This is the case of the polymetallic belt of

central and northern Peru, specifically in the Colquijirca, Cerro de Pasco, and Hualgayoc districts where important parts of the base metal mineralization are spatially related to Au high sulfidation epithermal ores (Fontboté and BendeZú, 1999; BendeZú and Fontboté, 2002; Baumgartner et al., 2002).

One of the open fundamental questions is to determine when cordilleran base metal lodes and replacement deposits are formed in the evolutionary history of porphyry-related hydrothermal systems. Are these ores formed from late stage fluids, as those responsible for sulfide-rich "D"-veins in porphyry copper

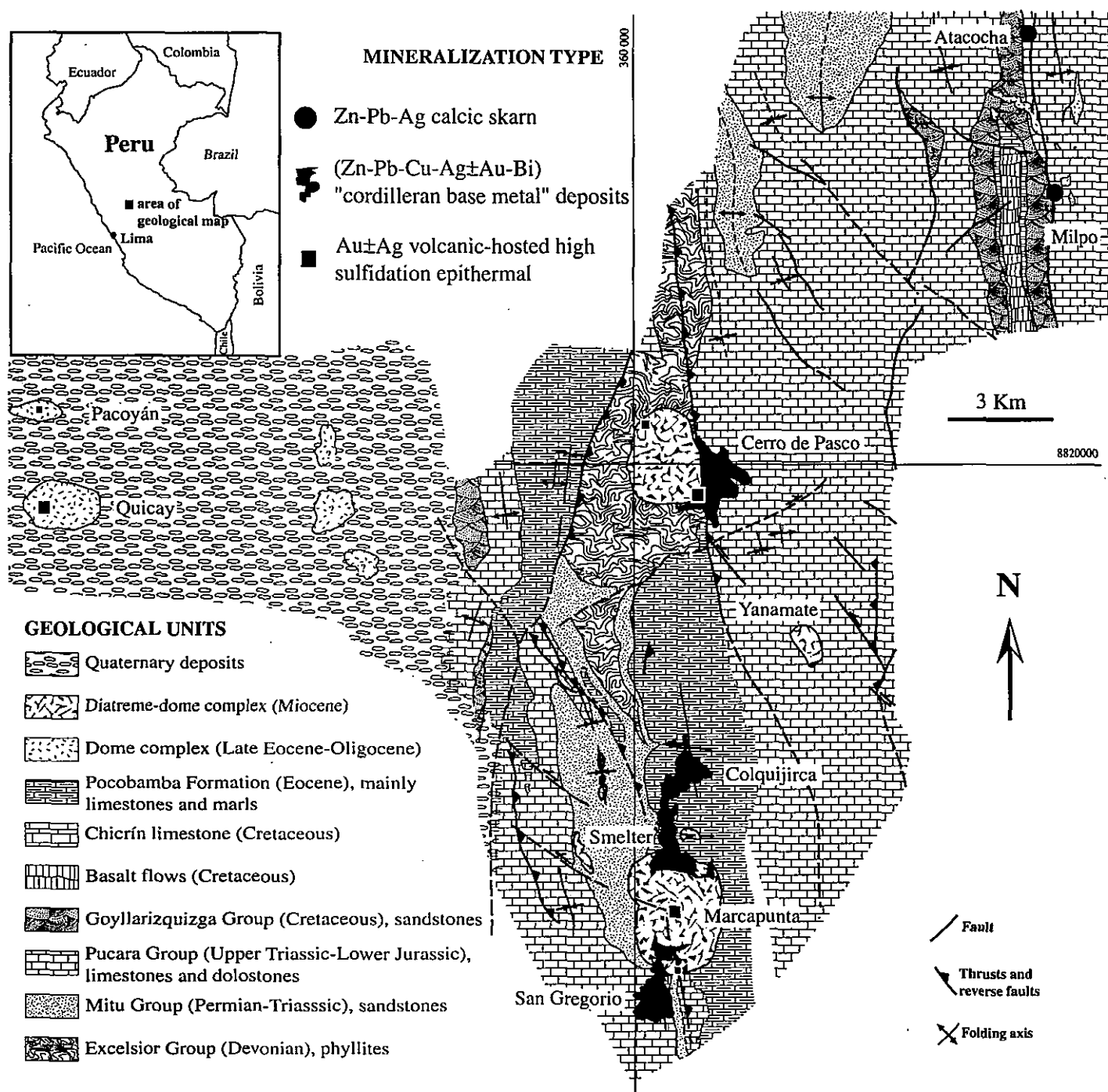


Figure 1: Geological map of the Cerro de Pasco, Colquijirca, and Atacocha districts showing the distribution of the different porphyry-related mineralization types. Geology compiled from Angeles (1999), Johnson et al., (1955), Brocal S.A. staff and own data.

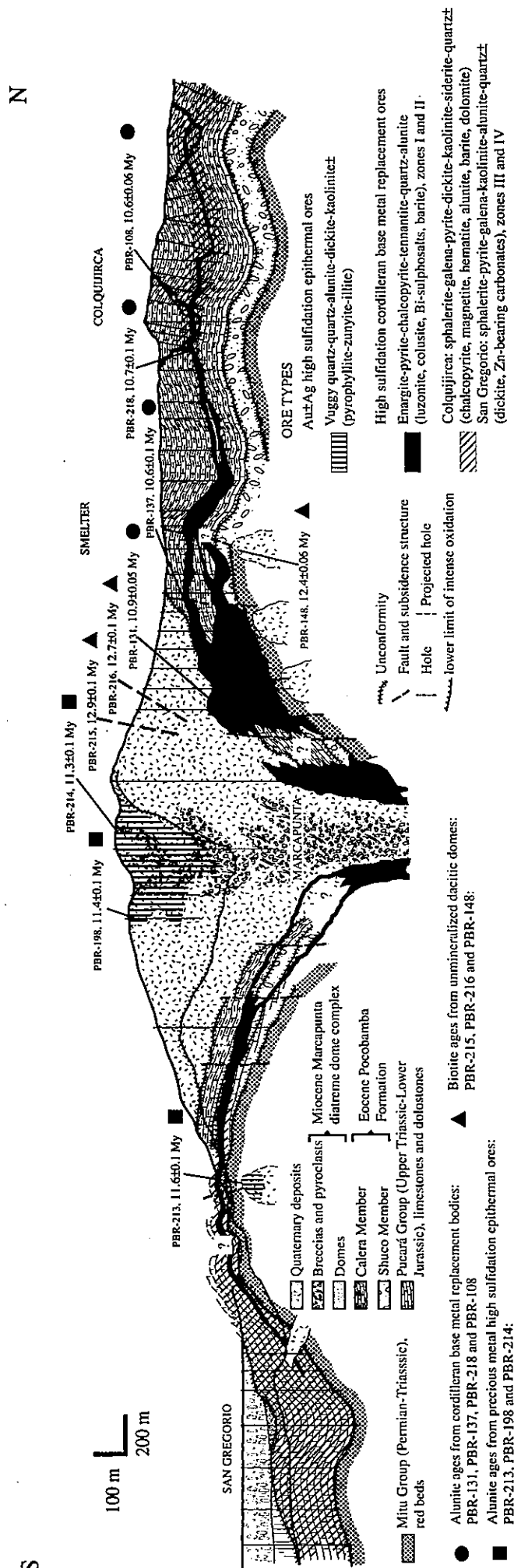


Figure 2: North-south longitudinal section of the Colquijirca district with main ore and alteration associations. $^{40}\text{Ar}/^{39}\text{Ar}$ determinations from Bendežú et al. (submitted).

deposits and, according to Muntean and Einaudi (2001) and at least in the Maricunga belt, for coetaneous high sulfidation epithermal precious metal mineralization? Or do they correspond to even later fluids? This contribution presents geometric and $^{40}\text{Ar}/^{39}\text{Ar}$ geochronological evidences indicating that at Colquijirca high sulfidation cordilleran base metal lodes and replacement deposits are post (~0.6 My) high sulfidation epithermal precious metal mineralization.

Geometric and temporal relationship of ore types at Colquijirca

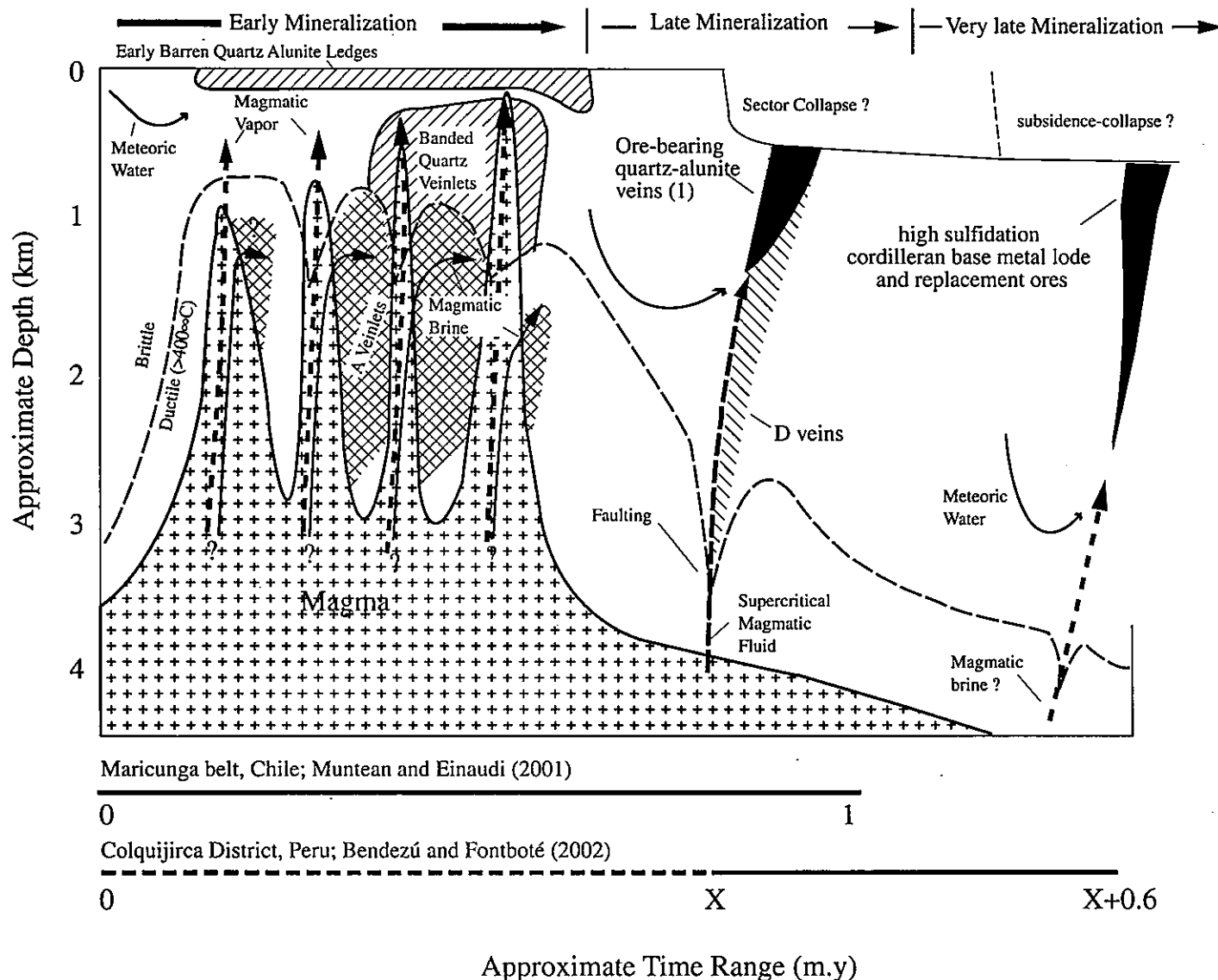
In the center of the Colquijirca district, a 4 km², Miocene, mainly dacitic, diatreme-dome complex intrudes a >300-m-thick sequence of folded carbonate rocks, continental Eocene limestones, marls and detritic sediments (Pocobamba Formation) to the north, and marine, Triassic-Jurassic, nearly pure limestones and dolostones (Pucará Group) to the south (Figs. 1, 2). The entire sedimentary pile surrounding the diatreme neck, including red beds of the Permo-Triassic basement, has subsided about 400-500 m (Fig. 2). A high precision $^{40}\text{Ar}/^{39}\text{Ar}$ survey (Bendežú et al., submitted) reveals two pulses of high sulfidation hydrothermal activity at 11.6±0.1 to 11.3±0.1 Ma (precious metals) and at 10.8 to 10.6 ±(0.06-0.1) Ma (base metals). They post-date formation of the volcanic complex (12.9-12.4±0.1 Ma.) as determined from $^{40}\text{Ar}/^{39}\text{Ar}$ dating of biotite samples from less altered adjacent dacitic domes. Previous K/Ar dating from other areas of the volcanic complex is consistent with the new data (Vidal et al., 1984).

The precious metal high sulfidation epithermal mineralization includes pervasive alteration of almost the whole diatreme-dome complex to assemblages of quartz – alunite – dickite –kaolinite ± (pyrophyllite – zunyite – illite) in mineralized areas and to kaolinite – illite ± (smectite) – sericite – chlorite – calcite beyond them. Shallow Au-(Ag) "vuggy silica" orebodies, as much as 100 m in vertical extent, exist mainly in the central portion of the complex, mostly within the diatreme breccia and pyroclastic infill, following a morphology apparently controlled by permeability (Fig. 2). As in other Au high sulfidation epithermal deposits (e. g., Summitville, in Gray et al., 1994), deep portions of non-oxidized ores contain characteristically <5 vol% of finely disseminated sulfide minerals, mainly pyrite-enargite and very minor sphalerite. The $^{40}\text{Ar}/^{39}\text{Ar}$ ages (11.6 to 11.3±0.1 Ma) on alunites from different parts of the diatreme-dome complex, including a strongly altered dome 2 km south of the diatreme vent, indicate that the precious metal high sulfidation epithermal mineralization constitutes the first recognizable hydrothermal pulse within the Colquijirca district.

The economically more important cordilleran base metal lodes and replacement deposits represent the other distinctive type of mineralization in the district. The ores consist of at least 150 Mt of Cu-Zn-Pb-Ag±(Au-Bi) high sulfidation, carbonate-hosted, massive replacement (Fontboté and Bendežú, 1999, 2001). Replacement temperatures range from about 300°C, near the diatreme-dome complex, to 150°C, in external positions. The ores

contain typically between 20 and 40 vol.% sulfide minerals, mainly in the form of flat, elongated mantos and irregular stacked bodies that extend from the external margins of the diatreme vent into the carbonate rocks (Figs. 1 and 2). Exploration drilling indicates that the bodies have their roots within the diatreme

complex, in deep subvertical narrow veins composed mainly of enargite-pyrite-quartz-alunite and minor pyrophyllite (Fig. 2). The veins have been intercepted between 500 m and >750 m depth with a mineral association similar to that of the core of the mantos (see below).



(1) typical of the precious metal high sulfidation epithermal environment (Muntean and Einaudi, 2001)

Figure 3: Extension of the diagram of Muntean and Einaudi (2001), which represents the timing of A veinlets, D veinlets and precious metal high sulfidation epithermal veins in the Maricunga belt, to the high sulfidation cordilleran base metal environment, using the data of the Colquijirca district.

Hosted by carbonate rocks of the Tertiary Pocobamba Formation, the mantos extend continuously for almost 4 km in length to the north, where they virtually attain the same shallow topographic level of the precious metal high sulfidation epithermal ores. Along this extension, the mantos are zoned in all directions from a Cu core of high sulfidation mineralization composed of enargite - pyrite - quartz - alunite \pm (luzonite, colusite, barite; Zone I). The surrounding economic ore zones include pyrite - chalcopryrite - dickite - kaolinite - siderite - quartz \pm tennantite, Bi-Ag sulphosalts, bornite, alunite, barite, quartz; Zone II; pyrite - sphalerite - galena - chalcopryrite - dickite - kaolinite - quartz \pm (siderite, hematite, magnetite, alunite; Zone III); and an outermost known zone of pyrite-galena-

sphalerite-siderite \pm (kaolinite, dolomite, Zn-bearing carbonates; Zone IV). A similar zoning is also present to the south (Fontboté and Bendezú, 2001), where ore bodies develop not only within the Pocobamba Formation, but mainly in Lower Jurassic carbonate rocks of the Pucará Group, which constitutes the host rock of San Gregorio, one of the biggest Zn-Pb deposits in Peru (> 70 Mt @ Zn+Pb ~10 %). Replacement at San Gregorio took place at very low temperature ($\leq 150^\circ\text{C}$), yielding fine-grained and not easily recognizable ores.

The superimposition of the cordilleran base metal lodes and replacement deposits on the Au-(Ag) high sulfidation epithermal mineralization is evidenced from crosscutting relationships. In the northern flank of the diatreme vent, alteration selvages from

the massive enargite-quartz-alunite ores overprint weakly argillized/propylitized dacitic domes and phreatomagmatic breccias related to the Au-(Ag) mineralization. To the east of the diatreme vent, the argillic associations related to the Au(Ag) ores are cut by narrow sphalerite-galena-pyrite veins. These

geometrical relationships are totally consistent with $^{40}\text{Ar}/^{39}\text{Ar}$ absolute ages obtained on alunite associated with the enargite-pyrite and sphalerite-galena zones of the "cordilleran base metal lodes", which have ages between 10.8 and 10.6 \pm (0.06-0.1) Ma, i.e. about 0.6 My younger than the precious metal mineralization.

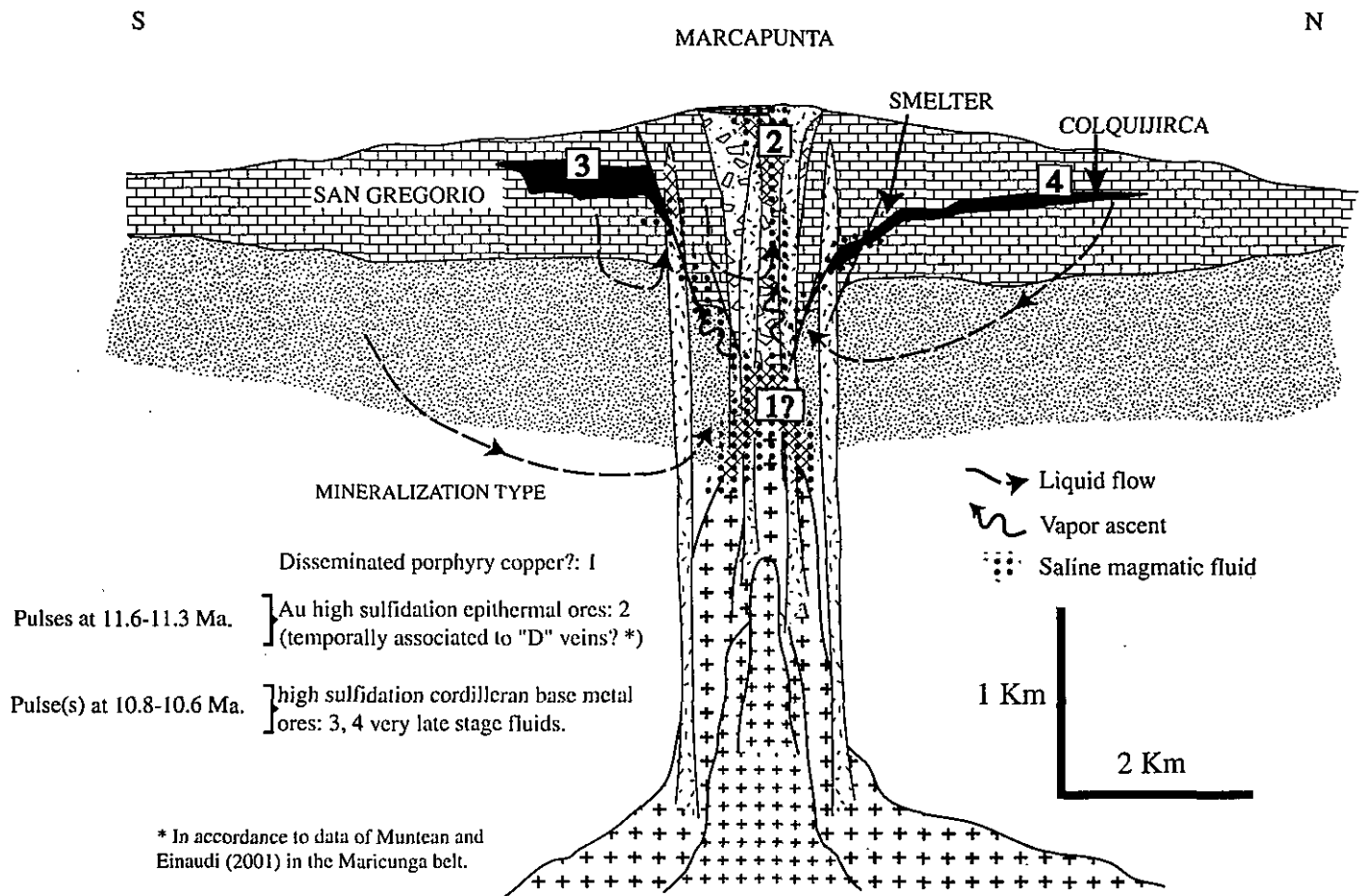


Figure 4: Schematic cross section through the Colquijirca district showing the spatial and temporal distribution of the different ore types. Presence of disseminated porphyry copper mineralization is only hypothetical, the erosion level does not allow any insight in deeper parts of the system.

Discussion

On the basis of the current knowledge on the lifespan of a single intrusion related hydrothermal system (< 40000 years; e.g., Marsh et al., 1997), the total duration of the hydrothermal activity recognized in each of the pulses in the Colquijirca district (in the range of 0.2-0.35 My, Bendežú et al., 2002) is representative of a relatively long-lived hydrothermal activity which probably was sustained by multiple pulses of shallow intrusions (Cathles et al., 1997), as indicated by the existence of several hundreds meter-wide stocks, specially on the immediate edge of the diatreme vent.

In the Maricunga belt, Chile, based on detailed mapping and $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology, Muntean and Einaudi (2001) favor a model whereby high sulfidation epithermal ores and porphyry-related late stage "D" veins are temporally and genetically linked and both postdate by several hundreds of thousands of years the early A veining (Fig. 3). At Colquijirca, the long time gap (0.5 to 0.6 My) between the precious metal epithermal mineralization and the younger cordilleran high sulfidation base metal ores indicates that the latter formed by even later hydrothermal fluids,

and combining with the results from the Maricunga belt, they would also postdate the hypothetical "D"-vein stage (Fig. 3).

The formation of cordilleran base metal lodes in the Colquijirca District seems to represent a late phase of the complex evolution history of a magmatic cycle active for at least two million years through multiple intrusions related to a single intrusive center.

Conclusions

The relative sequence of events and the absolute ages available in the Colquijirca district firmly establish, for the first time, a late timing for cordilleran base metal ores, which are mainly epithermal and display high sulfidation mineral assemblages. They postdate the early precious metal-bearing, high sulfidation epithermal mineralization. Based upon the sequence of events at Colquijirca, it can be hypothesized that similar crosscutting relations present in epithermal ores at other districts (e.g., Hualgayoc, Cerro de Pasco) represent high-level equivalents of the superimposition of deeper mineralization events noted by Brimhall (1979) and Einaudi (1982, 1994) in the upper part of porphyry copper and/or skarn deposits.

The results presented here have important implications for exploration, because many classic districts known for their porphyry copper and/or Au-(Ag) epithermal deposits may host concentrations of "cordilleran base metal lodes" at any spatial position upward from the porphyry environment. These may occur at levels as shallow as the epithermal environment, which in carbonate rocks may be characterized by fine-grained and not easily recognizable Zn-Pb mineralization (e.g., San Gregorio) and for lateral distances as far as more than 4 km from the intrusive center.

Acknowledgements

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June 17-21

CHAPMAN CONFERENCE: VOLCANISM AND THE EARTH'S ATMOSPHERE, Thera, Greece - Contact address: A. Singer, AGU Meetings, 2000 Florida Avenue, NW, Washington, DC 20009, USA; phone +1 202 462 6900; fax: +1 202 328 0566; e-mail: meetinginfo@agu.org; web-site: www.agu.org/meetings/cc02bcall.html

June 24-28

IGARSS 2002 AND THE 24TH CANADIAN REMOTE SENSING SYMPOSIUM, Toronto, Canada - Contact address: Lisa Ostendorf, IEE GRSS Director of Information Services, 63 Live Oak Lane, Stafford, VA 22554; phone: +1 540/658 1676; e-mail: ostendorf@email.msn.com; web-site: <http://www.igarss02.ca>

June 30-July 5 - **SGA-Cosponsored**

16TH AUSTRALIAN GEOLOGICAL CONVENTION. GEOSCIENCE 2002: EXPANDING HORIZONS, Adelaide Convention Centre, Adelaide SA, Australia - Contact address: The Organising Committee, 16th Australian Geological Convention, c/-the Secretary GSA (SA Division), P.O. Box 295, Kent Town, SA 5071; e-mail: 16thagc.gsa.org.au; web-site: www.16thagc.gsa.org.au

July 17-August 2 - **SGA-Cosponsored**

9TH INTERNATIONAL PLATINUM SYMPOSIUM AND FIELD TRIPS TO THE STILLWATER COMPLEX (IGCP 427/SEG/SGA), Billings, MT, USA - Contact address: Roger Cooper, Dept. of Geology, Lamar University, P.O. Box 10031, Beaumont, TX 77710; phone: +1 409 880 8239; e-mail: cooperrw@hal.lamar.edu; web-site: <http://www.platinumsymposium.org>

July 22-27 - **SGA-Cosponsored**

11TH IAGOD QUADRENNIAL SYMPOSIUM/ GEOCONGRESS 2002, Windhoek, Namibia - Contact address: The Secretary IAGOD/GEOCONGRESS 2002, P.O. Box 44283, LINDEN 2104, SOUTH AFRICA; web-site: <http://www.wits.ac.za/gssa> (see page 21)

August 18-23

12TH V.M. GOLDSCHMIDT CONFERENCE, Davos, Switzerland - Contact address: Prof. A. Halliday, Institut für Min. und Petrographie, ETH-Zentrum, CH-8092, Zürich Switzerland; e-mail: halliday@erdw.ethz.ch; website: <http://gs.wustl.edu/conferences/>

August 25-30

GONDWANA 11: CORRELATIONS AND CONNECTIONS, University of Canterbury, Christchurch, New Zealand - Contact address: Susannah Hawtin, Gateway Antarctica, University of Canterbury, Private Bag 4800, Christchurch, New Zealand; phone: +64 3 364 2136; fax: +64 3 364 2197; e-mail: s.hawtin@anta.canterbury.ac.nz; web-site: www.anta.canterbury.ac.nz

September 1-6

IMA 2002: 18TH GENERAL MEETING OF THE INTERNATIONAL MINERALOGICAL ASSOCIATION: MINERALOGY FOR THE NEW MILLENNIUM, Edinburgh, Scotland, UK - Contact address: Executive Secretary: Mr K. Murphy, Mineralogical Society of Great Britain and Ireland, 41 Queen's Gate, London SW7 5HR, United Kingdom; phone: +44 171 584 7516; e-mail: IMA2002@ed.ac.uk or info@minersoc.org; web-site: <http://www.minersoc.org>

★ September 4-7

MANTLE PLUMES AND METALLOGENY, International Symposium. Petrozavodsk, Russia - Contact address: A. F. Grachev, Institute of Physics of the Earth of the Russian Academy of Sciences, 10 Bolshaya Gruzinskaya Str., Moscow, 123810, Russia; e-mail: grachev@uipe-ras.scgis.ru; web-site: <http://geoserv.krc.karelia.ru>

September 9-11

IRON ORE 2002, Perth, Australia - Contact address: web-site: www.ausim.com

September 10-11

INTERNATIONAL WORKSHOP, URANIUM DEPOSITS: From their Genesis to their Environmental Aspects (IAGOD), Prague, Czech Republic - Bohdan Kribek, Czech Geological Survey, Geologicka 6, 15200 Prague 5, Czech Republic; phone/fax: +420 2 581 7390; e-mail: kribek@cgu.cz; web-site: <http://xrd.cgu.cz/uranium.htm>

September 15-21

URANIUM MINING AND HYDROGEOLOGY III, INTERNATIONAL MINE WATER ASSOCIATION SYMPOSIUM - MINE WATER AND THE ENVIRONMENT, Freiberg, Germany - Contact address: Prof. Dr. B. Merkel/Dr. Shristian Wolkendorfer, Lehrstuhl für Hydrogeologie, Gustav-Zeuner Street 12, D-09596 Freiberg/Sachsen, Germany; phone: +49 3731 393309; fax: +49 3731 392720; web-site: <http://www.geo.tu-freiberg.de>, www.IMWA.de

September 16-18

5TH INTERNATIONAL SYMPOSIUM ON ANDEAN GEODYNAMICS, Toulouse, France - Contact address: ISAG, IRD, LMTG, 38 Rue des 36 Ponts; 31000 Toulouse, France, Attn.: Patrice Baby, Gerard Herail, Alain Laenu; e-mail: ISAG@cict.fr

★ September 16-18

INTERNATIONAL CONFERENCE ON TECTONICS AND METALLOGENY OF NORTHEAST ASIA, Novosibirsk, Russia - Contact address: e-mail: berzina@uiggm.nsc.ru; web-site: www.uiggm.nsc.ru/uiggm/geology/admin/

September 18-20

INTERNATIONAL SYMPOSIUM "METALLOGENY OF PRECAMBRIAN SHIELDS", Kyiv, Ukraine - Contact address: Symposium Secretariat, 13A Tymoshenko str. 128, Kyiv, 04212 Ukraine; phone/fax: +380 44 295 72 98; e-mail: bt@ukrdgri.gov.ua

September 22-27

SOCIETY OF EXPLORATION GEOPHYSICISTS (SEG), INTERNATIONAL EXPOSITION AND 72ND ANNUAL MEETING, Las Vegas, Nevada, USA - Contact address: SEG Business Office; phone: +1 918/497 5500; fax: +1 918/497 5557; web-site: <http://seg.org>

September 23-25

APPLIED STRUCTURAL GEOLOGY FOR MINERAL EXPLORATION AND MINING, INTERNATIONAL SYMPOSIUM, Kalgoorlie, Western Australia - Contact address: AIG, P.O. Box 1094, West Perth 6827, Australia; phone: +61 8 9226 0500; fax: +61 8 9226 0700; e-mail: aig@aig.asn.au; web-site: <http://www.aig.asn.au>

★ September 30 - October 2

3RD INDUSTRIAL MINERALS SEMINAR: OUTSOURCING IN THE MINERALS INDUSTRY AND 7TH NORTH AMERICAN INDUSTRIAL MINERALS ANNUAL MEETING, Denver, USA - Contact address: e-mail: conferences@indmin.com, www.indmin.com

October 7-10

INTERNATIONAL SYMPOSIUM ON ENVIRONMENTAL ISSUES AND WASTE MANAGEMENT IN ENERGY AND MINERAL PRODUCTION (SWEMP-2002), Cagliari, Italy - Contact address: Prof. R. Ciccu, Dipartimento di Geingegneria e Tecnologie Ambientali, Università degli Studi di Cagliari, Piazza d'Armi 09123, Cagliari, Italy; e-mail: ciccu@unica.it; web-site: <http://geing.unica.it/digita/swemp/index.htm>

October 20-24

SEG, MINERAL PROCESSING: PLANT DESIGN, OPERATING PRACTICE AND CONTROL CONFERENCE, Vancouver, BC, Canada - Contact address: SME, Meetings Department, P.O. Box 625002, Littleton, CO 80162-5002, USA; phone: +1 303 973 9550; fax: +1 303 979 3461; e-mail: sme@smenet.org

★ October 24-25

THE SYMPOSIA - BOR 100 YEARS: GEOLOGY AND METALLOGENY OF COPPER AND GOLD DEPOSITS IN THE BOR METALLOGENIC ZONE, Bor, Yugoslavia -

Contact address: RTB Bor and Copper Institute Bor, Zeleni Bulevar 33-35, 19210 Bor, Yugoslavia. Phone +381 30 435-318, Fax +381 30 436-731, E-mail vucko@ibb.rtb.bor.ac.yu

★ October 27-30

GEOLOGICAL SOCIETY OF AMERICA (GSA), ANNUAL MEETING: Science at the Highest Level, Denver, CO, USA - Contact address: GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301-9140, USA; phone: +1 303-357-1038; fax: +1 303-357-1072; e-mail: meetings@geosociety.org or bmartinez@geosociety.org; web-site: <http://www.geosociety.org/meetings/index.htm>

★ December 6-10

AGU FALL MEETING, San Francisco, CA, USA - Contact address: web-site <http://www.agu.org>

★ December 7-18

MODULAR COURSE IN EXPLORATION GEOCHEMISTRY, Sudbury, Ontario, Canada - Contact address: Dr. Steve Piercey, Mineral Exploration Research Centre, Department of Earth Sciences, Laurentian University, Ramsey Lake Road, Sudbury ON Canada, P3E 2C6; phone: +1 705 675 11 51; or 23 64; fax: +1 705 675 48 98; e-mail: spiercey@laurentian.ca; web-site: <http://earthsciences.laurentian.ca>

★ December 14-19

GEOCHEMISTRY OF CRUSTAL FLUIDS: ROLE AND FATE OF TRACE ELEMENTS IN CRUSTAL FLUIDS, Seefeld in Tirol, Austria - Contact address: European Science Foundation, 1 quai Lezay-Marnésia, 67080 Strasbourg cedex, France; phone: +33-3-88767135; fax: +33-3-88366987; e-mail: euresco@esf.org; web-site: <http://www.esf.org/euresco>

2003

★ January 6-10

THE 10TH INTERNATIONAL SYMPOSIUM ON DEEP SEISMIC PROFILING OF THE CONTINENTS AND THEIR MARGINS, Huka Village Conference Centre, Taupo, New Zealand - Contact address: Fred Davey, Institute of Geological and Nuclear Sciences Ltd. (GNS); e-mail: f.davey@gns.cri.nz or seismix2003@gns.cri.nz, web-site: <http://www.gns.cri.nz/news/conferences/seismix2003>

February 24-26

SOCIETY FOR MINING, METALLURGY AND EXPLORATION (SME), ANNUAL MEETING, Cincinnati, OH, USA - Contact address: SME, Meetings Department, P.O. Box 277002, Littleton, CO 80127, USA; e-mail: sme@smenet.org

March 9-12

PROSPECTORS & DEVELOPERS ASSOCIATION OF CANADA, ANNUAL CONVENTION, Toronto, Canada - Contact address: PDAC, 34 King Street East, 9th Floor, Toronto, Ontario, Canada M5C 2X8; phone: +1 416 362 1969; fax: +1 416 362 0101; e-mail info@pdac.ca; web-site: www.pdac.ca

April 7-11

JOINT MEETING: EUROPEAN GEOPHYSICAL SOCIETY (EGS) XXVIII GENERAL ASSEMBLY AND THE AMERICAN GEOPHYSICAL UNION (AGU) SPRING 2003 MEETING, Nice, France - Contact address: EGS office, Max-Planck-Str. 13, 37191 Katlenburg-Lindau, Germany; phone: +49 5556 1440; fax: +49 5556 4709; e-mail: egs@copernicus.org; web-site: www.copernicus.org/EGS/ or AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA; phone: +1 202 462 6900; fax: +1 202 328 0566; e-mail: meetingsinfo@agu.org; web-site: www.agu.org/meetings/

April 13-17

EUROPEAN UNION OF GEOSCIENCES (EUG) XII, Strasbourg, France - Contact address: EUG Office-EOST, 5, rue Rene Descartes, 67084 Stasbourg Cedex, FRANCE; phone: +33 3 88 45 01 91; fax: +33 3 88 60-38 87; e-mail: eug@eost.u-strasbg.fr; web-site: eost.u-strasbg.fr/EUG

★ May 12-16

GEOFLUIDS IV: FOURTH INTERNATIONAL CONFERENCE ON FLUID EVOLUTION, MIGRATION AND INTERACTION IN SEDIMENTARY BASINS AND OROGENIC BELTS, Utrecht, The Netherlands - Contact address: The Netherlands Institute of Applied Geoscience TNO-National Geological Survey, Ms. J.M. Verweij, PO Box 80015, 3508 TA Utrecht, The Netherlands; phone: +31 30 256 4600; fax: +31 30 256 46 05; e-mail: j.verweij@nitg.tno.nl; web-site: <http://www.nitg.tno.nl>

★ May 18-24

39TH FORUM ON THE GEOLOGY OF INDUSTRIAL MINERALS, Sparks, Nevada, USA - Contact address: Terri Garside, NBMG/MS, 178, University of Nevada, Reno, NV 89557-0088, USA; phone: +1-775-784-6691 ext 126; fax: +1-775-784-1709; e-mail: tgarside@unr.edu; web-site:

<http://www.nbm.unr.edu/imf2003.htm>

June 22-27

8TH INTERNATIONAL KIMBERLITE CONFERENCE, Victoria, British Columbia, Canada - Contact address: Dr. Roger H. Mitchell, Geology Department, Lakehead University, Thunder Bay, Ontario, Canada P7B 5E1; phone: +1 807 343 8287; fax: +1 807 623 7526; e-mail: Roger.Mitchell@lakeheadu.ca; web-site: www.venuewest.com/8IKC

★ August 19-31 - SGA-Cosponsored

THE GEOLOGICAL SOCIETY PERMOR FLAGSHIP MEETING: WORLD CLASS MINERAL DEPOSITS AND EARTH EVOLUTION, Cardiff University and the National Museum and Galleries of Wales, Cardiff, Wales, U.K. Contact address: Iain McDonald, Department of Earth Sciences, Cardiff University, P.O. Box 914, Cardiff CF10 3YE, U.K.; email: mcdonaldil@cf.ac.uk; web-site: <http://www.mdsg.org.uk>

August 29-September 3

THE 21ST INTERNATIONAL GEOCHEMICAL SYMPOSIUM (IGES) OF THE ASSOCIATION OF EXPLORATION GEOCHEMISTS, Dublin, Ireland - Contact address: Eibhlín Doyle; e-mail: eibhlindoyle@gsi.ie; web-site: http://www.aeg.org/Symposia/21stSymposiumTrip/21st_international_geochemical_s.htm

August 31-September 3

NORTH ATLANTIC MINERALS SYMPOSIUM (NAMS-2003), Dublin, Ireland - Contact address: web-site: www.gov.nf.ca/nams/

September 7-11

6TH INTERNATIONAL SYMPOSIUM ON ENVIRONMENTAL GEOCHEMISTRY (ISEG), Edinburgh, Scotland - Contact address: John Farmer, Department of Chemistry, The University of Edinburgh, Joseph Black Building, Kings Buildings, West Mains Road, Edinburgh EH9 3JJ Scotland; phone: +44 131 650 1000; fax: +44 131 650 4757; e-mail: J.G.Farmer@ed.ac.uk

★ September 7-12

13TH V.M. GOLDSCHMIDT CONFERENCE, Kurashiki, Japan - Contact address: Organizing Committee of Goldschmidt 2003, c/o International Communications Specialists, Inc., Sabo Kaikan-bekkan, 2-7-4 Hirakawa-cho, Chiyoda-ku, Tokyo 102-8646, Japan; e-mail: gold2003@ics-inc.co.jp; web-site: <http://www.ics-inc.co.jp/gold2003/>

★ September 10-11

MANTLE PLUMES: PHYSICAL PROCESSES, Chemical Signatures, Biological Effects. Cardiff, Wales, UK. - Contact address: Dr. Andrew C. Kerr, Department of Earth Sciences, Cardiff University, Main Building, Park Place, Cardiff, Wales, UK. CF10 3YE; phone: +44-(0)29-2087-4578; fax: +44-(0)29-2087-4326; e-mail: kerra@cf.ac.uk; web-site: <http://www.geolsoc.org.uk/template.cfm?name=Plumes>

September 15-18

INDUSTRIAL MINERALS AND BUILDING STONES, INTERNATIONAL SYMPOSIUM (IAEG), Istanbul, Turkey - Contact address: Prof. Dr. Erdogan Yüzer, Istanbul Teknik Üniversitesi, Moden Fakültesi, Ayazaga Kampüsü 80626-Maslak, Istanbul, Turkey; phone/fax: +90 212 2856 146; e-mail: yuzer@itu.edu.tr

September 28-October 3

SOCIETY OF EXPLORATION GEOPHYSICISTS (SEG), INTERNATIONAL EXPOSITION AND 73RD ANNUAL MEETING, Dallas, TX, USA - Contact address: SEG Business Office; phone: +1 918/497 5500; fax: +1 918/497 5557; web-site: <http://seg.org>

October 5-10

THE XXII INTERNATIONAL MINERAL PROCESSING CONGRESS, Cape Town, South Africa - Contact address: Mrs. Meg Winter, Dept. of Chemical Engineering, University of Cape Town, Rondebosch 7700, South Africa; fax: +27 (0)21 689 7579; e-mail: mw@chemeng.uct.ac.za; web-site: <http://www.impc2003.org.za/>

November 1-5

19TH WORLD MINING: MINING IN THE 21ST CENTURY - QUO VADIS? CONGRESS & EXPO - 2003, New Delhi, India - Contact address: The Institution of Engineers (India), Indian National Committee of World Mining Congress, 8, Gokhale Road Calcutta -700020; phone: +91 33 2238311, 2238314, 2238316; fax: +91 33 2238345; e-mail: iei@iqrs@vsnl.com; web-site: www.taicon.com or <http://www.19wmcc2003.com>

November 2-5

GEOLOGICAL SOCIETY OF AMERICA: ANNUAL MEETING, Seattle, Washington, USA - Contact address: GSA Meetings Department, P.O. Box 9140, Boulder, CO 80301-9140, USA; phone: +1 303 447 2020; fax: +1 303 447 0648; e-mail: meetings@geosociety.org; web-site:

<http://www.geosociety.org/meetings/index.htm>

★ December 3-5 - **SGA-Cosponsorca**

FEM 2003, 3RD FENNOSCANDIAN EXPLORATION AND MINING, Rovaniemi, Finland.

2004

February 23-25

SME ANNUAL MEETING AND EXHIBITION, Denver, Colorado, USA - Contact address: Society for Mining, Metallurgy & Exploration; phone: +1 303 973 9550; fax: +1 303 979 3461; web-site: <http://www.smenet.org>

★ May 17-21

JOINT MEETING: 2004 AMERICAN GEOPHYSICAL UNION (AGU) SPRING MEETING AND THE CANADIAN GEOPHYSICAL UNION ANNUAL MEETING, Montreal, Canada - Contact address: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA; phone: +1-202-462-6900; fax: +1-202-328-0566; e-mail: meetinginfo@agu.org; web-site: www.agu.org/meetings

August 18-28

32ND INTERNATIONAL GEOLOGICAL CONGRESS, Florence, Italy - Contact address: Matteo Moscatelli or Erica Galli, Newtours SpA, Via San Donato 20, I-50127 Florence, Italy; phone: +39 055 33611; fax: +39 055 33611250/350; e-mail: newtours@newtours.it; web-site:

<http://www.newtours.it> or <http://www.32igc.org>

★ September 11-19

INTERNATIONAL ASSOCIATION ON THE GENESIS OF ORE DEPOSITS, VLADIVOSTOK-2004: INTERIM IAGOD Conference on Metallogeny of the Pacific Northwest: Tectonics, Magmatism & Metallogeny of Active Continental Margins, Vladivostok, Khabarovsk, Magadan Russian Far East, Russia - Contact address: Far East Geological Institute, FEB RAS 159, Prospekt 100-letiya, Vladivostok, 690022, Russia; phone: +7-4232-31-87-50; fax: +7-4232-31-78-47; e-mail: iagodconf@fegi.ru or fegi@online.marine.ru; web-site: <http://www.fegi.ru>

★ September 27-30

MINEXPO 2004, THE NATIONAL MINING ASSOCIATION, Las Vegas, Nevada, USA - Contact address: e-mail: rmaddalena@nma.org

★ September 27 - October 10

SEG: PREDICTIVE MINERAL DISCOVERY UNDER COVER, Perth, Western Australia - Contact address: web-site: www.cgm.uwa.edu.au/geoconferences

October 10-15

SOCIETY OF EXPLORATION GEOPHYSICISTS (SEG), 74TH ANNUAL MEETING AND INTERNATIONAL EXPOSITION, Denver, CO, USA - Contact address: Debbi Hyer, 8801 S. Yale, Tulsa, OK 74137, USA; phone: +1 918 497 5500; e-mail: dhier@seg.org; web-site: meeting.seg.org

THE SGA HOMEPAGE ON INTERNET

The SGA homepage has a new address on INTERNET. From this homepage you can get information about biennial scientific meetings in Europe, worldwide field trips and workshops, membership application form for the SGA and authors and titles of this year contributions to *Mineralium Deposita* as well as the electronic edition of SGA News.

<http://www.min.tu-clausthal.de/sga.html>

Netscape: Society for Geology Applied to Mineral Deposits - SGA

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Adresse : <http://www.min.tu-clausthal.de/sga.html> Infos connexes

SGA

SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS

Origin of SGA

In 1965 the Society for Geology Applied to Mineral Deposits was established by a group of economic geologists in Heidelberg. In 1971, SGA was legally incorporated in Switzerland with its statutes in English, French and German. Its journal **MINERALIUM DEPOSITA** is now recognized as a premier international mineral deposits journal.

Goals

The promotion of science of mineral deposit geology. Personal contact of members in order to exchange knowledge and experience. Organization of biennial scientific meetings in Europe, world wide field trips and workshops. For these events, SGA members have reduced registration fees.

Membership

Publication of *Mineralium Deposita* and scientific volumes. Co-operation with other scientific societies, especially with **SEG** and **IAGOD**.

Sponsorship of international symposia and workshops (only major high-profile meetings).

Recent Issue (No. 12)

SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS

SGA Membership Application Form

I would like to become a member of the Society for Geology Applied to Mineral Deposits (SGA) and to receive my personal copy of *Mineralium Deposita*.

Surname/Corporation
 First name
 Title
 Mailing address

 Phone Fax
 E-mail
 Date of birth..... Nationality.....
 Degrees obtained from Universities or Colleges

 Present position

 Membership in other scientific societies

 Are you a member of the Society of Economic Geologists? (If yes, no sponsors are necessary) ☐ Yes ☐ No

- | | |
|--|--|
| <input type="checkbox"/> 65 EUROS (~65 US\$) | Regular |
| <input type="checkbox"/> 10 EUROS (~10 US\$) | Student (up to Ph. D., max. 4 years)* |
| <input type="checkbox"/> 45 EUROS (~45 US\$) | Senior (after retirement)* |
| <input type="checkbox"/> 200 EUROS (~200 US\$) | Corporate (includes 3 copies of <i>Mineralium Deposita</i>) |

*Certificate required

If the application is approved by the SGA Council, I authorize the "Society for Geology Applied to Mineral Deposits" to charge the above amount (please tick)

to my ☐ Visa ☐ Mastercard/Eurocard ☐ American Express
 Card No.
 Expiry date

Signature
 Place and date
 (If you do not intend to pay by credit card, an invoice will be issued after acceptance of your application)

Two SGA Sponsors (If you have difficulty in finding sponsors, please send this form to the Executive Secretary who will recommend sponsors)

Name, place, date, signature
 SPONSOR 1

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Send the Membership Application Form to:

Dr. Jan Pasava
 SGA Executive Secretary
 Czech Geological Survey
 Klárov
 CZ-11800 Prague 1
 CZECH REPUBLIC

Tel.: +420 2 58 17 390
 Fax: +420 2 58 18 748
 e-mail: pasava@cgu.cz

Join the SGA now...



The Society of Geology Applied to Mineral Deposits was established in 1965 by an international group of economic geologists. Its Journal *Mineralium Deposita* is now recognized as a premier international mineral deposits journal.

GOALS

- The promotion of science of mineral deposit geology
- Personal contact of its members in order to exchange knowledge and experience
- Organization of scientific meetings, field trips, workshops. For these events, SGA members have reduced registration fees and in certain cases may apply for travel grants
- Cooperation with other scientific societies, especially with SEG and IAGOD
- Publication of *Mineralium Deposita* and scientific volumes

MEMBERSHIP

Membership in SGA is open to all persons interested in economic geology, mineral resources, industrial minerals and environmental aspects related to mineral deposits. SGA is an international society with global membership in over 50 countries. Members have reduced registration fees in SGA-sponsored events and in certain cases are eligible for travel grants. Subsidies for publication of color plates in *Mineralium Deposita* also may be applied. Current membership fees are listed on the left-side column of this page.

MINERALIUM DEPOSITA

Editors: Richard Goldfarb (Denver, CO, USA) and Bernd Lehman (Clausthal, Germany).

Mineralium Deposita publishes papers on all aspects of the geology of mineral deposits. It includes new observations on metallic and non metallic minerals and mineral deposits, mineral deposit descriptions, experimental and applied inorganic, organic and isotope geochemistry as well as genetic and environmental aspects of mineral deposits. *Mineralium Deposita* is published bimonthly. Fast publication: *Mineralium Deposita* publishes *Mineral Deposita Letters* within 3 months and regular papers normally within 4 months after manuscript acceptance and usually 6-9 months after manuscript submission.

..and receive

MINERALIUM DEPOSITA & SGA NEWS!!!

Additional information in the
 SGA homepage on Internet:

<http://www.min.tu-clausthal.de/www/sga/sga.html>



SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS (SGA)



Seventh Biennial SGA Meeting

Mineral Exploration and Sustainable Development

August 24-28, 2003
Athens (Greece)

Co-organizers

INSTITUTE OF GEOLOGY AND MINERAL EXPLORATION (IGME)
ATHENS TECHNICAL UNIVERSITY (NTUA)
ATHENS UNIVERSITY
UNIVERSITY OF THESSALONIKI
SOCIETY OF ECONOMIC GEOLOGISTS (SEG)
GEOLOGICAL SOCIETY OF GREECE - SECTION OF ECONOMIC GEOLOGY
AND GEOCHEMISTRY

Preliminary Information

The 7th Biennial SGA Meeting will be held in Athens, Greece, August 24-28, 2003. Athens is the historical capital of Greece, a scientific and cultural center and the Host City of the Olympic Games of 2004.

Under the general theme "Mineral Exploration and Sustainable Development" the conference will bring together economic geologists from industry, government and universities to discuss current issues on ore geology, exploration and sustainable development. Participants are kindly invited to offer papers for oral and poster presentations in the following topics:

- Sustainable development and geo-environmental impact models
- Supergene metallogenic processes
- Seafloor hydrothermal systems
- Porphyries/granites and the magmatic-hydrothermal transition
- Epithermal systems
- Mafic-ultramafic magmatism and ore deposits
- Basin evolution and mineral deposits
- Orogenic hydrothermal systems
- Organic matter and mineral deposits
- Industrial minerals
- Laurium, 3000 years of silver mining
- Open session

Several post-meeting field trips will be organized and the participants will have the opportunity to visit different metallogenic provinces of Greece and neighboring countries, including Milos Island, Santorini Island, Cyprus etc.

For more information, please, visit our website: www.igme.gr/sgaconference.htm

Deadlines

September, 2002, Pre-registration
October, 31, 2002 Second Circular

January 31, 2003 Abstract submission
April 30, 2003 Registration for Conference and Field trips

Contact address

7th Biennial SGA Meeting
Secretary: Dr. Demetrios Eliopoulos
Institute of Geology and Mineral Exploration
70 Messoghion Str.

GR-115 27 Athens, Greece
FAX: 00 30 1 77 73 421
e-mail: eliopoulos@igme.gr