SGA News
SOCIETY for GEOLOGY APPLIED to MINERAL DEPOSITS
December 2000 Number 10

CRUSTAL-SCALE HYDROTHERMAL PALAEOFIELD AND RELATED VARISCAN Au, Sb, W OROGENIC DEPOSITS AT 310-305 MA (FRENCH MASSIF CENTRAL, VARISCAN BELT)

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Introduction

The metallogeny of the orogenic domains has developed considerably over the last 20 years, in particular as regards the Archaean and Proterozoic provinces of the earth. Initially, a concept of "metalliferous peak" has emerged from the links observed between the continent growth, orogenic cycles and distribution of metal deposits through time (Meyer, 1988; Barley and Groves, 1992). Later, the amount of geological data collected in the mines has led to the definition of a crustal continuum model for late-Archaean lode gold deposits, revealing the "crustal-scale of the hydrothermal system " (Colvine, 1984; Groves, 1993; Groves et al., 1998; McCuaig and Kerrich, 1998). Following these approaches, the links between metallogeny and geodynamics become operational tools and guides for understanding fluid-rock interaction and permeability network during the orogens and estimating potentiality of orogenic zones for mining exploration.

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IMPORTANT NOTICE

THIS ISSUE OF SGA NEWS INCLUDES EXTENSIVE INFORMATION ON THE 6TH BIENNIAL SGA MEETING JOINTLY ORGANIZED WITH SEG, CRACOW, POLAND, 26-29 AUGUST 2001

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GEOCHIM 2000 - POSTGRADUATE CERTIFICATED TRAINING COURSE IN GEOCHEMICAL EXPLORATION METHODS AND THEIR ENVIRONMENTAL APPLICATIONS SUCCESSFULLY TERMINATED IN THE CZECH REPUBLIC

Jan Pasava

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A very old and famous prospecting and mining tradition, coupled with a strong emphasis on environmental issues on the territory of the Czech Republic, are reflected in the character of a newly recovered GEOCHIM - Certificated Postgraduate Training Course. GEOCHIM 99 was held in Prague and Dolni Rozinka (Czech Republic) from September 6 to 20, 1999, and 12 geoscientists, representing 8 developing countries participated in this event.

The GEOCHIM 2000 was organized in Prague and Dolní Rozínka (Czech Republic) from September 4 to 18, 2000. Thirteen participants (of which 7 were women) from *Albania, Botswana, Burkina Faso, Jordan, Malaysia, Nepal, Romania, Russia* and *Zambia* were trained both theoretically and practically in the geochemical exploration methods and their environmental applications.

This course was organized by the Czech Geological Survey and IGCP 429 under the auspices of the Ministry of the Environment, Czech Republic and the Czech IGCP National Committee and financially sponsored by the Czech Commission for UNESCO, Czech Geological Survey in Prague, Division of Earth Sciences (UNESCO/Paris) - through the contract no. SC/RP 205.516.0, and the International Geological Correlation Programme - IGCP 429 „Organics in Major Environmental Issues". North Bohemian Mines j.s.c. kindly hosted one day field trip to the North Bohemian Coal Basin.

It should be noted that the course was launched on September 5th, 2000, in the building of the Czech Geological Survey in Prague by opening speeches delivered by Mrs. M. Motlová, Director, Department of Global Relations of the Ministry of the Environment, Czech Republic, Mrs. J. Herzingerová from the Czech Commission for UNESCO, Mr. V. Lysenko from the Department of Geology, Ministry of the Environment, Czech Republic, Mr. M. Ruzicka, Director of the Czech Geological Survey, Mr. P. Pálensky, Scientific vice-director of the Czech Geological Survey, Mr. Z. Kukal, the former director of the Czech Geological Survey and Dr. J. Pasava, Chairman of the Czech IGCP National Committee, Co-leader of the IGCP 429 and Director of GEOCHIM 1999 and 2000.

Lectures, seminars and practical field training started on September 6th, 2000, in Dolní Rozínka and included the following subjects: (1.) Introduction to the geochemical prospecting methods, (2.) Principles of environmental geochemistry, (3.) Principles of analytical methods, (4.) Heavy minerals prospecting and evaluation of heavy mineral concentrates with environmental applications, (5.) Stream sediment prospecting with environmental applications, (6.) Soil prospecting with environmental applications, (7.) Biogeochemical prospecting with environmental applications and up to date results of the IGCP 429, (8.) Lithogeochemical prospecting, (9.) Hydrogeochemical prospecting with environmental applications, (10.) Geophysical prospecting methods with environmental application and radon risk, and (11.) Computer modelling of prospecting and environmental data.

Morning theoretical classes covering various geochemical methods were followed by afternoon practical field and computer training. The underground visit to the uranium mine as well as processing plant and remediated sites at Dolní Rozínka (Moravia) and also full day field trip observing surface lignite mining operations and examples of various types of remediation in the North Bohemian Coal Basin (North Bohemia) were a part of this course. The aim of these visits was to demonstrate possible ways of effective usage of geochemical methods in both prospecting and environmental fields.

The course was successful. Many participants highly appreciated both organization and scientific level of the course through their personal letters mailed directly to the organizers or to Mr. F. Repetto from the Division of Earth Sciences, UNESCO, Paris.

The GEOCHIM 2001 is under preparation (see page 15).◆

SGA News

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NEWS OF THE SOCIETY

☞ News of the Council

Report of the President

H. Papunen, SGA President, thanked J. Pasava, SGA Executive Secretary, for his efforts in the organization of the SGA Council Meetings and SGA General Assembly and for representation of SGA at the 31st IGC in Rio de Janeiro. He also informed the Council on the preparation of a letter of congratulations to Dr. F. Saupé on the occasion of his nomination as SGA Honorary Member (see page 4).

Report of the Executive Secretary

Jan Pasava reported on the new membership to October 10, 2000. He also informed the Council about the result of the recent SGA ballot on the Revision of the SGA Constitution which obtained the majority approval. The revised SGA Constitution will be effective from January 1, 2001.

The question of sponsorship of SGA membership for some people from economically disadvantaged countries was raised. The Council approved that recent applicants from Albania, Botswana and Jordan will be receiving MD for 2001 free of charge (from issues donated by Ch. Amstutz) and that future applications will be evaluated by the Council.

Report of the Treasurer

P. Herzig, SGA Treasurer, presented the financial report covering the period from January 2000 to September 2000. The Society has 614 paying members.

Report of the MD Chief Editors

The report was prepared by B. Lehmann (Chief Editor, European MD Office) and R. Goldfarb (Chief Editor, North American MD Office). The online connection with Springer will start in November, 2000 and will significantly speed up the publishing process. The Council approved Georges Beaudoin (Université Laval, Québec, Canada) in replacement of Lance Miller and Larry Meinert (Washington State University, USA) as new members of the MD Editorial Board from January 1, 2001.

Report of the SGA Promotion Manager

G. Borg, SGA Promotion Manager, presented the report on the SGA promotion activities covering communication with Regional Vice-Presidents, new promotional items and standardized promotion packs for conferences.

Status of the SGA-SEG collaboration

H. Papunen (SGA President) summarized a deal between SGA and SEG worked out at the Kraków SGA Council Meeting in spring 2000. Additional information was provided by Holly Stein (SEG Vice-President and SGA Council Member) who presented a letter from J. Franklin, SEG President, confirming previous agreement and suggesting new fields of possible future collaboration. The Council highly appreciated the letter from the SEG President and suggested that a joint Council Meeting should be considered on the occasion of the SEG-SGA Meeting in Denver 2002. The Council also approved that at least 1 short course run under the SGA logo at the SEG-SGA Meeting in Denver will be announced shortly to SEG organizers.

Plans for future SGA-IAGOD collaboration

J. Pasava informed about the participation to the last IAGOD Council Meeting and the General Assembly (August 2000, Rio de Janeiro), where the new IAGOD Officers were proposed and approved for the period 2001-2004:

President - E. Hammerbek (RSA)
Secretary General - N. Cook (Norway)
Associated Secretary General - J. Aichler (Czech Republic)
Membership Secretary - R. Seltmann (UK)

The IAGOD Council has also offered to the SGA Council:

- to sponsor the 2004 IAGOD Meeting on the Metallogeny of the Pacific Northwest, tectonics, magmatism and ore deposits at continental margin (Vladivostok, Russia);
- to co-organize the 12th IAGOD Quadrennial Symposium in 2006 (St.Petersburg, Russia).

The SGA Council highly welcomed IAGOD's invitations and is ready to work with the IAGOD Council on a mutually beneficial cooperative program development in the future.

☛

✂.....

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:

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

6th Biennial SGA Meeting, jointly organized with SEG

Information on the preparation of the joint SGA-SEG Meeting was provided by H. Kucha. The report on the status of the scientific committee of the joint SGA-SEG Meeting was prepared by A. Piestrzynski. The Council very highly appreciated the work of the Organizing Committee.

7th Biennial SGA Meeting in Greece?

D. Eliopulos and D. Bitzios (Head, Economic Geology Department of IGME) informed the SGA Council about a serious interest to organize the next 7th Biennial SGA Meeting in late August 2003 in Athens. IGME (Institute of Geology and Mineral Exploration), the Technical University (Athens) and the University of Athens would be involved in the preparation of this important international event. The complete bid, including a tentative budget, will be presented at the next SGA Council Meeting in Spring 2001.

Past Activities

SGA sponsored or was involved in the following symposia at the 31st IGC (August 6-17, 2000, Rio de Janeiro, Brazil):

C-7 Symposium on the Organics in Major Environmental Issues - J. Pasava and Laecio Cunha de Souza co-convenors.

G-5 Ore Deposits of the Andes - B. Lehmann and L. Fontboté co-convenors.

11-1 Pre-Atlantic Metallogeny of West Africa and Eastern South America - A.F. Kamona and H. Beurlen co-convenors.

11-3 Mineral Deposits Associated with Black Shales - J. Pasava and R.M. Coveney co-convenors.

11-4 Mineral Deposits Associated with Laterites and Related Environments - S. Baros de Oliveira convenor.

11-6 Mineralization Associated with Mafic and Ultramafic Igneous Rocks - T. Naldrett and V. Giardi co-convenors.

13-1 Mineral Resources and Development - I. Nyambock, S. Suslick and N. Grant co-convenors.

13-3 Earth Minerals - B. Skinner and R. Rocha co-convenors.

Future Activities

- Prospectors & Development Association of Canada (March 14-17, 2001 Toronto, Canada).
- XVI ECROFI Meeting (May 2-4, 2001, Porto, Portugal).
- 4th International Archaean Symposium (September 24-28, 2001, Perth, Australia).
- A joint SEG-SGA Global Exploration 2002 «Integrated Methods for Discovery» Conference (April 2002, Denver, Colorado, USA).
- 11th IAGOD Symposium (July 22-27, 2002, Windhoek, Namibia).
- Uranium Deposits: From Their Origin To Their Environmental Impacts (September 24-26, 2002, Prague, Czech Republic).

Sponsorship

SGA will sponsor the following events:

- 2001 A Hydrothermal Odyessy (May 17-19, Jupiter's Casino, Townsville, Queensland, Australia, organized by the Economic Geology Research Unit (EGRU), James Cook University School of Earth Sciences).
- 11th IAGOD Symposium (July 22-27, 2002, Windhoek, Namibia).

Various

The Council thanked D. Eliopoulos for excellent organization of the SGA Council Meeting in Athens and a great hospitality provided by IGME.

☞ SGA General Assembly

The SGA General Assembly was held in Rio de Janeiro on the 9th August 2000. After official opening and presentation of agenda, J. Pasava, SGA Executive Secretary, delivered on behalf of the SGA President, H. Papunen, the SGA activity report which covered the period from the last SGA General Assembly (August 1999, London, UK) to date. The report was approved by the General Assembly.

On behalf of the SGA Treasurer, J. Pasava presented the Financial Report for 1999. The report was approved by the General Assembly.

After informing about major SGA past and future activities, Jan Pasava presented for voting at the General Assembly the proposal of nomination of Dr. Francis Saupé, former SGA Treasurer and Executive Secretary, to become a Honorary Member of SGA from 1.1.2001. The proposal was approved unanimously. ◆

!!! 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/www/sga/sga.html

Other requests will be not considered.

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

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SGA Executive Secretary

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SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS (SGA)

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SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS

Report of the Executive Secretary about membership

24 Regular Members, 5 Junior Members and 13 Student Members applied for membership from March 28, 2000 to October 10, 2000

LIST OF NEW SGA MEMBERS
(March 28, 2000-October 10, 2000)

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1: CRUSTAL-SCALE HYDROTHERMAL PALAEOFIELD AND RELATED LATE VARISCAN AU, SB, W OROGENIC DEPOSITS

Among the main metallogenic peaks recorded during earth history, the period which covers the building of the Variscan belt (Devonian-Carboniferous) is highly significant at the scale of Europe. Several types of Cu-Zn, Au, W, U world-class deposits have been mined since a very long time and are well documented. From Iberia to Bohemia, but also extending further East to the Urals and Tien Shan, the Variscan belt and its extension were formed during the tectonic accretion which conducted to the constitution of the Pangea continent. The links between this orogen and metallogeny have been often considered at the ore deposit or district scales, or else in reference to large sectors defined without any geodynamic background. It is therefore interesting to look at mineralisation at the scale of the province and of the crust and to date ore events in order to have better constraints on the duration of the "metalliferous peak".

Since the revival of gold exploration in France, and around the world, in the 1980's, a vast amount of exploration and research data has been acquired concerning French Variscan gold mineralisation. The in-depth consideration of ore-deposit genesis, both at gold-field and French Variscan belt scale, has revealed a major crustal-scale hydrothermal event at the end of the Variscan orogeny (Bouchot *et al.*, 1997). In the framework of the French research program GeoFrance 3D, it has been decided to focus the conceptual approaches of "metalliferous peak" and "crustal-scale hydrothermal palaeofield" on the French Massif Central as a test for the Variscan belt.

Research Framework: "3D Mapping and Metallogeny of the Massif Central" as part of GeoFrance3D

A research project, called "3D Mapping and Metallogeny of the Massif Central", has been launched in 1996 and will be achieved at the end of 2000. It was one of the regional projects under GeoFrance 3D programme, associating BRGM, INSU-CNRS and the French Ministry responsible for Scientific Research. The general aim of GeoFrance 3D is a detailed study of the lithosphere through setting up a 3D observatory that will concentrate the means for probing the earth's crust. The current approach is to combine geological and geophysical methods offering a "3D exchange system" for testing 3D imagery modelling resulting from each method.

The French Massif Central (Figure 1) is a metalliferous province that contains W-, Au-, Sb-rich districts for which a great deal of geological and metallogenic information is available (e.g. Cuney *et al.*, 1990; Cathelineau *et al.*, 1990). It is thus an area where 2D and 3D syntheses can be drawn using the available multi-source data, either acquired during the MCF3D project or already existing, and thus consolidated: i.e., data from the mining industry (mineral exploration, deposit development, associated thematic surveys), from scientific research on the Variscan belt (metamorphic assemblages and P-T conditions, structural and geochronological studies, etc.) and from field mapping, deep drilling and geophysics (seismic refraction, gravimetry).

The specific objective of the "3D Mapping and Metallogeny of the Massif Central" project was to study material transfer (fluids, magmas, metals, etc.), which is fundamental for understanding crustal dynamics. Oriented by the general theme of GeoFrance 3D, i.e., combining geological and geophysical methods, the study aims to: i) determine the source, circulation and trapping of the mineralising fluids at crustal scale, during the metalliferous peak that occurred around 300 Ma; ii) illustrate the permeability of the continental crust during a late collision stage and evaluate the contribution of deep fluid sources to the thermal balance.

The project was focused on three main questions:

1. The "metalliferous peak": which was its actual duration between 330 and 300 Ma? Did it consist of one or several pulses? Was it linked to particular geological and tectonic event(s)?
2. The crustal dimension of the hydrothermal palaeofields: apart from 2D Mapping of the Au-As pathfinders, can the hydrothermal palaeofields be documented in 3D and to what depth?
3. The origin and processes of magma and fluid circulation, and the conditions of mineralised fluid trapping: what were the events, at the province scale, likely to explain the origin of the metals and their concentrations?

The objective of this paper is to propose some answers to these questions. First, however, the late Variscan metalliferous peak will be framed within the orogenic history of the Variscan chain and differentiated from other known metalliferous peaks.

Variscan orogeny and metalliferous peaks

The European Variscides, extending from the Iberian Peninsula to Bohemia, are the result of continental collision between Gondwana and Baltica. This collision caused the development of a polyphased orogeny, lasting more than 100 Ma from the Devonian to the Autunian, and comprising three major successive periods - Eovariscan, Mesovariscan and Neovariscan (Ledru *et al.*, 1994).

The *Eovariscan period* (450-400 Ma) is characterized by the burial of oceanic and continental units during resorption of the Early Paleozoic ocean by subduction. In a sub-emerged island-arc context, sparse polymetallic Ag-Au VMS of epithermal affinity (La Haie Claire deposit, French Armorican Massif) were associated with acid volcanic activity at about 400 Ma.

The *Mesovariscan period* (400-350 Ma) is characterized by major thrusting events responsible for crustal thickening in the internal zone of the orogen. It ends by an early exhumation stage and lithospheric detachment marked since 360 Ma by the emplacement of tholeiitic successions and Zn-Cu-Pb-Ba VMS mainly in the northern part of the French Massif Central (Chessy, Brévenne, Figure 1).

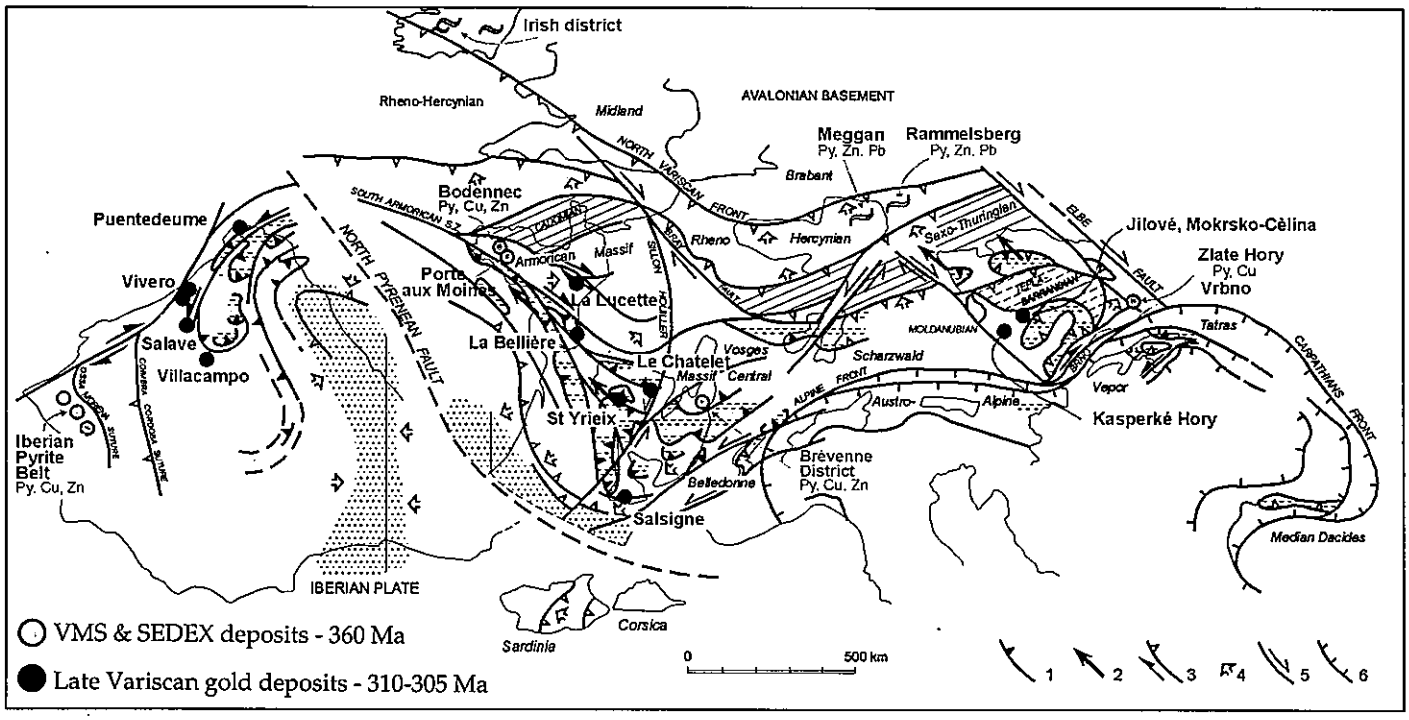

Figure 1: The French Massif Central in the European Variscan Belt: Location of main Gold and VMS/Sedex deposits.

The *Neovariscan I period* (350-325 Ma) is reflected by the development of surficial nappes in the external orogenic domain and major strike-slip faults (e.g., the South Armorican Shear zone) in the internal domain, representing evidence of post-collision adjustments. No mineralised fluid circulation in the crust is associated with this compressive period.

The *Neovariscan II period* (325-290 Ma) is marked by the progressive transition from a compressional to a generalized extensional regime characterized by major normal faults, return to equilibrium of the thickened crust, widespread granite intrusion and granulitisation of the base of the crust probably related to sub-crustal accretion of basic magma at about 300±15 Ma (Pin and Vielzeuf, 1983). This evolution corresponds to the final exhumation of the belt, associated with erosion and development of intracontinental coal basins (300-290 Ma). It was under these favourable conditions that occurred the main metalliferous peak marked by the circulation of arsenic-bearing fluids in the crust and the accumulation of W, Au and Sb concentrations throughout the Variscan belt.

Au-W-Sb metalliferous peak at 310-305 Ma

Almost all of France's lode gold deposits, distributed throughout 20 deposits (210 t of known gold production plus reserves) and 500 recorded occurrences, are genetically linked to a major Neovariscan II hydrothermal event. These gold deposits are epigenetic, post-metamorphic and structurally controlled. They belong to orogenic lode gold type ("mesothermal") according to the definition of Groves *et al.* (1998). In addition, a large part of W and Sb mineralisation is sub-coeval to gold deposition.

The uniqueness of this hydrothermal event is demonstrated by the sub-synchronous age of the different deposits. The absolute (Ar/Ar, U/Pb) and relative (geometry, biostratigraphy) dating methods that have been applied to the orebodies and associated rocks (granite, basin sediments, etc.) indicate that, at the scale of the Massif Central, trapping of W, Au, Sb in the crust occurred over a short lapse of time -in the order of 5 Ma- between 310 and 305 Ma:

- In the Limousin (Western Massif Central), indirect data show that the hydrothermal event occurs after the emplacement of Namuro-Wesphanian granites (gold-bearing quartz veins crosscuts the Porcherie granite, 317 ± 3 Ma U/Pb) and before the deposition of Stephanian conglomerates (palaeoplacers containing reworked gold-bearing pebbles in the Argentat basins, Bouchot *et al.*, 1999a);
- Radiometric Ar/Ar data on muscovite gives new constraints on the age of the main mineralisation events, between 309 ± 1.4 Ma (e.g., W-(Au) Vaulry deposit, Alexandrov, 2000) and 305±3 Ma (e.g. Au-Sb Cévennes, W-(Au) Châtaigneraie districts, Monié *et al.*, 2000).

The uniqueness of the mentioned hydrothermal event is also demonstrated by a similar two-stage paragenetic evolution both in the W, Au, and Sb mineralisation types; ores are differentiated only by variations of the W, Au, Sb ratios:

- *Stage 1* (W, As) – Infill of massive milky quartz with arsenopyrite (As), pyrite/pyrrhotite and wolframite/scheelite (W); later, this quartz is commonly deformed with syntectonic enrichment in arsenopyrite (As). Systematically present in the French Variscan mineralisation, arsenopyrite generally shows very low Au grades within its lattice, except in rare shallow deposits of the La Marche district (up to 1.6% Au in Le Châtelet deposit);
- *Stage 2* (Au followed by Sb) – Fissure infill of hyaline quartz with gold (Au) and a polymetallic sulphide and/or sulphosalt association (Bi, Pb, Zn, Ag, Cu), often followed by stibnite or Sb-sulphosalts.

This two-stage evolution is accompanied by an evolution in the nature of the fluids, with:

- *Stage 1* - C-O-H-N deep fluids, which were equilibrated with graphite-bearing metasediments at high temperature (~450°C in most cases). Whatever their ultimate origin, these "pseudo-metamorphic" fluids have lost their pristine signatures through protracted interaction with crustal reservoirs (Cathelineau *et al.*, 1999). In rare cases, saline (up to 15 wt % eq. NaCl) aqueous fluids have been identified (e.g., Châtaigneraie W district, Lerouge *et al.*, 2000);
- *Stage 2* – Progressive dilution and cooling of the deep crustal fluids by low-salinity aqueous shallower fluids (~150°-200°C) (Marignac *et al.*, 2000).

Crustal-scale As-Au-(Sb-)bearing hydrothermal palaeofields

Concerning the lode gold deposits, some differences are recorded (Bouchot *et al.*, 1997) in i) the textural history of the quartz veins (ductile polygonisation to brittle cataclasis); ii) deformation of gold-bearing faults (ductile to brittle), iii) mineral assemblages within their alteration zones (biotite to illite) and iv) P-T conditions. These differences reflect various trapping conditions related to a depth of emplacement between 15 km and the subsurface (less than 1 km deep at Le Châtelet). Peak P-T conditions were reached during the trapping of Stage 1 and varied between P= 5.5 kbars for T= 450°C (e.g., Salsigne) and P= 0.4 kbar for T= 200 ± 20°C (e.g. Villeranges). However, stage 2 P-T trapping conditions were typical of a shallower environment, thus reflecting a rapid rise of the crust during free gold trapping.

On the other hand, the gold concentrations occur within a hydrothermal palaeofield context with an arsenic signature, which is in accordance with the systematic presence of arsenopyrite in the Stage 1 of the Late Variscan mineralisation. The palaeofields are marked by continuous regional As anomalies (>80 ppm As) in the stream sediments. Mapping at the 1:1,000,000 scale (Bouchot *et al.*, 1997) has revealed that these geochemical anomalies mainly follow regional scale faults and fold (antiform). These structures served as channelways for hydrothermal fluids, as demonstrated in the field by large dissemination of phengite ± chlorite, arsenopyrite and pyrite.

In this context, the Argentat normal fault can be considered as a first order channelway of As-Au fluids at the regional scale. 3D-modelling from geological and geophysical data (seismic and gravimetric) shows the crustal extension of this fault which is extending down to the layered lower crust at about 20 km depth (the Argentat profile, Figure 2, Bitri *et al.*, 1999). It is thus confirmed that, as it has been demonstrated in Archaean and Proterozoic terranes (e.g. Mc Cuaig and Kerrich, 1998), the hydrothermal paleofield was of crustal-scale extension. Second order channelways for mineralisation have been identified at depth beneath the main St. Yrieix gold field (Figure 1). Lode gold deposits correspond to NE-SW quartz veins hosted by granites and gneisses. From the surface to 9 km depth (the Laurieras profile, Figure 2, Bitri *et al.*, 1999), low to moderately dipping discontinuities crosscut the flat reflectors of the gneissic units. These discontinuities are related in surface to WNW dipping senestral brittle NNE-SSW strike-slip fault and to ductile-brittle NE-SW gold-bearing faults.

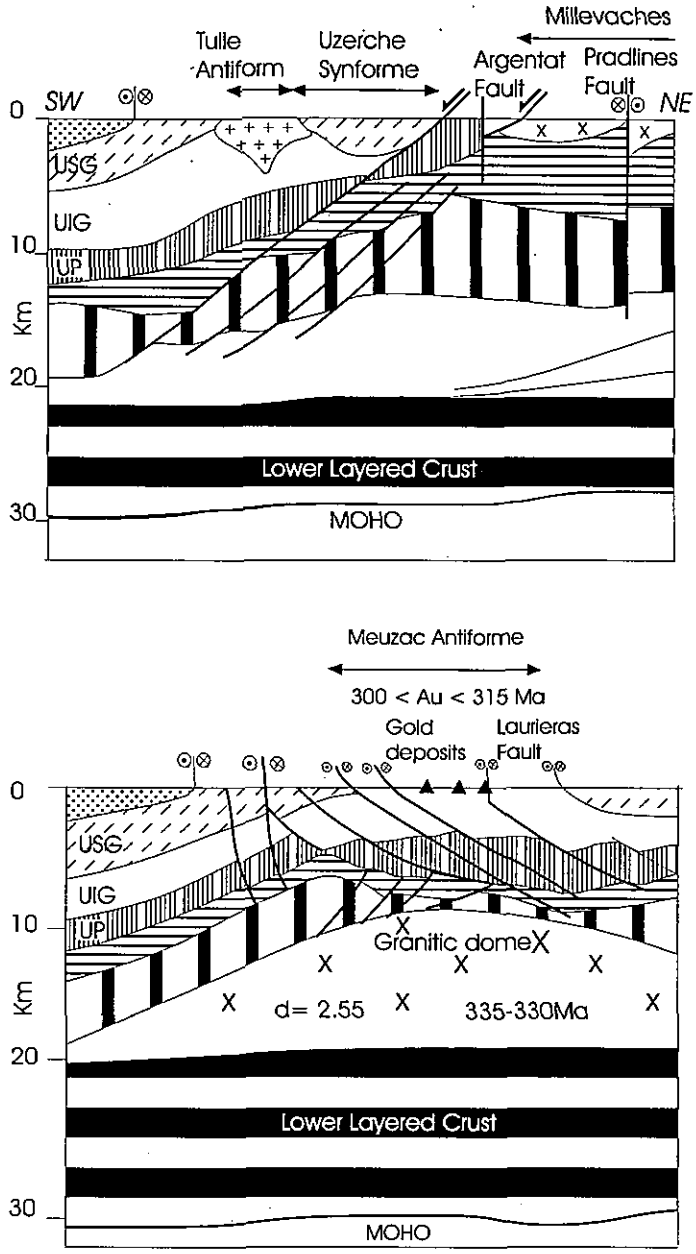

Figure 2 (top): Geological cross-section through the Argentat fault, based on seismic interpretation (Argentat profile) and gravimetric modelling; (bottom): Geological cross-section through the Saint-Yrieix gold based on seismic interpretation (Lauriéras profile) and gravimetric modelling. USG=Upper gneiss unit; UIG=Lower gneiss unit; UPM=Parautochthonous unit.

Consequently, the 3D extension of the channelways, their interconnection and the distribution of gold deposits at different crustal depths indicate that the Au-As hydrothermal palaeofields correspond to a complex network of crustal-scale hydrothermal system.

W, Li-F mineralisations related to specialised granites

In addition to Au-As-Sb bearing hydrothermal fluids, the transfer of other metals like W, Sn, As, Li, F is closely linked to a specialised magmatic activity, dated at 310-305 Ma:

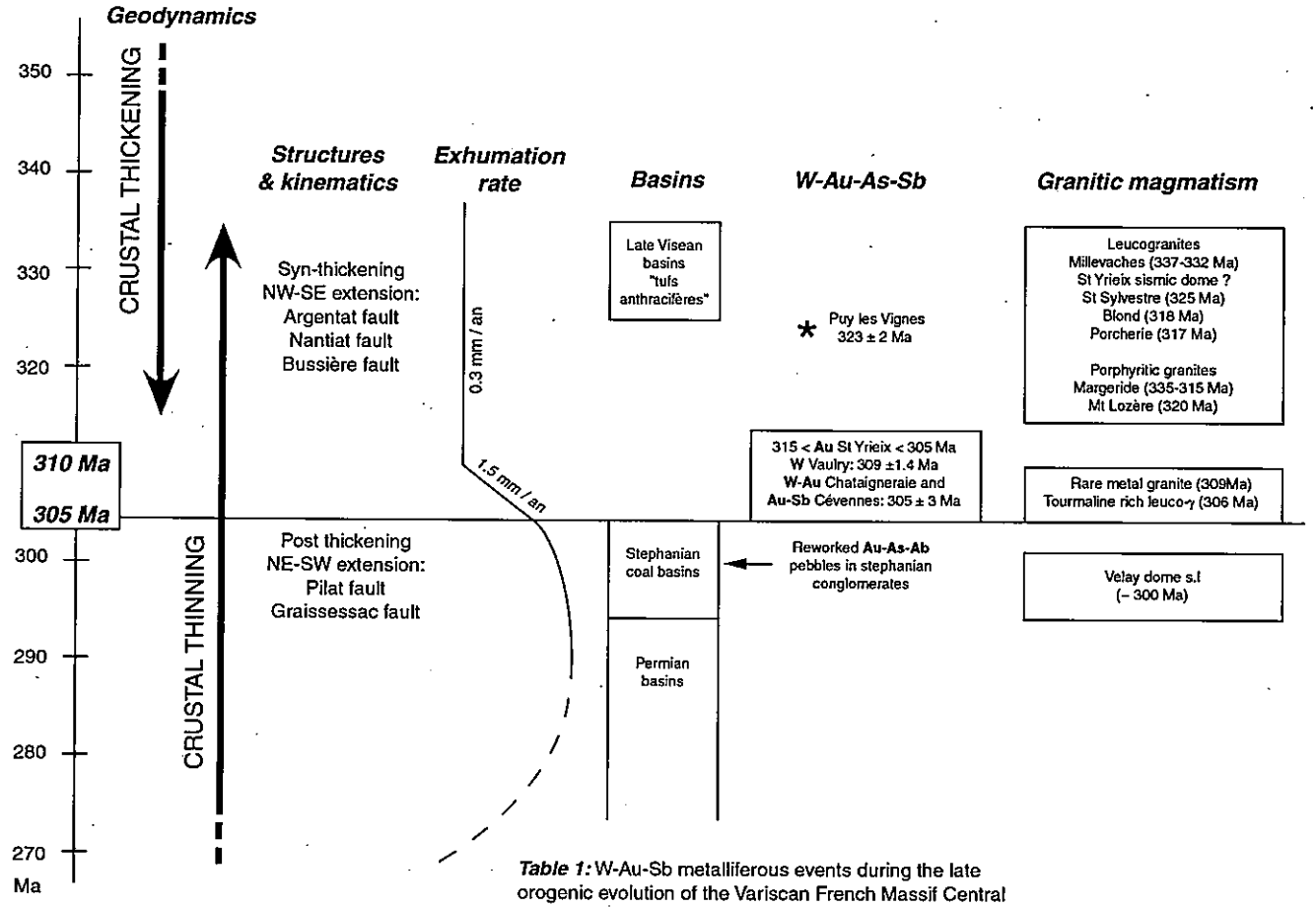

Table 1: W-Au-Sb metalliferous events during the late orogenic evolution of the Variscan French Massif Central

- The wolframite-bearing quartz veins of the Enguialès tungsten and minor gold deposit are dated at 305 ± 3 Ma (Ar/Ar, Monié *et al.*, 2000). This W mineralisation is genetically (isotopic study in Lerouge *et al.*, 2000) and temporally associated with tourmaline-rich leucogranites, dated also at 306±3 Ma (Ar/Ar, Monié *et al.*, 2000);
- Rare-metal (Li, F) leucogranites, located in the Northern part of the FMC, are dated at 308 ± 2 Ma (Ar/Ar, Cheilletz, 1992);The Vaulry W-(Au) veins, in the N-Limousin, are dated at 309 ± 1,4 Ma (Ar/Ar, Alexandrov, 2000). However, some tungsten deposits have been trapped earlier around 325 Ma (Ar/Ar in Alexandrov, 2000, see for example Puy des Vignes W deposit in Table 1).

From geochemical and isotopic data, these Late Variscan leucogranites are considered to have been derived from the granulitised lower crust (Williamson et al., 1996; Pichavant, oral comm. and Marignac and Cuney, 1999 for the rare-metal leucogranites). This granulitisation, illustrated by xenoliths brought up by Cenozoic volcanoes, is dated at 300 ± 15 Ma (Pin and Vielzeuf, 1983) and results from the rejuvenation of the lower crust during post-thickening collapse (Costa and Rey, 1995). Consequently, it is suggested that at 310-305 Ma, the transfer of metals was produced by two ways: (i) hydrothermal fluids carry Au, Sb, As (low amounts of W) metals, using structural channelways (first and second order faults) while (ii) specialised magmas carry magmatophile Li, F, W, As (low amounts of Au) metals. At the scale of the Province it appears that these specialised magmas are not associated with the gold-field.

The role of pre-existing structures within the upper crust

Structures observed in the upper crust of the French Massif Central are inherited from (i) the main thrust tectonics, (ii) the intense granitisation marked by the development of large migmatite-granite domes and intrusions along deep rooted fracture zones, (iii) a first syn-collision extensional phase followed by a second post-collision extension marked by normal faults. The development of the hydrothermal field between 310-305 Ma has interacted with these pre-existing structures whose role for the channelling of the mineralising fluids is discussed.

The early thrust-related structures are not affected by any significant hydrothermal alteration. They were active during the main stage of crustal thickening in the internal zone and are equilibrated in the conditions of the barrovian-type metamorphism as the regional foliation. However, the lithological contrasts and the mylonitic zones between the Upper and Lower Gneiss units, may have acted as a screen during later hydrothermal fluid circulation. Thus, in the Limousin, the fluids are trapped within granites and orthogneisses of the Lower Gneiss Unit, beneath the ophiolitic complexes and metagrauwackes with intercalations of eclogitic metabasics of the Upper Gneiss Unit.

The role of the granite-migmatite domes as pre-existing structures is one of the major contribution of the GeoFrance 3D project. Beneath the St. Yrieix gold field, from 9 to 11 km depth, the Laurieras seismic profile (Figure 2) indicates that the lowest unit, named Para-autochtonous unit, is crosscut by two types of discontinuities with opposite vergencies. The base of the two

systems is connected at 10-11 km at the top of a seismically dome-shape deaf zone. This dome is located in the core of the regional-scale Meuzac antiform. 2D gravimetric modelling taking into account the geological, structural and seismic imaging give a good fit between calculated and observed anomalies, by considering a buried dome with the density of a granite (d=2.55). This negative Bouguer anomaly linked with the granitic dome has an E-W trend on the Bouguer anomaly map and is limited eastward by the Argentat fault system. The origin of this granitic dome and its relationships with the hydrothermal palaeofield has been discussed (Bellot *et al.*, 2000). It is likely that the dome belongs to a late Visean granitic suite, represented by leucogranites and pegmatites known in the St. Yrieix gold field and dated at 330-335 Ma (Ar/Ar, Alexandrov, 2000). The hypothesis of a genetic link between the mid-crustal dome and a high temperature metamorphic event is also supported by the fact that Ar/Ar cooling ages show that the 350°C isotherm is crosscut at 338 ± 1,5 Ma (Alexandrov, 2000). A similar phenomenon is observed along the Argentat fault (Figure 1), where a synchronism is described between the migmatite-granite Millevaches dome emplacement, extensional tectonics along the Argentat fault and channelling of K- and B-rich hydrothermal fluids (Roig *et al.*, 2000). Therefore, it is suggested that the deep dome acted as a passive pluton and provided geometrical and rheological controls for the development or reactivation of extensional faults. Finally, extensional faults have often been percolated by hydrothermal fluids as at least a part of their development was coeval with the circulation of the fluids. This is the case of the Argentat normal fault which formed since late Visean and acted as the main channelway of As-Au fluid around 305 Ma.

Concerning the intrusion of specialised leucogranite at 305-310 Ma, it has been shown by 3D geological and geophysical modelling that intrusions often re-use conducts used by older granite marked by the location of root zones. This is the case of the 315 Ma Veinazès granite and spatially associated leucogranite (W-Châtaigneraie) dated at 305 Ma. Later, these conducts and the contact between the granites and their host rocks have played an important role in the channelling of the specialised magma.

The consequence of this structural and hydrothermal alteration pattern is that the permeability field of the Variscan belt, which was activated during the metalliferous peak, can be precisely defined in terms of mechanical discontinuities and used for predicting zones of transfer and possible metal concentration.

Orogenic evolution at 310-305 Ma

The Au-W-Sb metalliferous peak, dated at 310-305 Ma, occurred during a transition period in the orogenic evolution of the belt, coinciding with the transition between (Table 1):

1. the diachronous syn-collision NW-SE extension, marked by a slow rate of uplift (0.5 mm/y in Limousin, Scaillet,1996),
2. the generalised post-collision NNE-SSW extension that began with a sharp increase in the rate of uplift, estimated at 1.5 mm/y in the Limousin around 305 Ma, during the development of the metalliferous event. The peak therefore ended around 300 Ma, as indicated by conglomerates containing pebbles showing As-Au-Sb mineralisation in the Argentat and Alès Stephanian basins (Nomade *et al.*, 1999; Bouchot *et al.*, 1999-a).

It turns out that the geological setting of the W, Au, Sb mineralisation commonly records the transition between the NW-SE extension and the NNE-SSW extension (Au in South Limousin, Au-Sb in the Cévennes and W-(Au) in Châtaigneraie in Bouchot *et al.*, 1999b), while in other gold fields (e.g. Châtelet, Salsigne) only a sub-N-S shortening is indicated (Bouchot *et al.*, 1997).

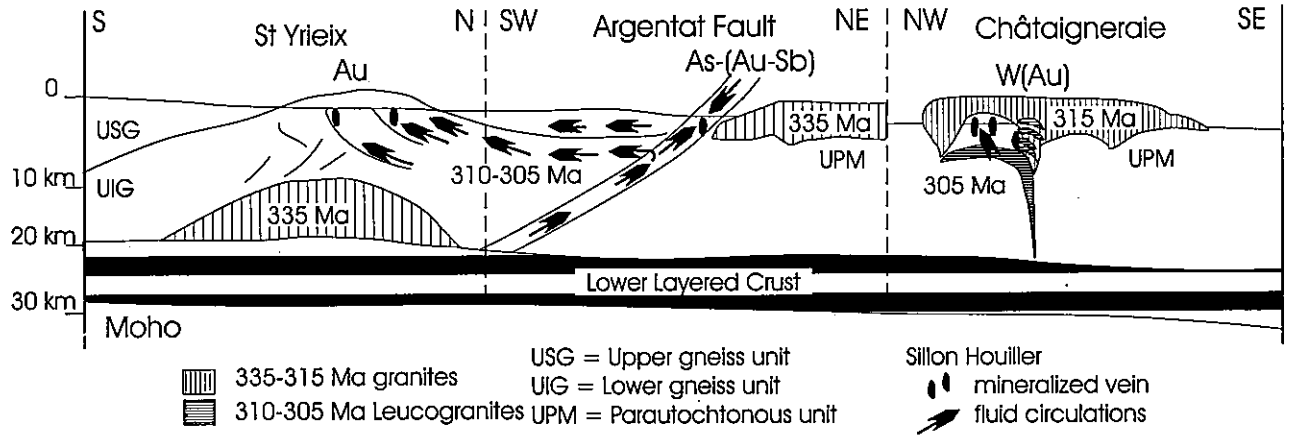

Figure 3: Crustal model at 310-305 Ma, realised from large range of geological (mapping, structural geology) geophysical (seismic, gravimetry), geochemical (stable isotope, dating, stream sediment geochemical inventory) data.

Granulitisation of the lower crust: A possible source for the late Variscan hydrothermal palaeofield

What event can be so widespread that it can account for the crustal-scale and shortness of the hydrothermal event? The hydrothermal event recorded at the scale of the crust coincide neither with the thermal peaks marked by the emplacement of large magmatic bodies in the crust (at 360 Ma; St. Sylvestre leucogranite and Margeride monzogranite at 330-315 Ma; Velay anatectic granite at 300 Ma), nor with the tectonic transition between the purely compressive stage of the collision and the syn-collision extension around 330 Ma. The metalliferous peak at 310-305 Ma corresponds to the transition to generalised post-collision extension and appears synchronous with the LP-HT granulitisation at the base of the crust (300 ± 15Ma, Pin and Vielzeuf, 1983). According to seismic profiles, the Moho is found between 28 and 31 km below the 8-10 km thick layered crust (Figure 2). Under such conditions, one can invoke the hypothesis (Figure 3) of a lower crust being the source of Au, As, W, As, Li, F metals, thus suggesting that the extraction of the metals was associated with a devolatilisation of the lower crust during granulitisation (Bouchot *et al.*, 2000). This hypothesis can partly explain the emplacement, during a short period, of Au-, Sb-, W-bearing mineralisation, distributed at the scale of Western Europe.

Conclusions

The GeoFrance 3D multidisciplinary approach, combining a large range of geological (mapping, structural geology) geophysical (seismic, gravimetry), and geochemical (stable isotope, dating, stream sediment geochemical inventory) methods, bring the following new results:

1- Evidence of a short duration Au-W-Sb metalliferous peak, between 310-305 Ma.
2- A complex network of crustal-scale hydrothermal system has been demonstrated by 3D extension of the channelways (seismic profiles), their interconnection (mapping) and the distribution of gold deposits at different crustal depths.
3- Two vectors for the metals are identified: hydrothermal fluids carried Au, Sb, As (low amounts of W) metals, using structural channelway (first and second order faults) and specialised magmas carried magmatophile Li, F, W, As (low amounts of Au) metals.
4- The importance of the pre-deformation of the upper crust, especially the role of large migmatite-granite domes as heterogeneity and mechanical discontinuity of the crust.
5- A possible common source for metals and deep seated fluids: the granulitisation of the lower crust.

The hypothesis of metal extraction from a deep source, coeval to granulitisation, enables one to explain (i) the continental and crustal extension of the metalliferous peak and (ii) its shortness at 310-305 Ma. Finally, the W-As-Au-Sb metalliferous peak constitutes an excellent marker of the late orogenic evolution of French Variscan Belt.

Could it exist, in other Palaeozoic belts, a similar metalliferous peak, related to orogenic Au, W, Sb deposits? A first answer is the evidence of an analogue metalliferous peak recognised in the Variscan Central Andes (Haeberlin, 2000). The test performed on the French Massif Central by compiling existing data and combining geological and geophysical methods has given sufficient new results on how a metallogenic province develops and could be extended to other segments of the Variscan belt.

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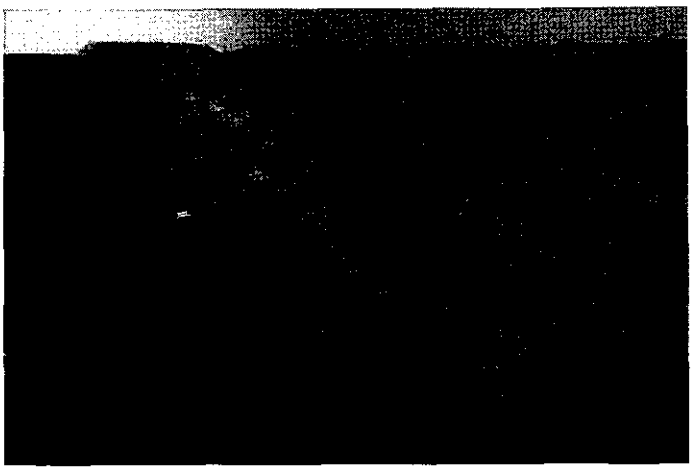

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18TH ANNUAL CORDILLERAN EXPLORATION ROUNDUP, Vancouver, B.C., Canada - Contact address: B.C. and Yukon Chamber of Mines, 840 West Hastings Street, Vancouver, B.C. V6C 1C8; phone: +604.681.5328; e-mail: chamber@chamberofmines.bc.ca; website: www.chamberofmines.bc.ca/rdup2001

★ February 12-16

CENTRAL NAMIBIAN PROTEROZOIC COPPER WORKSHOP, Windhoek, Namibia. Also included a Copper Hydrometallurgy (leaching) short course by Dr. Corale Brierly of Brierly Consulting, Colorado – Contact address: Nick Steven, Rockwater Consulting, 10 Evergreen Lane, Constantia, 7806, Cape Town, South Africa; phone: +27 21 794 4485; fax: +27 21 794 7641; e-mail: nsteven@mweb.co.za

★ February 26-28

SEG ANNUAL MEETING WITH THE SOCIETY FOR MINING, METALLURGY AND EXPLORATION (SME), Denver, CO, USA – Contact address: Diane Wolfgram, School of Mines and Engineering, Montana Tech of the University of Montana, 1300 West Park St., Butte, Montana 59701; phone: +1 406 4964 353; fax: +1 406 4964 260; e-mail: dwolfgram@mtech.edu

★ March 10-11

STRUCTURAL CONTROLS ON ORE GENESIS, Toronto, Ontario, Canada - Contact address: Brian Hoal, Executive Director, Society of Economic Geologists, Inc., 7811 Shaffer Parkway, Littleton, CO 80127; phone: +720.981.7882 Ext. 209; fax: +720 981 7874; e-mail: brianhoal@segweb.org

★ March 11-14

2001 INTERNATIONAL PROSPECTORS & DEVELOPERS ASSOCIATION OF CANADA (PDAC) CONVENTION, Toronto, Ontario, Canada. Contact PDAC, 34 King Street East, Ste. 900, Toronto, Ontario, Canada M5C 2X8; phone: +1 416 362 1969; fax: +1 416 362 0101; e-mail: info@pdac.ca

★ April 8-12 SGA-COSPONSORED

EUG XI, EUROPEAN UNION OF GEOSCIENCES, Strasbourg, France - Contact address: EUG Office, 5 rue René Descartes, 67084 Strasbourg Cedex, France; phone: +33 (0)3 88 45 01 91; fax: +33 (0) 3 88 60 38 87; e-mail: eug@eost.u-strasbg.fr; web-site: http://eost.u-strasbg.fr/EUG. A special symposium (A6) will be organized by GEODE/SGA: "The timing and location of major ore deposits in an evolving orogen". Convenors: Derek Blundell (Royal Holloway, London), Albrecht von Quadt (ETH-Zürich), and Franz Neubauer (Salzburg) (see page 16)

April 24-27

PROEXPLO 2001, II INTERNATIONAL CONGRESS OF PROSPECTORS AND EXPLORERS, Lima, Peru - Contact address: Instituto de Ingenieros de Minas del Perú, Los Canarios 154, Lima 12, Perú; phone: +51 1 349 4262; fax: +51 1 349 3721; e-mail: proexplo@iimp.org.pe; web-site: http://www.iimp.org.pe

★ May 2-4

XVI ECROFI - EUROPEAN CURRENT RESEARCH ON FLUIDS INCLUSIONS, Porto, Portugal - Contact address: XVI ECROFI, Depart. de Geologia, Faculdade de Ciências, Praça Gomes Teixeira, 4099-002 Porto, Portugal; phone: +351 22 3401471; fax: +351 22 2056456; e-mail: ecrofi@fc.up.pt; web-site: http://www.fc.up.pt/geo/ecrofi/ecrofi.htm

★ May 6-10

20TH INTERNATIONAL GEOCHEMICAL EXPLORATION SYMPOSIUM (IGES): «GEOCHEMISTRY AND EXPLORATION: 2001 AND BEYOND», Santiago de Chile, Chile - Contact address: 20th IGES c/o Acme Analytical Laboratories Chile; phone: +56 2 748 6771; fax: +56 2 748 6772; e-mail: proger3attglobal.net; web-site : http://www.aeg.org

★ May 9-12

47TH ANNUAL INSTITUTE ON LAKE SUPERIOR GEOLOGY, Madison, Wisconsin – Contact address: 47th Annual Institute on Lake Superior Geology c/o Wisconsin Geological and Natural History Survey, 3817 Mineral Point Road, Madison, WI 53705, USA; web-site: http://www.ilsgeology.org/2001Mtg.html

★ May 17-19

NEW DEVELOPMENTS IN METALLIFEROUS HYDROTHERMAL SYSTEMS, Jupiter Hotel, Townsville, Queensland, Australia – Contact address: Lucy Chapman, Manager, Economy Geology Research Unit, School of Earth Sciences, James Cook University, Townsville, Queensland, 4811, Australia; phone: + 61 7 4781 4726; fax: +61 7 4725 1501; e-mail: lucy.chapman@jcu.edu.au; web-site: http://www.es.jcu.edu.au/soseg (see page 16)

★ May 23-25

37TH FORUM ON THE GEOLOGY OF INDUSTRIAL MINERALS 2001, Victoria, B.C., Canada – Contact address: for technical program George Simandl, B.C. Geological Survey; phone:+1 250 952 0413; fax: +1 250 952 0381; e-mail: George Simandl@gems2.gov.bc.ca; for registration Susan Dunlop, CEOR, University of Victoria; phone:+1 250 472 4347; fax: 1 250 472 4100; e-mail: sdunlop@uvic.ca

★ May 27-30

GEOLOGICAL ASSOCIATION OF CANADA - MINERALOGICAL ASSOCIATION OF CANADA , JOINT ANNUAL MEETING, St John's, Newfoundland, AIB 4J6; phone: +1 709 729 4014; e-mail: dgl@zeppo.geosurv.gov.nf.ca; web-site: www.geosurv.gov.nf.ca/ listserv@morgan.ucs.mun.ca

May 28-31

6TH INTERNATIONAL SYMPOSIUM ON MINING IN THE ARCTIC, "Mining and Man", Nuuk, Greenland - Contact address: 6th International Symposium on Mining in the Arctic, Bureau of Minerals and Petroleum, Government of Greenland, P.O. Box 930, DK-3900 Nuuk, Greenland; phone: +299 34 68 00; fax: +299 32 43 02; e-mail: bmp@gh.gl; website: www.bmp.gl (see page 16)

★ June 10-15

10TH INTERNATIONAL SYMPOSIUM ON WATER-ROCK INTERACTION, Sardinia, Italy. Sponsored by the Working Group of the International Association of Geochemistry and Cosmochemistry - Contact address: Rosa Cidu, Dipartimento di Scienze della Terra, via Trentino 51, 1-09127 Cagliari, Italy; e-mail: cidur@unica.it

★ August 18-25 SGA-COSPONSORED

PALEOZOIC GEODYNAMICS AND INTRUSION-RELATED Au DEPOSITS IN THE ALTAIDS (KYRGYZSTAN), IGCP-373 field conference and excursion, Bishkek, Kyrgyzstan - Contact address: Reimar Seltmann, Natural History Museum, Dept. Mineralogy, Cromwell Road, London SW7 5BD, UK; phone: +44 207 942 5042; fax: +44 207 942 5537; e-mail: rs@nhm.ac.uk; web-site: http://www.nhm.ac.uk/mineralogy/ seltmann/IGCP/index.html

(☛ to page 17)

ANNOUNCEMENT

Training Course in Exploration and Environmental Geochemistry

Geochim
postgraduate course

Organized by the Czech Geological Survey, Prague and IGCP 429 with the support of UNESCO

Prague and Dolní Rozínka, Czech Republic 3 - 17 September 2001

Aims of the course
Certificated postgraduate course aims at providing knowledge of important geochemical methods widely used in the prospecting for ore deposits and at showing their applications in the solution of environmental problems. Individual lectures covering various geochemical methods will be accompanied by practical field and also computer training. The course will be followed by a 3 day field trip visiting ongoing open and underground mining operations and processing plants as well as abandoned mining sites with the aim to demonstrate possible ways of effective usage of geochemical methods in both exploration and environmental issues.

Contents of the course
Principles of exploration and environmental geochemistry, exploration and environmental applications of soil geochemistry, stream sediments, heavy minerals, biogeochemical, lithogeochemical, hydrogeochemical, geophysical and radiometric studies with practical field and computer training.

Language of the course
The official language of the course will be English.

Other information considered relevant to the course
For technical reasons, the number of participants has to be restricted to 15 persons.
Tuition fees including the cost of printed handouts is USD 100 for university postgraduate students, USD 200 for personnel from state agencies such as geological surveys and USD 400 for staff members of private companies. Accommodation, travelling and meals during the course will be covered by the organizers. International travelling to Prague is not included.
A diploma will be awarded to each successful participant.

Place: Prague (2 days), Dolní Rozínka - Hotel Duo (40 km North of Brno).

Duration: 3-17 September 2001

Application procedure
Applicants must have a good knowledge of English and the fundamentals of geochemistry. A BSc degree or equivalent is the minimum requirement.
The application form together with a short CV should be sent to organizers not latter than March 15, 2001.
Letter of acceptance with detailed programme, travel and payment instructions will be sent to selected applicants during May 2001.

Deadline for application
March 15, 2001

Contact address:
GEOCHIM 2001
Dr. Jan Pasava
Czech Geological Survey
Geologická 6
152 00 Prague 5 - Barrandov
phone: +420-2-5817390
fax:+420-2-5818748
e-mail: pasava@cgu.cz
masek@cgu.cz

APPLICATION FORM

GEOCHIM 2001
Training Course in Geochemical Exploration Methods and their Environmental Applications

Organized by the Czech Geological Survey in Prague and IGCP 429 with the support of UNESCO
Prague and Dolní Rozínka, Czech Republic
3 - 17 September, 2001

Name: ..... Surname: .....

Obtained degree: ..... Present position .....

Institution .....

Address .....

.....

.....

Phone: ..... Fax: .....

E-Mail: .....

Male/Female (please tick): Male ☐ Female ☐

Date: ..... Signature: .....

Return by March 15, 2001 to the above address

ANNOUNCEMENTS

MEETINGS, CONFERENCES, FIELD TRIPS AND SHORT-COURSES

GEODE/SGA SYMPOSIUM AT THE EUROPEAN UNION OF GEOSCIENCES ASSEMBLY

Strasbourg, France

8-12 April, 2001 SGA-COSPONSORED

SYMPOSIUM (A6): The timing and location of major ore deposits in an evolving orogen.
Convenors: Derek Blundell (Royal Holloway, London), Albrecht von Quadt (ETH-Zürich), and Franz Neubauer (Salzburg).

Major ore bodies form at particular times and locations within an evolving orogen as a consequence of the concurrence of geological circumstances that bring about the fluid transport of a metal charge, which is concentrated in a host rock. Different styles of mineralisation occur at different stages in the evolution of an orogen. An understanding of the timing and location of major ore deposits requires an appreciation of the tectonic settings and lithospheric processes that generate fluids and transport systems which lead to the concentration of ore deposits. This symposium, based on current research stimulated by the ESF programme GEODE, but looking globally, will focus on mineralisation processes on a range of scales within the lithosphere in areas of current tectonic activity, such as the SW Pacific region, the Andes, the Mediterranean region and the Carpathian Arc, and will relate them to major ore deposits in older orogens. In particular, it will emphasise the timing of events.

Contact persons:
Derek Blundell (d.blundell@gl.rhbnc.ac.uk)
Albrecht von Quadt (albrecht.vonquadt@erdw.ethz.ch)
Franz Neubauer (Franz.Neubauer@sbg.ac.at)
website: http://eost.u-strasbg.fr/EUG.

20TH INTERNATIONAL GEOCHEMICAL EXPLORATION SYMPOSIUM (IGES): «GEOCHEMISTRY AND EXPLORATION: 2001 AND BEYOND»

Santiago de Chile, Chile

6-10 May, 2001

Call for papers
A wide ranging and varied technical programme is planned to attract the practising exploration geologist to a forum for a frank interchange of ideas and models. Applications of Bleg, Rego Leach, Enzyme Leach and MMI have all proven of value in mineral exploration here recently. Applications of environmental geochemistry are also increasing very rapidly in South America, including sampling the sea bed and water at mineral export ports. Discussion of these, as well as testing conventional stream sediment, soil and rock geochemistry, using broad ranges of low levels of less common elements that are now available, due to rapid strides made in instrumentation, is proposed.

The technical programme will include:

- Exploration for concealed gold, diamond, porphyry copper and other base metal deposits
- Methods and case histories
- Arid saline environment exploration geochemistry
- Port site sea water and sea bed geochemistry
- Exploration in deeply weathered areas emphasizing partial extractions
- Isotope geochemistry applied to ore search
- Industrial mineral exploration for lithium, iodine, boron, borates and nitrates
- Geochemical bridges: environment and exploration applications

Short courses (provisional) to be held the weekend before the conference
1. Sediment exploration
2. Vegetation exploration
3. Quality control in exploration
4. Porphyry copper exploration models
5. Deep cover geochemical exploration methods
6. Application of Pearce element ratio (PER) diagrams

Planned trips
1. Covered and partially covered porphyry copper deposits in Chile
2. Weakly mineralized tops of high-sulfidation gold deposits in the Maricunga and El Indio belts of Chile and Argentina
3. Skarn deposits of the Tintaya area of Peru and the Cuzco area
4. Several low-sulfidation gold deposits of the Andes
5. Operating lithium, nitrate and borate mines in Chile and Argentina
6. Ore deposits and exploration geochemistry in Brazil

Additional information can be found at the following web-page: www.aeg.org

Contact address
20th IGES c/o Acme Analytical Laboratories Chile.
Phone: +56 2 748 6771
Fax: +56 2 748 6772
E-mail: proger3@attglobal.net or via www.aeg.org

NEW DEVELOPMENTS IN METALLIFEROUS HYDROTHERMAL SYSTEMS "2001, A HYDROTHERMAL ODYSSEY"

Townsville, Queensland, Australia

17-19 May, 2001

(Annoucement of 1st circular)

MAIN THEMES
1. Tectonic and Metallogeny
2. Deformation/ Chemistry/ Fluids/ modelling
3. Magmatic/ Metamorphic systems
4. Sed/ Volc systems
5. Microanalytical advances
6. Exploration technologies

There are pre-conference workshops (numerical/fluid flow; hydrothermal geochemical modelling, Andean tectono-metallogeny; epithermal-related clay alteration; skarn-porphyry-epithermal links; Fe-Cu-Au systems, intrusion-related sheeted gold systems), and a 5 day post-conference field trip to Mt Isa Block eastern succession to look at Fe-Cu-Au and regional alteration, including trips to Ernest Henry and Osborne.

CONTACT ADDRESS
EGRU 2001 Conference, School of Earth Sciences,
James Cook University,
Townsville QLD 4811, Australia.
Phone: +61 (0) 7 4781 5563; fax: +61 (0) 7 4725 1501; e-mail: odyssey@jcu.edu.au; web-site: www.es.jcu.edu.au/dept/earth/E/EGRU2.shtml

6TH INTERNATIONAL SYMPOSIUM ON MINING IN THE ARCTIC, "Mining and Man"

Nuuk, Greenland

28-31 May, 2001

MAIN THEMES
1. Mineral exploration
2. Mining engineering and mine design
3. Mining and sustainable development
4. Environmental impact, and mine opening/closure issues
5. Socio-economic issues related to mining
6. Health and safety

CONTACT ADDRESS
6th International Symposium on Mining in the Arctic, Bureau of Minerals and Petroleum, Government of Greenland, P.O. Box 930, DK-3900 Nuuk, Greenland
Phone: +299 34 68 00; fax: +299 32 43 02; e-mail: bmp@gh.gl; website: www.bmp.gl

GORDON CONFERENCE ON "INORGANIC GEOCHEMISTRY

Proctor Academy, New Hampshire

August, 2001

The next Gordon Conference on "Inorganic Geochemistry" particularly related to mineral deposits, is scheduled for August 19-24, 2001 at Proctor Academy, New Hampshire. The theme of the next conference will be the formation, modification and preservation of ore deposits, with a focus on geochemical processes related to tectonic, climatic and surficial factors.
As in previous years, space will be limited and the organizers will be seeking expressions of interest from those in academia, government and industry with interests in this general topic. Students will be encouraged to attend and subsidies for students are anticipated.
Registration details will be provided in early 2001. If you wish more information in the meantime, please contact Jeff Hedenquist at the following e-mail address: Gordongeochem@aol.com

Organizers: Jean Cline, Jeff Hedenquist and John Thompson

11TH IAGOD QUADRENNIAL SYMPOSIUM/ GEOCONGRESS 2002

Windhoek, Namibia

22-27 July, 2002 SGA-COSPONSORED

THEME
Earth Processes and Metallogenesis, with emphasis on Africa.

DATES
20 to 27 July, 2002: Pre-Congress Excursions (in various countries of southern Africa, possibly as far afield as Madagascar and Ghana).
29 July to 2 August, 2002: Congress in Windhoek, Namibia.
3 to 10 August, 2002: Post-Congress Excursions (as above).

CONGRESS VENUE
Safari Hotel, Windhoek, Namibia.

HOSTS
Geological Society of Namibia
Geological Society of South Africa
Geological Society of Zambia

CONTACT ADDRESS
The Secretary, IAGOD/GEOCONGRESS 2002
P.O. Box 44283
LINDEN 2104
SOUTH AFRICA

A Congress web page will be online in due course with updated information at http://www.wits.ac.za/gssa and other links.

FORTHCOMING EVENTS *(from page 14)*

August 19-24

GORDON CONFERENCE on "Inorganic Geochemistry" particularly related to mineral deposits, Proctor Academy, New Hampshire - Contact address: Jeff Hedenquist; e-mail: Gordongeochem@aol.com (see page 16)

August 26-29 SGA-COSPONSORED

6TH SGA BIENNIAL MEETING JOINTLY ORGANIZED WITH SEG, Kraków, Poland - Contact address: Secretary - Dr. Adam Piestrzyński, University of Mining and Metallurgy, av. Mickiewicza 30; 30-059 Kraków, Poland; phone: +48-12-6172433; fax: +48 12 6332 936; e-mail: piestrz@geol.agh.edu.pl; web-site: http://galaxy.uci.agh.edu.pl/~sga/ (see page 20)

★ August 31- September 12

FIELD EXCURSION TO THE SKAERGAARD INTRUSION, EAST GREENLAND. Sponsored by the Camborne School of Mines, IGCP Project 427, and affilated with the 6th Biennal SGA Meeting - Contact address: Dr. Jens C. Andersen, Camborne School of Mines, University of Exeter, Redruth, Cornwall, UK; phone: +44 1209 714866; fax: +44 1209 716977; e-mail: andersen@csm.ex.ac.uk; web-site: http://www.ex.ac.uk/CSM/news/confs.htm

★ September 24-28 SGA-COSPONSORED

4TH INTERNATIONAL ARCHAEAN SYMPOSIUM, Perth, Australia - Contact address: Dr. Susan Ho, Secretary 4th International Archaean Symposium, PO Box 80, Bullcreek WA 6149, Australia; phone: +61 8 9332 7350; fax: +61 8 9310 6694; e-mail: susanho@geol.uwa.edu.au; web-site: http://redback.geol.uwa.edu.au/~ias/general.html

★ October 21-24

3RD SOUTH AMERICAN SYMPOSIUM ON ISOTOPE GEOLOGY, PUCON, CHILE - Contact address: The organizing commitee, III SSAGI, Laboratorio SERNAGEOMIN, Til-Til 1993 Ñuñoa, Santiago, Chile; phone: +56 2 238 5292; fax: +56 2 238 5332; e-mail: ssagi@sernageomin.cl; web-site: http://www.sernageomin.cl/ssagi

★ October 28-November 3

EPITHERMAL GOLD MINERALIZATION AND MODERN ANALOGUES FIELD TRIP, Kyushu, Japan - Contact address: The Society of Economic Geologists, Inc., 7811 Shaffer Parkway, Littleton, CO 80127; phone: +720 981 7882; fax: +720 981 7874; e-mail: seg@segweb.org

2002

★ 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 17)

★ September 24-28 SGA-COSPONSORED

URANIUM DEPOSITS: FROM THEIR GENESIS TO THEIR ENVIRONMENTAL IMPACTS, Prague, Czech Republic - Contact address: Bohdan Kříbek, Czech Geological Survey, Geologická 6, 152 00 Prague 5, Czech Republic; phone: +422 51085 518, +422 5817390, fax: +422 5817 390; e-mail: kribek@cgu.cz

OPEN POSITION

Lowell Chair in Economic Geology
University of Arizona

The Department of Geosciences invites applications for the J. David Lowell Chair in Economic Geology, a tenure-eligible faculty position to be filled in 2001. We seek applicants interested in carrying out innovative teaching and research in the area of economic geology, including applied issues directly related to the discovery, development and production of mineral deposits. We are looking for individuals who approach broad-based applied issues from a geological perspective and who can combine academic and industrial interests. A requirement of the position is to develop and coordinate innovative graduate professional training programs related to mineral exploration and production. Excellence in basic or applied research related to mineral deposits is also expected. The level of appointment will be commensurate with qualifications. A Ph.D. or equivalent degree is required.

The Department of Geosciences is committed to sustained excellence in research and innovative teaching in economic geology both at the undergraduate and graduate levels. The selection process will begin December 15, 2000, and will continue until the position is filled. Interested applicants should submit a curriculum vitae, a statement of research, a statement of teaching interests (specifically addressing opportunities in professional education), and a list of at least three references (with addresses, e-mail, phone, and fax numbers) to:

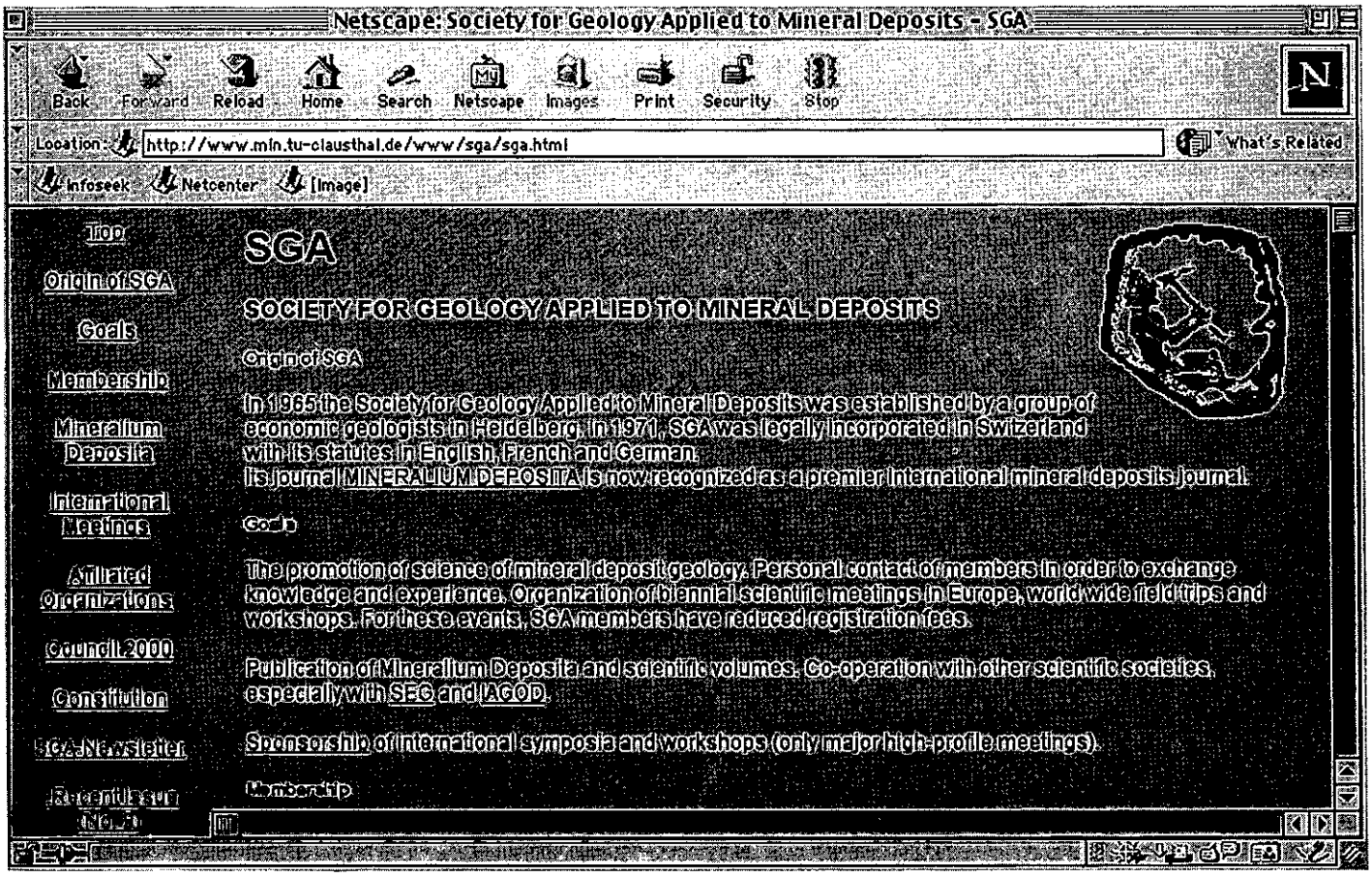
Chairman, Lowell Search Committee
Department of Geosciences
The University of Arizona
Gould-Simpson Building
1040 E. Fourth Street
Tucson, AZ 85721
phone: (520)-621-6024
FAX: (520)-621-2672
chair@geo.arizona.edu

Please reference job number 19393.

The University of Arizona is an EEO/AA Employer - M/W/D/V

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, world-wide 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.



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

❑ 65 EUROS (~65 US$)	Regular
❑ 45 EUROS (~45 US$)	Junior (up to 4 y after Ms. Sc., Ph.D.)*
❑ 25 EUROS (~25 US$)	Student (up to Ph. D., max. 4 years)*
❑ 45 EUROS (~45 US$)	Senior (after retirement)*
❑ 200 EUROS (~200 US$)	Corporate (includes 3 copies of *Mineralium Deposita*)

*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 _____
_____

SPONSOR 2 _____
_____

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. Subsides 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)

in collaboration with

SOCIETY OF ECONOMIC GEOLOGISTS (SEG)

in cooperation with

UNIVERSITY OF MINING AND METALLURGY
STATE GEOLOGICAL INSTITUTE
KGHM POLISH COPPER Ltd.

August 26-29, 2001
Kraków (Poland)

Sixth Biennial SGA Meeting

ORGANISATION COMITEE

Adam Piestrzyski (UMM, Chairman), Maciej Podemski (PGI, Vice-Chairman), Wojciech Mayer (UMM, Secretary), Jadwiga Pieczonka (UMM, Treasurer), Janusz Magiera (UMM, Exhibitions), Zbigniew Sawlowicz (JU, Excursions), Cezary Bachowski (KGHM PC SA), Marian Banao (UMM), Marta Basta-Grzywacz, (UMM), Pavel Boultruchuk (Ukraine), Peter Herzig (Treasurer, SGA), Henryk Kucha (UMM), David Leach (SGA), Heikki Papunen (President, SGA), Jan Pasava (Executive Secretary, SGA), Tadeusz Peryt (PGI), Slawomir Porzucek (UMM, Internet), Holly Stein (SEG), Chris Stanley (SGA).

SPONSORS

Ministry of Education, Ministry of Environment, University of Mining and Metallurgy, KGHM Polish Copper S.A., International Geological Correlation Programs 373, 429, 443, GEODE, Polish Geological Institute

INVITATION BY THE ORGANISING COMMITTEE

The Organising Committee of the Joint 6th biennial SGA-SEG Meeting invites geologists from universities, research institutions and industry to the discussion on the role of economic geology in the new century - a period of global economy - with special attention paid to central and eastern Europe where ore deposits are still exploited. We would like to summarize what has already been achieved in studies on mineral deposits and what should be done in the immediate future in order to further understand geological processes and to meet the expectations of the mineral industry with due attention paid to environmental aspects.

The meeting will be held in Kraków, Poland, at the Main Building of the University of Mining and Metallurgy (UMM).

GENERAL INFORMATION

Travel to Kraków

Kraków has convenient flight connections with major European international airports including Frankfurt, London, Paris, Vienna, Zurich, Rome and Chicago. Good railway and bus connections are also available with western, eastern and southern Europe.

Public transport is available from and to the Kraków Airport and railway station. Bus numbers are indicated in the sketch map. The Organising Committee recommends the Radio Taxi Company to provide transport in the city area (dial 919). Approximate transportation cost from/to the Kraków Airport is 15 USD (one way).

Language

The official language of the Meeting will be English. All publications and information will be issued in English. Simultaneous translations of oral presentations will not be available.

Meeting Venue

The Meeting will be held at the Main Building of the University of Mining and Metallurgy in Kraków, 30-059 Kraków, Al. Mickiewicza 30.

SCIENTIFIC PROGRAMME

Thematic Sessions

There will be three days of oral and poster

S1. The role of organic matter in the formation of mineral deposits and related environmental issues (co-sponsored by the IGCP 429).

S2. Lead-zinc deposits

S2.1 Special session co-sponsored by the GEODE: Geodynamic setting of major basin-hosted lead-zinc mineral provinces)

S3. Formation and evolution of stratiform and strata-bound copper deposits

S4. Styles and global comparison of volcanogenic massive sulphide deposits (VMS) - ancient and modern

S5. Mineralising systems associated with acid magmas (co-sponsored by the IGCP 373)

S5.1 Special session co-sponsored by the GEODE: Balkan-Carpathian magmatic hydrothermal Cu-Au-Pb-Zn-Ag Province

S6. Mineral deposits associated with mafic and ultramafic rocks, including chromitites, Fe-Ti oxides, Ni-Cu sulphides (intrusive or extrusive), Ni-Co laterites

S6.1 Special session dedicated to Professor Eugen F Stumpfl: Genesis of PGE deposits -further thoughts 2001

S7. Gold and precious metal deposits

S7.1 Special session co-sponsored by the GEODE: Gold deposits in orogenic belts focusing on the Variscides)

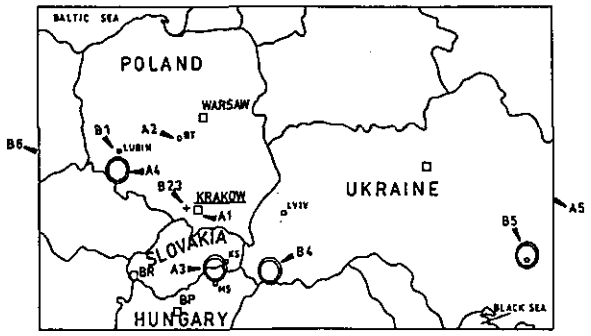
S8. Metamorphism affecting mineral deposits

S9. Industrial mineral deposits
S9.1 Special session co-sponsored by the IGCP 443 - Magnesite and Talc)
S10. Environmental aspects of mining industry
S11. Economic evaluation of mineral deposits
S12. Open session

Workshops
The following workshops are proposed under working titles.
1. Remote Sensing in the Environmental Issues
Leaders: Dr. J. M. Moore, Dr. Jian Guo Liu (Imperial College, London, UK)
E-mail: j.m.moore@ic.ac.uk
Topic: Application of various RS and GIS techniques to the environmental problems. Duration and details under negiotiations.
2. Geoenvironmental Models of Mineral Deposits
Leader: Dr. Geoff Plumlee,(US Geological Survey, Denver, USA)
E-mail: gplumlee@helios.cr.usgs.gov
Topics: Development and application of geoenvironmental models of mineral deposits.
Duration and details under negiotiations.
3. The Role of Geology in Preventing Underground Mining Disasters
Leader: Prof. Walter Pohl, (Technical University, Braunschweig, Germany)
E-mail: walter.pohl@tu-bs.de
Duration: one day
Minimum number of participants: 12
Topics: Water and mud inrushes, failures of crown pillars, sinkhole formation, ground collapse, rockbursts, methane or carbon dioxide bursts. It is expected that participants will contribute with their own experience and studies on specific cases.
4. Tectonics and metallogeny of Northeastern Asia
Leaders: Dr. W. J. Nokleberg (US Geological Survey, USA), Prof. A. A. Obolenskiy (Russian Academy of Science, Russia)
E-mail: obolensk@uiggm.usc.ru
Topics: Geodynamic and metallogenic maps of NE Asia, preliminary time - space tectonic and metallogenic model of NE Asia from Archean to Present.

FIELD EXCURSIONS

The Organising Committee offers a variety of pre- and post-meeting excursions, indicated as A and B, respectively. The excursions aim to present a wide spectrum of geological and environmental problems related to mineral deposits in Poland, Slovakia, Hungary, Ukraine, Scandinavia, Kyrgystan and Greenland. Pre-registration for field excursions should be made together with the meeting registration. All excursions are offered on a first come-first served basis. Excursion will cancelled if insufficient numbers of participants registered. Registration fees should be paid to the Organising Committee except the A5, A6, B6 and B7 trips.
For information please, contact the Field Excursion Manager: Dr. Zbigniew Sawlowicz (E-mail: zbyszek@ing.uj.edu.pl; fax: 48-12-6332270). Additional information on specific excursions can be obtained directly from the named organizer by e-mail, fax or phone.



BP: Budapest, BR: Bratislawa, KS: Kosice, MS: Miskolc, BT: Belchatów

Premeeting trips
A1. Miocene rock salt deposit in Wieliczka near Kraków
Course leaders: A. Garlicki and K. Bukowski (e-mail: tob@geolog.geol.agh.edu.pl)
The Wieliczka Rock-salt Mine is the oldest still operating mine in the world (first UNESCO list of World Cultural Heritage). The Tertiary (Miocene) layered salt deposit was deformed by the overthrusting Carpathian Flysch nappes. The standard tourist route (including the underground museum) will be extended to visit various geological aspects of the salt deposit, including the excellent examples of salt tectonics. Hydrological and ecological problems will be discussed underground and on the surface.
25th August, 2001 (one day). Start and end: Kraków. Minimum and maximum number of participants: 10-25. Cost: 90 USD (including transport, lunch and ticket to the historical mine).

A2. Miocene brown coal deposit (tectonic type) in Belchatów (Central Poland)
Course leader: Tadeusz Ratajczak (e-mail: rataj@agh.edu.pl). The huge, Tertiary (Miocene) brown coal (lignite) deposit (annual production about 40 Mt) is located in a deep tectonic graben. The interesting tectonic features including Quaternary glacitectonics, geotechnical problems of slope stability, hydrogeological problems related to the adjacent salt diapir, accompanying raw-materials (clays, sands, chalk) and environmental issues will be presented and discussed.
25th August, 2001 (one day). Start and end: Kraków. Minimum and maximum number of participants: 15-20. Cost: 100 USD (including transport and lunch)

A3. Polymetallic mineralisation and mineral deposits of Slovakia and Hungary
Course leaders: Slovakia: Jaroslav Lexa (lexa@gssr.sk) and Igor Rojkowic (e-mail: rojkovic@fns.uniba.sk); Hungary: Ferenc Molnar (e-mail: molnar@ulixes.geobio.elte.hu) and Tibor Zelenka (e-mail: zelenka@ mgsz.hu).
Slovakia: 1.Hydrothermal mineralisation in the Central Slovakian Volcanic Field: Kremnica - collapsed mine field with typical low-sulfur, epithermal siliceous veins, visit to historical Kremnica town, Stara Kremnicka - siliceous lacustrine sediments, Hodrusa - gold mine, Hudorsa - underground museum of the "All Saints" veins, Banska Stiavnica: Lobov quarry with high-sulfur system alterations, Spitaler Pb-Zn-Cu (Au, Ag) vein open pit, Klokoc: high-sulfur system Au-mineralisation. 2.Mineral deposits in the Slovenske Rudohorie Mts: Nizna Slana: metasomatic-hydrothermal siderite deposit, Jelsava: magnesite deposit, Ochtina: aragonite cave with siderite mineralisation.
Hungary: 1.The Tokaj Mts.: volcanism and shallow levels of low-sulfur-type epithermal systems, siliceous lacustrine deposits, hydrothermal eruption breccia with cinnabar mineralisation, steam-heated alteration zones, Telkibanya: Medieval gold-silver deposit, zeolitic tuffs, Palhaza perlite quarry, dacite paleovolcano with lava and pyroclastic flow deposits. Wine party and closing dinner at the old Sarospatak castle.
21-26 August, 2001 (six days). Start and end: Kraków. Minimum and maximum number of participants: 18-25. Cost: 700 USD (including transport and accommodation)

A4. Mineral deposits of the Lower Silesia (including the Sudety Mts.) (Poland)
Course leaders: Andrzej Solecki, Wojciech Oliwilski, Stanislaw Mikulski (smik@pgi. waw.pl)
Zloty Stok (ancient Au-As mine, ore tailings, environmental impact), Stronie Ol1skie (limestone quarry, construction stones), Oldrzychowice (crystalline limestone quarry, aggregate and grit), Szklary Z1bkowickie (abandoned lateritic nickel mine with chrysoprase and magnesite veins), Kowalskie and Targowica (Tertiary basalt neck and lava flows, explosive facies), Strzelin (granitoid quarry), Jeglowa (refractory schists), Wiry (underground magnesite mine), Jaroszów (refractory kaolinite clays and Tertiary lignite seam); Strzegom area (granite quarries); Walbrzych area (trachyandesite/"melaphyre" quarry), Krzeniów (Tertiary basalt with bentonite by-product), Boleslawiec area (construction sandstone quarry), Nowogrodziec (kaolinite mine in Santonian sandstones), Osiecznica - one of the best, high-quality glass-sand deposits in Europe, museum of Abraham Gottlob Werner.
22-26th August, 2001 (five days). Start: Wroclaw, end: Kraków. Minimum and maximum number of participants: 20-25. Cost: 450 USD (including transport and accommodation)

A5. Paleozoic geodynamics and intrusion-related Au deposits in the Altaids (Kyrgystan)
Course leaders: A. Bakirov, R. Jenchuraeva, R. Maksumova, N. Maliukova, N. Pak, V. Pomaskov, Yu. Rykov
Trip Organising Committee: Chief Organizer: R. Seltmann (NHM London/UK), A.Bakirov (Director, Institute of Geology, NAS), R. Jenchuraeva (Chief of the

laboratory, Institute of Geology), S. Murzagaziev (Director, Agency of Geology and Interior Protection), O. Sadyrov (Director, Alex Stewart Assayers Kyrgyzstan Ltd. Kara-Balta), K. Kudaybergenov (President, Kyrgyz Altyn, Kumtor Operating Company), Terry Rogers, T. Shaildaeva (Kumtor Operating Company).
18-25 August 2001 (8 days) Start and end: Bishkek, Maximum number of participants incl. leaders is 32. Cost: 1000.- USD. (Fee includes local flight, accommodation and food for excursion period from 18 Aug. a.m. to 25 Aug. 2001 incl., i.e. 8 days and 7 nights, but does not include accommodation and subsistence before and after those dates. Not included are the travel expenses to/from Kyrgyzstan that may be block-booked when number of participants is known. Contact address for more detailed information and payment: Dr. Reimar Seltmann (rs@nhm.ac.uk) Natural History Museum, Department of Mineralogy, Cromwell Road, London SW75BD, UK; Phone: +44 207 942-5042; Fax: +44 207 942-5537.
Provisional Itinerary: *Details of the programme may be changed depending on international flight schedules and accessibility.*
Saturday, 18 August: 8:00 a.m. local time departure by plane (Yak-40) for Makmal gold deposit. Visit to open pit, lunch and return to Bishkek in the evening (hotel). Impregnation-type gold mineralisation at the contact of Permian leucocratic granites (magnetite skarns, rare-metal greisens, massive pyrite-base metal and impregnated gold-sulfide ore mineralisation) controlled by quartz-plagioclase metasomatites, beresites and zones of silicification.
Sunday, 19 August: Breakfast and bus trip to Orlovka settlement (110km), 2 nights at hotel. Bus trip (14km) to the Taldy-Bulak Levoberezhny gold deposit (adit, outcrops) and to the Boordy Au-bearing base metal deposit. Taldy-Bulak Levoberezhny: gold-sulfide-quartz-tourmaline mineralisation (copper-gold porphyry, grade: Au - 4.7 ppm; Ag - 4.5 ppm) in the melange zone hosted by subvolcanic intrusions accompanied by explosive breccias. Orebodies are controlled spatially by diorites and monzo-diorites (D-C). Boordy: temporarily closed base metal deposit with gold mineralisation hosted in quartz-tourmaline veins at the contact of rhyolite dikes with porphyritic granites and gneisses.
Monday, 20 August: Early breakfast and bus trip (70km) to the REE-base metal deposit Aktyuz (open pit). Field lunch, at 2 p.m. departure to the Issyk-Kul lake (180km). On the way: Devonian bimodal volcanics and megacrystalline Akkulen syenites.
The Aktyuz REE-base metal deposit (Nb-Th-Zr-REE-base metals) comprises two separated stocks of alaskite-type granite and granophyre (P). The main ore mineralisation is controlled by quartz-sericite and quartz-sericite-chlorite metasomatites.
Tuesday/Wednesday, 21/22 August: Issyk-Kul (hotel White Ship). Trip by bus or plane (if mining site of the Kumtor Operating Company will be at disposal) to the large gold deposit Kumtor (about 4,000m a.s.l.). The Kumtor deposit (Au-quartz-type, grade: Au - 4.1 ppm, Ag - 2 ppm, WO3 - 0.12 %.) forms a large stockwork in Vendian carbon-bearing schists. The quartz veins and veinlets are combined with quartz-albite, quartz-feldspathic and sericitic (beresite) wallrock metasomatites. Ore zones are localized in a thick overthrust zone.
Thursday/Friday, 23/24 August: Visit to Issyk-Kul coastal placers of gold and ruby. Scientific discussion. Final dinner with cultural programme (picnic on board of the ship "Moskva").
Saturday, 25 August: Departure to Bishkek, arrival in late afternoon.
Sunday, 26 August: Block-booked or individual return flights of participants.

A6. Svecofennian ore-forming environments (sponsored by SEG)
The c.1.9 Ga old Svecofennian crust of the Fennoscandian Shield is the most densely mineralized crustal segment of Europe with a mining record for more than millenium. Metal production includes Fe, Mn, Cu, Zn, Pb, Ag, Au, W, and Mo. This field tripwill focus attention on three principal ore-bearing terranes in Sweden: Norrbotten, Skellefte district and Bergslagen with visits to among others Kiruna, Aitik, Kristineberg, Boliden, Sala, Garpenberg, Falun, Bispberg, Wigstrom and Zinkgruvann.
15-25 August, 2001. Estimated Costs: USD 1450-1700. More information will be obtained from Krister.Sundblad@geo.ntnu.no or Per.Weihed@sgu.se

Post-meeting trips

B1. Copper-silver deposits (Kupferschiefer-type) in the Lubin-Glogów district (Poland)
Course leaders: Zbigniew Sawlowicz (e-mail: zbyszek@ing.uj.edu.pl) and mining geologists.
The copper-silver, Kupferschiefer-type deposit in Lubin District belongs to the largest recently mined base metal localities in the world with mineable reserves nearly 1 Bt of wet ore grading between 1.5 and 2.0 wt.% Cu. The tabular ore zone includes Upper Permian (Zechstein) sandstones, black shales and carbonate sequence. Apart from Cu the disseminated sulphide mineralisation includes numerous trace elements including noble metals. First day (29th August) - late afternoon, departure from Kraków by bus, accommodation in Lubin. Second day (30th August): Visit to the Rudna Mine - thick ore body in sandstones and overlying shales, massive ores and anhydrite bodies in fossil dunes. In the afternoon - visit to the drill-core storage camp. Accommodation in Lubin. Third day (31st August): Visit to the Polkowice Mine - typical ore zone in sandstones, shales and carbonates, oxidized facies with presumed economic concentrations of Au and PGM. In the afternoon - return bus trip to Kraków (optionally to Wroclaw) included.
29-31st August, 2001 (three days). Start and end: Kraków (optionally Wroclaw). Minimum and maximum: 10-15. Cost: 200 USD (includes transport Kraków-Lubin-Kraków/Wroclaw, accommodation and meals).

B2. Zinc and lead deposits (MVT), in the Muschelkalk carbonates, transgressive contact of the Muschelkalk with the Paleozoic basement (Poland)
Course leaders: Maria Sass-Gustkiewicz (e-mail: sass-gus@geol.agh.edu.pl), Marek Michalik (e-mail: michalik@ing.uj.edu.pl), Jerzy Socha.
The "Pomorzany" Mine near Olkusz; 40 km NW from Kraków - Kraków-Silesian lead and zinc deposits (MVT) hosted in the Muschelkalk carbonate rocks - metasomatic and breccia ores, mineralized karst with the internal karst sediments; Boleslaw - abandoned open pit, gossan (galman) ores; Stare Gliny near Klucze - transgressive contact of Triassic carbonates with Devonian rocks, Triassic paleogeography.
30th August, 2001 (one day). Start and end: Kraków. Minimum and maximum number of participants: 10-14. Cost: 80 USD (including transport and lunch).

B3. Zinc and lead deposits (MVT) in the Muschelkalk carbonates, Paleozoic and Mezosoic formations in Kraków region (Poland)
Course leaders: Marek Szuwarzylski, Marek Michalik (e-mail: michalik@ing.uj.edu.pl).
The "Trzebionka" mine in Trzebinia (35 km W from Kraków) - Kraków-Silesian lead and zinc MVT ore deposits in the Muschelkalk carbonates; metasomatic ores and processes; Psary -Lower Muschelkalk limestones; sedimentation in epicontinental Triassic sea, Czerna - abandoned exploitation of oxidized ores; old galeries, Dubie quarry - Devonian carbonate rocks and Permian volcanics, contact metamorphism.
31st August, 2001 (one day). Start and end: Kraków. Minimum and maximum number of participants: 10-14. Cost: 80 USD (including transport and lunch)

B4. Mineral deposits of the Eastern Carpathian Mts. (Ukraine)
Leaders: Pawel Boltruchuk (fax: 0380 322 351030), Zbigniew Sawlowicz (e-mail: zbyszek@ing.uj.edu.pl)
Geology of the Eastern Flysch Carpathian Mts., Marmarowskye "diamonds" (bipiramidal quartz), Muzejevskye epithermal Au and polymetallic deposit, Beregovskye kaolinite and alunite deposits, Biegan polymetallic epithermal deposit, Ilnickye natural pigments, brown coal and bentonite deposit, Sokirnickye zeolite deposit Slotvinskye rock salt deposit - open pit, Saulak Au-polymetallic deposit, Jazowskye sulphur deposit.
30th August - 4th September, 2001 (six days, including 2 days travel. Field excursion starts in Kraków. Participants are transported to and from Lviv (Ukraine) by bus. Minimum and maximum number of participants: 15-25. Cost: 480 USD (includes bus transport Kraków-Lviv-Kraków and local travels, accommodation and meals).

B5. Banded iron formation deposits of Krivyj Rih (Ukraine)
Course leaders: S.V. Jevtiechov, V.D. Sotokor, I.S.Paranko, Z.Saw_owicz (e-mail: zbyszek@ ing.uj.edu.pl)
Krivyj Rih region: Proterozoic metaconglomerates (Witwatersrand-type equivalent), Skelevatskye BIF-type magnetite deposit in iron-bearing quartzites with supergenic massive ores, Pyervomayskye BIF-type deposit with intensive metasomatic alterations and allogenic brecciation, impactites, granitoid-gneiss complex with Archean protogranites.
30th August - 5th September, 2001 (seven days, including 2.5 days travel). Start and end: Kraków.
Cost: 700 USD (includes transport Kraków-Lviv-Kraków by bus, Lviv-Krivyj Rih-Lviv by train and local travels, accommodation and meals).

B6. The Skaergaard Intrusion (SGA and IGCP 427 "Ore-forming processes in dynamic magmatic systems"), Kangerdlugssuaq, Greenland.

Course leaders: C.K. Brooks, J.C. Andersen (e-mail: andersen@csm.ex.ac.uk), T.N. Irvine

Trip Organising Committee: C.K. Brooks (Danish Lithosphere Centre, Copenhagen, Denmark), J.C. Andersen (Camborne School of Mines, University of Exeter, UK), T.N. Irvine (Geophysical Laboratory, Carnegie Institution of Washington, USA), S.J. Barnes (University of Quebec, Chicoutimi, Canada).

Itinerary for the field trip (provisional):

3 - 10 September: Day excursions to areas of the Skaergaard intrusion and its host rocks. The following areas will be visited (for abbreviations and nomenclature, see Irvine et al. 1998, GSA Bulletin, v. 110, 1398-1447): Uttental Plateau and the toe of Forbindelsesgletcher. The lower intrusive margin and the lower part of the MBS. A suite of ultramafic autoliths (or xenoliths) in the MBS,transition between the MBS and the LS (the cross-bedded belt), igneous layering of the LZa and b, suites of autolithic blocks, anorthositic replacement structures, and gabbroic pegmatite bodies. The toe of Forbindelsesgletcher displays the Triple Group and the Platinova Au and Pd reefs. Kraemer Island and Ivnarmiut. The western margin of the intrusion including a possible intrusive breccia, the chilled margin, the perpendicular feldspar rock, pyroxene replacement structures, pegmatitic features, and layering (colloform banding) in the MBS. The transition between the MBS and the LS. Layering in the LZc and MZ, and its relations to the autolithic blocks (including impact and other magmatic-sedimentary structures). Basaltic xenoliths on the south coast of Kraemer Island. The plateau to the west of Basistoppen peak and the Skaergaard peninsula. Layering in the UZ, pegmatitic replacement of layers, the trough banding, the "purple band", transgressive granophyres, the Basistoppen Sheet, and the Sandwich Horizon. The Eastern shore of Skaergaardsbugt. A section through the UBS with the exposures of the UBS units and the upper intrusive contact. Furthermore, the Tinden granophyre sill can be examined. The Kraemer Island macrodike and the Kraemer Island syenite. The western part of Kraemer Island offers an opportunity to examine an example of the late, alkaline magmatic activity in the area. Massive syenites, intrusive breccias and peralkaline pegmatites are well exposed. The macrodike is one of a suite of small layered intrusions which occur in the Skaergaard area. If ice conditions permit, a brief visit will be made to the Kap Edvard Holm complex, which is many times larger than Skaergaard, to look at the very fine-layered features. Sodalen. A section through the lowermost volcanic rocks of the east Greenland plateau basalt province. This includes successions of hyaloclastites, pillow breccias, and lavas, and a sequence of Cretaceous to Early Tertiary sediments. En route to Sodalen we will pass Hangefjeldet where it is possible to examine from the ship the coastal flexure and the coast parallel dike swarms. 11 September: Departure to Keflavik, expected arrival on 12 September in the afternoon.

31 August - 12 September, 2001. Start: Keflavik 31 August p.m.; End: Keflavik 12 September p.m. Maximum number of participants, incl. leaders is 32. Registration Fee: 3400 USD. A deposit of 1200 USD is required by 1 September 2000 to secure the ship. Due to the complex arrangements of this trip, no cash refund can be expected if the schedule is changed.

Contact address for more detailed information and payment: Dr. Jens C. Andersen (e-mail: andersen@csm.ex.ac.uk), Camborne School of Mines, University of Exeter, Redruth, Cornwall, TR15 3SE, UK; phone: +44 1209 714866; fax: +44 1209 716977.

B7. Field Correlation in Slovakia - Magnesite and Talc Deposits

Course leaders: M. Radvanec, P. Grecula

Program: field correlation on magnesite and talc deposits in Slovakia, relating to their geology, mineralogy, dressing and environmental impacts of exploitation. Localities: Kosice, magnesite deposits: Jelsava and Lubenik; talc deposits: Gemerska Poloma and Mutnik.

30 August - 3 September, 2001. Starting point: Kraków or Kosice. No. of participants: 10-25. Cost: 150 USD. Excursion is organized by IGCP 443 (Magnesite and Talc-Geological and Environmental Correlations). All requests should be sent directly to: nemeth@dodo.sk

ABSTRACT AND THE PROCEEDINGS VOLUME

The Organising Committee kindly invites the participants to prepare oral presentations and/or posters. Extended abstracts will be reviewed by the Scientific Committee and those accepted for publication will be printed in the Proceedings volume, distributed at the Meeting. The price of Proceedings volume is included into the registration fee. The abstract language is English. Abstracts submitted by non-English-speaking authors should be checked by native English speakers. The official Publisher of the Proceedings volume will be A.A. Balkema. The maximum length of abstract manuscripts is four pages including figures, gray-tone photographs and references. Coloured photographs and drawings will not be accepted. Abstracts will be printed only if the registration fee is paid together with the submission of camera-ready manuscript (i.e. before April 30th, 2001). For late payments (after April 30th, 2001) publication of abstracts cannot be guaranteed. Authors of papers to proceedings have to type these in a form suitable for direct photographic reproduction by the publisher. In order to ensure uniform style throughout the volume, all the papers have to be prepared strictly according to the instructions set below. Poster session will be held from August 27 to 29, contemporaneously with the thematic sessions. The offered space is: vertical length 195 cm, horizontal length 95cm. Poster authors will be requested to reserve time for discussion.

Further informations: http://galaxy.uci.agh.edu.pl/~sga/index2.html

DEADLINES

The above material should be submitted to the Organising Committee before **January 31, 2001**. Any material received too late will not be considered. Abstracts will be accepted before **February 28, 2001** and returned to the Authors for corrections. Final versions in camera ready form must be submitted before **April 30, 2001**. The accepted abstracts will be printed only if the registration fee is paid by the returning of abstract. Send the material by airmail or by courier well packed and on time. Be sure that all pages are included in the parcel.

SOCIAL PROGRAMME

26 August 18.00: Ice-breaking party at the Wawel Castle Restaurant

27 August 20.00 : Concert

28 August 19.00: Conference dinner at the Wieliczka Museum (departure from hotels at 18.30)

Accompanying persons programme

The accompanying persons programme will be organized by the "Symposium Cracoviensis". The following activities will be available: Kraków tours - sightseeing of the Old Kraków Wieliczka Museum - visit to underground mine and museum Concert - to be scheduled Auschwitz/Birkenau - visit to the memorial and museum is possible under separate request (minimum number of participants required) Other activities will be possible at the request but minimum number of participants will be expected.

REGISTRATION

Meeting Venue: The Meeting will be held at the Main Building of the University of Mining and Metallurgy in Kraków, 30-059 Kraków, Al. Mickiewicza 30.

The registration form enclosed as a separate page contains registration for the Meeting and its social events, for field trips and workshops, and hotel booking. Please, indicate the code of session for which you intend to submit the presentation(s) or poster(s) and the code of field trip or workshop you wish to attend. Registration will be confirmed in writing. The registration fee includes the scientific programme, Proceedings volume, lunches and refreshments during thematic sessions. Please, return your registration form at the following address: Dr. Wojciech Mayer University of Mining and Metallurgy Faculty of Geology, Geophysics and Environment Protection Al. Mickiewicza 30; 30-059 Kraków, Poland; phone: (+48 12) 617 23 85; fax: (+48 12) 633 29 36, e-mail: wmayer@geol.agh.edu.pl

PAYMENTS OF FEES

For payment	*before April 30*	*after April 30*
SGA/SEG Non-members:	150 USD	200 USD
SGA/SEG Members:	100 USD	150USD
SGA Junior Members :	75 USD	125 USD
Students:	50 USD	100 USD
Accompanying person:	50 USD	100USD
Conference dinner:	50 USD	50USD

Registration fee should be paid in USD, by bank transfer or internationally accepted credit card (VISA, MasterCard, EuroCard, Dinners Club), free of bank charges to the recipient, at the Organising Committee bank account:

BPH S.A. IV O Kraków 10601389-380000021929
Swift code: BPHKPLKA (with the note "SGA 2001")
Unfortunately, we are unable to accept personal, company or Euro cheques. Attention! Polish participants are kindly requested to pay the equivalent of registration fee in PLN (at the daily NBP exchange rate for the day of money transfer) at the following account: BPH S.A. IV O Kraków 720140903 with the note "SGA 2001". In agreement with the SGA Board the Organising Committee has allocated limited funds to cover travel and accommodation expenses for a number of students and junior staff.

Cancellation

The written cancellation must be sent to the Organising Committee before July 10, 2001. A refund of 80% of registration fee will be made before this deadline. No refunds are possible after this date. For hotel booking full refund is possible before July 10, 2001. After this date a deposit for first day will be charged by the Symposium Cracoviensis.

ACCOMMODATION

The Symposium Cracoviensis has been appointed to provide the accommodation for Meeting participants and accompanying persons. Rooms will be booked at first come-first served base. The Symposium Cracoviensis reserves the right to book another hotel of the same category in case hotel indicated is fully booked. For questions about the accommodation please, contact: Ms. Dorota Dziewonska Symposium Cracoviensis 31-123 Kraków, ul. Krupnicza 3; phone: + 48(12) 422 7600; fax: +48(12)4213857; e-mail: sga@symposium.pl; web-site: http://www.symposium.pl

INSURANCE

Important notice: The Organising Committee does not take responsibility for any infirmities, personal accidents and damages.

MORE INFORMATION ON THE MEETING AT THE FOLLOWING WEB-SITE: http://galaxy.uci.agh.edu.pl/~sga/index2.html

✂.....

Registration Form

6th BIENNIAL SGA MEETING JOINTLY ORGANIZED WITH SEG: "Mineral Deposits at the beginning of the 21st century"
August 26-29, 2001, Kraków, Poland

(Please, use block letters)

First name .....
Last name .....
Title ..... M ☐ F ☐
Institution .....
Address .....
Street .....
City .....
Zip Code ..... Country .....
Phone .....
Fax .....
E-mail .....
I intend to submit (please tick):
Abstract ☐ Poster ☐
Title .....
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Session code .....
I attend field trip (code): .....
I attend workshop (code) .....
I will be accompanied by ..... person(s)

Date ..... Signature .....

Registration fee (before April 30, 2001):

SGA/SEG Non-Member	USD 150 ☐
SGA/SEG-Member	USD 100 ☐
SGA Junior Member	USD 75 ☐
Student	USD 50 ☐
Accompanying person	USD 50 ☐
Conference dinner	USD 50 ☐

Total charge: ..... USD

Payment mode:
☐ *Bank transfer:*
Foreign participants: BPH S.A. IV O Kraków 10601389-380000021929
Polish participants: BPH S.A. IV O Kraków 720140903
all with the note "SGA 2001"
☐ *Credit Card: VISA* ☐ *MasterCard* ☐ *EuroCard* ☐ *Diners Club* ☐
Name: .....
Number: ..... Exp.Date.....
For total USD: .....
Date ..... Signature .....

Hotel Booking Form

Hotels (please tick):	Single	Double
Continental	USD 120 ☐	USD 150 ☐
Cracovia	USD 85 ☐	USD 135 ☐
Logos	USD 85 ☐	USD 104 ☐
Dom Turysty	USD 70 ☐	USD 85 ☐
Dormitory		USD 22 ☐

Arrival: ..... Departure .....
By: plane/railway/car
Total charge ..... USD

Payment mode:
☐ *Bank transfer* to: Symposium Cracoviensis, BRE Bank S.A. O/Kraków, 11401081-516700-USDCUR01-44, Symposium Cracoviensis, Kraków – SGA/011
☐ *Credit Card: VISA* ☐ *MasterCard* ☐ *EuroCard* ☐ *Diners Club* ☐
Name: .....
Number: ..... Exp.Date.....
For total USD: .....
Date ..... Signature .....