

SGA

December 2003



News

Number 16

Enrichment processes in oxidizing sulfide mine tailings: Lessons for supergene ore formation

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Introduction

The investigation of the geochemical, mineralogical, and microbiological processes in oxidizing sulfide mine tailings gives the possibility to trace in real-time the parameters controlling element mobility and enrichment processes in giant open-air laboratories. Water and oxygen are the two key reactants which initiate sulfide oxidation, resulting in acidic, metal-rich solutions, today better known as acid rock drainage

(ARD) or acid mine drainage (AMD). AMD is the main environmental problem of mining activities. In former times, the same processes have led to the nowadays highly appreciated supergene enrichment of porphyry copper deposits and associated "Exotic" deposits.

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7th Biennial SGA Meeting Mineral Exploration and Sustainable Development



August 24 – 28, 2003, Athens, Greece

Demetrios Eliopoulos
Chairman of the Organizing Committee of the 7th Biennial SGA Meeting
IGME, Athens, Greece



The Council of the Society for Geology Applied to Mineral Deposits (SGA), at their Biennial Meeting in Krakow, in August 2001, decided to offer the organization of the 7th Biennial Meeting to Athens, Greece. The world knows Athens mainly from its history and monuments, but most of all for its greatest gift that gave to humanity, the Democracy and the freedom of thought and expression.

The Meeting was held at the National Technical University of Athens under the general theme "Mineral Exploration and Sustainable Development". The concept of sustainable mining has recently emerged as a central theme for geologists worldwide. The finite number of economic mineral deposits are increasingly difficult to locate and development must be conducted with due diligence for the environment. As economic geologists we not only have a special view of the environment in which ore deposits formed but we also have unique insights and responsibilities for the environmental issues associated with resource development. The focus of sustainable development includes the environmental, social and economic aspects of achieving our resource needs.

The call for Abstracts brought 324 extended abstracts for review from 51 countries worldwide. 309 abstracts were accepted for presentation in the Meeting and are published in two volumes. Numerous contributions have emerged from the international collaboration programme "Geodynamics and Ore Deposit Evolution" of the European Science Foundation. All abstracts offer an interesting state-of-the-art review of ongoing research in the many aspects of economic geology related to exploration.

The Society of Economic Geologists kindly organized and sponsored a one day Symposium on the theme "Exploring for Tethyan ores: Development from historic roots". The Special Session "FeOx-Cu-Au, VMS, and orogenic gold deposits in light of the tectonic evolution of the Fennoscandian Shield" was kindly organized and sponsored by the GEORANGE.

The Organizing Committee offered nine fieldtrips in association with the Meeting to locations in Greece, Cyprus, Bulgaria, Turkey and Germany. Four of them got enough participants to be put into effect.

The organizers wish to express their sincere thanks and appreciation to all members of the Scientific Committee, listed in the proceeding Volumes, for critically reviewing all abstracts and organizing the Thematic Sessions. Our appreciation is extended to all keynote lecturers in the Plenary and Thematic Sessions for their contribution to the success of this Meeting.

Finally the Organizers thank all participants for their efforts and the Millpress Publishers for efficient and professional production of the volumes.

As Chairman of the Organizing Committee of the 7th SGA Meeting, I would like to wish every success to the 8th SGA Meeting to be held in Beijing, China, in August 2005, and hope to meet all of you again there.

Athens, October 2003

SGA News

N. 16 December 2003

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Information for contributors

Items for publication may be sent to SGA News care address below. Manuscripts should be sent on computer diskette in Microsoft Word 97/98 format using Microsoft Word. Please always send a paper copy and indicate the format you are using.

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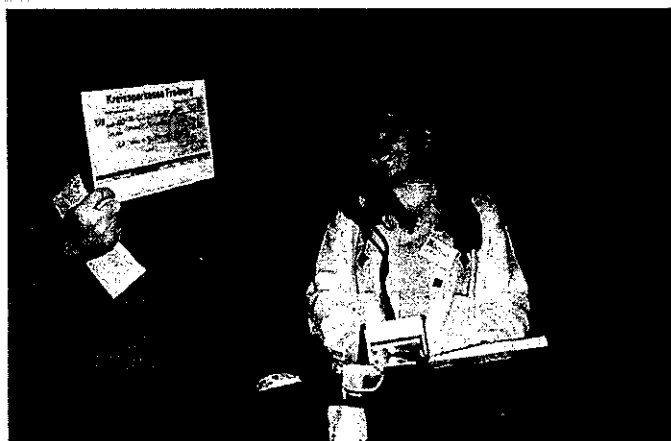
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SNAPSHOTS FROM THE 7TH BIENNIAL SGA MEETING, ATHENS 24-28 AUGUST 2003



David Leach, SGA President, addressing the assembly during the opening ceremony of the 7th Biennial SGA Meeting (left) and together with J. Price, SEG President (right).



Dave Leach presenting the SGA Young Scientist Award to Dr. Noreen Mary Vielreicher (Centre for Global metallogeny, Department of Geology and Geophysics, University of Western Australia).



Bernd Lehmann, MD Editor, presenting the award for the best MD 2001 paper to Dr. Jorge Relvas (University of Lisbon, Department of Geology, Portugal) for the paper "Multiple sources for ore-forming fluids in the Neves Corvo VHMS deposit of the Iberian Pyrite Belt (Portugal): strontium, neodymium and lead isotope evidence" by Relvas J. et al. Published in MD 36: 416-427.

NEWS OF THE SOCIETY

News of the Council

Report of the President

D. Leach welcomed both SEG and IAGOD representatives at the Council Meeting. Then he reported on the period from the last Council Meeting (April 2003) to August 2003 and described his activities towards his priority goals (increased role of SGA Regional VPs, development of increased participation of industry in SGA activities and development of strategic planning of SGA Biennial Meetings).

SGA-SEG collaboration

SEG President J. Price thanked SGA President and Council for inviting him to Athens. He briefly summed up past successful collaboration between both Societies and emphasized that there is plenty of room for all three economic geology oriented Societies (SEG, SGA, and IAGOD) to work together for better promotion of mineral deposit research worldwide. He informed SGA Council that SEG approved the further collaboration between SEG and SGA.

SGA-IAGOD collaboration

IAGOD Secretary General N. Cook thanked SGA President and Council for inviting him to Athens. Similarly as SEG President he also emphasized the importance of future collaboration with SGA especially through sponsoring of Societies stand-alone meetings. Then he briefly discussed a possible role of SGA in the organization of the 12th Quadrennial IAGOD Symposium (2006, Russia), possible participation of IAGOD in the SGA 8th Biennial Meeting in China (2005) and joint activities within the IYPE.

SGA membership

Jan Pasava reported on new membership from April 25, 2003 to August 12, 2003. SGA has 680 paying members. A new membership directory has been published in Freiberg and will be distributed to SGA membership.

SGA-Springer-Verlag

A meeting of SGA Executive Officers (D. Leach, J. Pasava, P. Herzig and G. Borg) with Dr. W. Engel (Springer Verlag) was held in Heidelberg on July 21, 2003. Based on negotiations the following outcomes were approved by Springer:

- In future issues of MD, the editors will select which articles can have color plates and figures at no charge to the authors. Selection criteria include relevance of topic, importance of field, and the advantage/necessity to print the figures of the manuscript in color.
- SGA members will be offered a 20% discount on Springer books.
- Springer shipped two copies of Borradaile "Statistics of Earth Science Data" which were given to two geologists in the Athens meeting as part of an award for outstanding

publication in *Mineralium Deposita* and SGA Young Scientist Award.

The SGA Council highly appreciated the generosity of Springer.

Mineralium Deposita

Significantly, the latest citation index for *Mineralium Deposita* is 1.39, which ranks first among the journals directly related to the field of economic geology including *Economic Geology*, *Ore Geology Reviews*, *Resource Geology*, *Geology of Ore Deposits*, and the *Journal of Exploration Geochemistry*. SGA Council welcomed this news and highly appreciated efforts of the past and present Chief Editors.

The Council discussed the possibility of having SGA Proceedings included into refereed publications.

SGA News

SGA News no. 17 will be published in a new layout and will be printed by Springer in June/July 2004. Springer will produce the SGA-newsletter and bear the costs. Springer will have the right to place a complimentary advertisement of its books and journals in each newsletter (2 times a year). It is intended to distribute the newsletter along with issues 4 and 8.

SGA Promotion

Latest negotiations with Balkema (Swets and Zeitlinger) resulted in the receipt of display copies of the SGA-conference volumes at no costs. They will be distributed to SGA Regional VPs. Balkema provided a reduced "SGA-conference price" on these volumes.

Reports of Regional VPs

In order to improve our service to our membership, G. Beaudoin (Regional VP for N. America) suggested that relevant names of SGA officers responsible for various matters should be prominently displayed on all SGA promotional materials, website, etc. The Council highly appreciated efforts of regional VP's and extended great thanks especially to R. Hill and M. Shimizu whose terms end on December 31, 2003 and who are, based on SGA Constitution, not eligible for re-election.

7th Biennial SGA-SEG Meeting

D. Eliopoulos provided information on the organization of the 7th Biennial Meeting. Three hundred twenty participants paid their registration fee and 40 participants confirmed their on-site payment. The Council thanked D. Eliopoulos for his efforts associated with the organization of the SGA Meeting in Athens.

8th SGA Biennial Meetings in 2005 (Beijing, China)

Mao Jingwen reported on the status of preparation of the 8th SGA Biennial Meeting. This will be a stand-alone SGA meeting with SEG and IAGOD invited to be co-sponsors to run their own modules and/or field trips. The meeting will be held in Beijing on August 20-23, 2005 and a number of interesting field

trips will be offered. The first circular should appear in December 2003 and the SGA Executive Committee discussed important aspects of the preparation of the meeting directly with Mao Jingwen. The most important outcomes from this meeting can be summarized as follows: SGA President, Executive Secretary and Treasurer will become ex-officio members of the Organizing Committee, B. Lehmann will become the Technical Liaison for the Beijing meeting – a major link between SGA and local Organizing Committee (supervising general matters); R. Goldfarb will become chair of field trip committee; P. Herzig will be responsible for the monitoring of the development of the meeting budget; D. Groves, Mao Jingwen, Mei Fu Zhou, and Craig Hart will be responsible for the technical program of the meeting, Mao Jingwen and Frank Bierlein will be responsible as the "Chief Editors" of the Proceedings to be published by Swets and Zeitlinger (Balkema); G. Borg and Mao Jingwen will be responsible for the promotion of the meeting and organization of a possibly continuously staffed Society booth and for coordinating company/corporate support; Tim Baker and Mr. Nie will be responsible for organization of workshops and short courses, and two people will be selected to be "Student Coordinators" that will assist students attending the meeting. The Student Coordinators will work with G. Borg and the Corporate Committee Members to assist and encourage student attending the meeting; G. Borg will enlist one or two SGA members from the industry to serve on the committee as "Corporate Committee Representatives" – these members will promote the meeting and seek financial contributions that will be mainly directed at support for students.

Proposals for 9th SGA Biennial Meetings (2007)

Two very high quality proposals – one from Sweden and the second one from Ireland were evaluated. The secret vote by Council members resulted in the approval of the Irish bid for 2007. The Swedish team represented by P. Weihed confirmed the continuous interest in the organization of the 9th SGA Biennial Meeting in 2009.

SGA-SEG-IAGOD contribution towards IUGS/UN activities (IYPE)

Jan Pasava summarized the status of preparation of individual scientific topics suggested to SPC as possible contributions to

the three-year IYPE. Discussion on a joint SGA-SEG-IAGOD contribution resulted in a decision to set up a joint committee to prepare a proposal for ICSU grant most likely in the field of educational courses for third world countries. P. Herzig, G. Borg and J. Pasava will represent SGA on this committee.

Past Activities

- GAC-MAC-SEG joint annual meeting (Vancouver, May 25-26, 2003) - G. Beaudoin; SGA exhibit
- VI. National Geological Congress (June 2003, Lisboa, Portugal) – F. Barriga; SGA exhibit
- GEOFORUM – Geological Society of South Africa Meeting (June 25-27, Gauteng, South Africa); G. Borg was an SGA keynote speaker and SGA exhibit was organized by R. Viljonen
- World class mineral deposits and earth evolution (19-21.8.2003, Cardiff, UK) - A. Boyce; Chris Heindrichs represented SGA

Future Activities

- 3rd Fennoscandian Exploration and Mining (Rovaniemi, December 3-4, 2003); Robin Hill will represent SGA
- 32nd IGC (Florence, August 20-28, 2004)- several Symposia co-sponsored; SGA Council Meeting planned
- SEG 2004 (Perth, Sept. 27-Oct. 10, 2004) - SGA runs its own module at this conference; R. Goldfarb responsible
- 8th SGA BIENNIAL MEETING - "MINERAL DEPOSIT RESEARCH: MEETING THE GLOBAL CHALLENGE" – Mao Jingwen et al. (August 20-23, 2005, Beijing, China)



SGA NEWS MAILBOX

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



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

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

Name:

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

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!!! 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 NEW SGA home page on Internet:

<http://www.e-sga.org>

Other requests will be not considered.

SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS**SGA COUNCIL 2003****Executive Committee**

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Promotion Manager	G. Borg (Germany)
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Asia	M. Shimizu (Japan)
Australia	R. Hill (Australia)
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D. Eliopoulos (Greece)
B. Gemmel (Australia)
I. R. Jonasson (Canada)
F. Mitrofanov (Russia)
H. Stein (U.S.A.)

Councillors: term ending on December 31, 2005

N. Arndt (France)
F. Barriga (Portugal)
A. Boyce (U.K.)
H. Frimmel (South Africa)
Ch. Heinrich (Switzerland)
J. Mao (China)
P. Weihed (Sweden)

Ex officio Members, SEG

President	J. G. Price (Australia)
Executive Director	B. G. Hoal (U.S.A.)

Ex officio Members, IAGOD

Secretary General	N. Cook (Norway)
Membership Secretary	R. Seltmann (U.K.)

Requests for sponsorship

SGA free subscription program for MD was approved for Mongolian Research Institute and Cuban Institute of Mining and Technology.

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

Dr. Jan Pasava
SGA Executive Secretary

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CZ-118 21 Prague 1
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Report of the Executive Secretary about membership

12 Regular Members and 9 Student Members applied for membership from April 25, 2003 to August 12, 2003

LIST OF NEW SGA MEMBERS
(April 25 – August 12, 2003)

Regular Members

Mr. John MENLIED, Cmic Capital Limited 4th Floor, 2A Saborna St 1000 Sofia BULGARIA
Dr. James FRANKLIN, 24 Commanche Ottawa, Ontario K2E 6E9, CANADA
Dr. John W. LYDON, 601 Booth Street Ottawa, Ontario K1A 0E8, CANADA
Mr. James WALKER, N.B. Dept. of Natural Resources P.O. Box 50, Bathurst E2A 3Z1 New Brunswick, CANADA
Mr. Nick CALLAN, Casilla 400 Correos Puente Alto Puente Alto, Santiago CHILE
Mr. Iija KNÉSL, Czech Geological Survey Geologická 6 152 00, Prague 5, CZECH REPUBLIC
Prof. Toshio MIZUTA Akita University, Dept. of Applied Earth Sciences 1-1 Tegata-Gakuen, Akita, 010-8502, JAPAN
Ms. Yacila CARLOS, Sociedad Minera el Brocal s.a., Av. Faustino Sanchez Carrion, No 451-479, Lima 27, PERU
Mr. Cesar MUNOZ, Pasaje Rada 185, Dpto 201 Chorrillos Lima 9 PERU
Mr. Ramon AGUIRRE, 274 Main St., Apt. 2R, Binghamton, NY, U.S.A.
Dr. Philip BROWN, 1215 W. Dayton Madison, WI 53706, U.S.A.
Dr. John F. SLACK, U.S. Geological Survey National Center, MS 954 Reston VA 20192, U.S.A.

Student Members

Mr. Bryan BOWDEN, CODES src, University of Tasmania GPO Box 252-79, Hobart, Tasmania 7001, AUSTRALIA
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Mr. Mark A. BIETTING, Dept. of Earth Sciences, University of Waterloo, 200 University Avenue West, Waterloo, Ontario N2L 3G1, CANADA
Mr. Alan D'HULST, 2839 Rue Toussaint Dussault App 5, Sainte-Foy, Quebec G1V 1K9, CANADA
Mrs. Ewa GAWECKA, Jagiellonian University Institute of Geological Sciences Oleandry str. 2A 30-063 Krakow POLAND
Mr. Jorge CARVALHO, Apartado 7586 2721 866 Alfragide, PORTUGAL
Mr. Paulo Hagendorf ALVES IICENTRO GEOLOGIA Al. Afonso Henriques 41-4-D 1000-123 Lisbon, PORTUGAL
Mr. Craig McCLUNG, Dept. of Geology, Rand Afrikaans University P.O. Box 524, Auckland Park 2006 SOUTH AFRICA
Ms. Petronella MUBITA, Department of Geological Sciences, University of Cape Town Rondebosch 7701, SOUTH AFRICA

- The 12th IAGOD Quadrennial Symposium (August 2006, St. Petersburg, Russia) – V. Shatov SGA will organize its own module and possibly SGA exhibit
- 9th SGA BIENNIAL MEETING (2007, Ireland)



WHOM TO CONTACT IN CASE OF PROBLEMS AND/OR SUGGESTIONS 2004 – 2005

SUBMISSION OF SGA MEMBERSHIP APPLICATION FORM AND REQUEST FOR MEETING SPONSORSHIP (electronic versions of these forms are available at the society website)

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MISSING MINERALIUM DEPOSITA ISSUES

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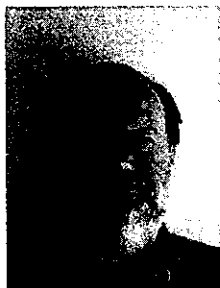
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Reports of SGA President and Executive Secretary

SGA News dedicates a new space to SGA officers to introduce them to SGA membership.

David Leach
SGA President



As I approach the end of my first year as President, I want to present a view of where our Society is going. However, I will first reflect on some important changes in SGA that I have observed since 1996 when I became the Regional Vice President for North America. Despite the declining public support for ore deposit research, decreasing numbers of economic geology students, and recent economic stress in the minerals industry, SGA continues to grow scientifically and professionally. Our journal, *Mineralium Deposita*, is now the most cited journal in the area of economic geology, and is a recognized leader in earth science. This significant achievement of our journal can be credited to the outstanding work by our present and past editors together with our excellent relationship with Springer-Verlag, a world leader in scientific publishing. Credit is also due to our members who continue to submit quality manuscripts. Our membership continues to increase along with our international visibility. It is clear that as SGA continues to grow, we improve our ability to serve our members and the community of ore deposit geologists.

Looking to the future, SGA Council is dedicated to improving how we serve our membership. You will soon see dramatic changes in SGA News, more support for scientific conferences, workshops, and professional training opportunities, and a greatly enhanced website. We seek more collaboration with SEG and IAGOD as witnessed by the Athens SGA Biennial meeting in which SEG organized a symposium and in the SEG 2004 Perth conference where SGA is organizing a full day session on Cutting-Edge Developments in Economic Geology. SGA continues to expand our visibility internationally as indicated by the 2005 SGA Biennial Meeting in Beijing, which will be the first Biennial Meeting outside of Europe. We are improving the advance planning and organization of our Biennial meetings. In addition to the 8th Biennial Meeting in Beijing, we have chosen Dublin as the site of the 2007 9th SGA Biennial Meeting in connection with the Irish Association of Economic Geology. We are increasing the responsibilities and visibility of the regional Vice Presidents and have added two new positions, Regional Vice President for Europe and for the Middle East.

One high priority area for SGA Council is to increase student participation in SGA, as they are the future of our Society. Presently, we offer student memberships at 10 EURO that give the students the same benefits as a regular member; additionally, we have created the Young Scientist Award that recognizes outstanding scientific contributions of our young members. We are trying to get more student participation in our Biennial meetings and we will be working with the Beijing Organizing committee to provide some level of support for travel expenses for students making presentations in Beijing. The Beijing Organizing committee will have a student representative who will support various needs of students traveling to Beijing. Finally, but certainly not least is the goal of SGA Council to increase the participation of industry geologists and corporate managers in SGA activities. We will continue to offer a Corporate Membership that provides attractive benefits and are working to involve industry geologists in the organization of our meetings and other activities.

It is the contributions and support of our members that make SGA the fine organization that it is. Please contact me (DLeach5100@aol.com) or anyone on Council with your ideas, suggestions, and criticisms.

Jan Pasava
SGA Executive Secretary



Jan Pasava graduated from the Charles University in Prague, Czech Republic in 1981 with the degree of MSc (hon.) and RNDr. He obtained his PhD from Academy of Sciences, Prague, Czech Republic in 1990 (origin of Neoproterozoic metalliferous black shales in the Bohemian Massif). In 1981 he joined the Department of Mineral Resources of the Czech Geological Survey where he currently works. Between 1991-1993, he completed post-doctoral research at the Dalhousie University (Nova Scotia, Canada) on the metallogeny of black shales.

He was the leader of the IGCP Project 254 on Metalliferous Black Shales (1987-1992), IGCP 357 on Organics and Mineral Deposits (1993-1997) and IGCP 429 on Organics in Major Environmental Issues (1998-2002). In 1999, he initiated the organization of postgraduate courses together with UNESCO.

Later he also involved SGA on postgraduate courses on Geochemical Exploration methods and their environmental applications. His research interests are focused on the metallogeny of black shales with a special emphasis on precious metals, roles of organic matter in the genesis of mineral deposits and environmental aspects associated with exploitation, and processing of black shale-hosted mineral deposits.

In 1995, he was the Secretary General of the 5th SGA Biennial Meeting, which was held in Prague, Czech Republic. He was Vice-President of SGA in 1997 and became SGA Executive Secretary in 1998. The most important duties of the SGA Executive Secretary include:

- preparation of the agenda and minutes of all official Society meetings
- preparation of Executive Secretary activity report to every Ordinary Council Meeting and Executive Committee Meeting
- preparation of SGA Annual Report for IUGS (every year)
- organization of SGA ballot (every two years)
- assisting the organization of the SGA Biennial Meetings
- processing of membership applications
- processing of applications for SGA sponsorship of various international meetings
- processing of applications for SGA Young Scientist Award
- processing of applications for Subsidized subscription program of Mineralium Deposita
- varied correspondence with Society members and different institutions/organizations

From 1998 to 2003, SGA has made a significant progress in its development and international visibility and impact.

Changes were implemented with a revised SGA Constitution effective from 2001. In addition, student membership fees were established (10 EUR) giving students all issues of Mineralium Deposita and Society Newsletter. The SGA Young Scientist Award was introduced to recognize promising young scientists. Free advertisement in SGA News and free exhibit space at Society Biennial Meetings were offered to Society corporate members. The position of SGA Promotion Manager along with efforts for advancing SGA worldwide was initiated. This task depends on the involvement of SGA Regional Vice-Presidents as well as the new Regional Vice-President Offices for Europe and Middle East. The SGA Award for the best paper in Mineralium Deposita and the Mineralium Deposita best reviewer award also contributed to the increase in the quality of the Society journal. Closer collaboration with IAGOD, SEG, and other international geosciences societies resulted in co-organization of joint scientific meetings.

Building an administrative friendly and financially healthy international society, which will enable to extend Society benefits towards its membership, belong to the Executive Secretary's major priorities. The highest scientific quality of the SGA journal, increasing quality of SGA Newsletter, improving of organization of SGA stand-alone biennial meetings, promotion of SGA through sponsorship of various international scientific meetings, presentation of Society awards and keeping membership fees in reasonable level – all these aspects helped to make membership in SGA a very attractive option. This can be documented by an increase in membership during past few years (1995 – about 450 members; 2003 – about 700 members). Another important aspect of the Executive Secretary's work is to help to improve collaboration with IUGS and together with other international earth sciences societies to fight for better exposure of earth sciences worldwide.

Peter Herzig new Director of Marine Research at Kiel University, Germany

Peter Herzig, SGA Treasurer, has been appointed Director of the new Leibniz Institute for Marine Sciences at Kiel University, Germany. The new institute is the result of a merger of GEOMAR (Research Center for Marine Geosciences) and the Institute of Marine Research (Institut für Meereskunde) and will officially be established on January 1, 2004. The institute, which will have a staff of about 400 scientists and technicians, will be jointly funded by the Federal Ministry for Education and Science and the State of Schleswig-Holstein. The main fields of research include climate dynamics and ocean circulation, crust and mantle dynamics, marine biogeochemistry, and marine ecology. A particular focus will be the study of interactions between the marine lithosphere, biosphere, hydrosphere and atmosphere. The institute will have access to various research vessels including RV Poseidon, RV Meteor, and RV Sonne.

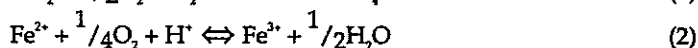
Peter Herzig will continue to serve as SGA Treasurer (if re-elected) and is planning to establish the new Treasurer's Office (that is professionally operated by Sabine Lange) at the Institute for Geosciences at Kiel University later next year. Further details will be announced.

Peter Herzig

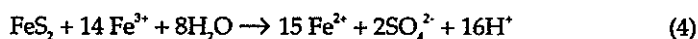


1: ENRICHMENT PROCESSES IN OXIDIZING SULFIDE MINE TAILINGS: LESSONS FOR SUPERGENE ORE FORMATION

Oxidation of pyrite (FeS_2) - the most abundant sulfide mineral in the earth crust - takes place in several steps including the formation of meta-stable secondary products such as ferrihydrite ($5\text{Fe}_2\text{O}_3 \cdot 9\text{H}_2\text{O}$), schwertmannite (between $\text{Fe}_8\text{O}_8(\text{OH})_6\text{SO}_4$ and $\text{Fe}_{16}\text{O}_{16}(\text{OH})_{10}(\text{SO}_4)_3$), as well as the more stable secondary jarosite ($\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$), goethite ($\alpha\text{-FeO}(\text{OH})$) and hematite (Fe_2O_3), depending on the geochemical conditions. Oxidation of pyrite may be considered to take place in three major steps: (I.) oxidation of sulfur (equation 1 below); (II.) oxidation of ferrous iron (equation 2); and (III.) hydrolysis and precipitation of ferric complexes and minerals (equation 3). The kinetics of each reaction are different and depend on the conditions prevailing in the tailings.



The reaction rates of these reactions are strongly increased by microbial activity (e.g., *Acidithiobacillus ferrooxidans* or *Leptospirillum ferrooxidans*).



Equation (1) describes the initial step of pyrite oxidation in the presence of atmospheric oxygen (after the drop of the water level in the tailings impoundment and the formation of an unsaturated or vadose zone). The liberated ferrous iron is oxidized to ferric iron with consumption of protons (equation 2). At higher pH conditions ($\text{pH} > \sim 4$), this is a very fast reaction (auto-oxidation). At low pH condition this reaction is very slow under abiotic conditions, but it is strongly accelerated by microbiological activity (equation 2). Once ferric iron is formed, it becomes the primary oxidant (equation 4) of pyrite. The microbiological activity, which compensates the abiotic geochemical decrease of the ferrous iron oxidation, has a key role in the kinetics of ferric iron production, and subsequently for the oxidation of pyrite, because its oxidation by ferric iron is much faster than by oxygen.

The secondary ferric sulfate minerals, for example jarosite and schwertmannite, which are common minerals in oxidation zones of porphyry copper tailings (Dold and Fontboté, 2001), can liberate acidity during transformation into more stable phases (e.g., goethite). The acidity produced by the reactions described in equations 1, 3, and 4 will lead to an acid environment in porphyry copper systems, due to the general absence of neutralizing minerals (e.g. carbonates). In the acid oxidizing environment, it is mainly bivalent cations (e.g. Cu^{2+} , Zn^{2+} , Pb^{2+} , Ni^{2+} , among others) that are mobile, and thus become enriched. The study of these processes in mine tailings gives additional information on the kinetics, since the time of exposure to oxidation is known exactly. These kinetics may be extrapolated to the supergene enrichment processes which

formed the world-class porphyry copper deposits in Chile (Fig. 1), giving a better understanding of this process. The enrichment processes in oxidizing sulfidic mine tailings here presented are summarized in three schematic models for A) precipitation-controlled climates (humid - alpine), B) evaporation controlled climates (Mediterranean - hyper-arid), and C) importance of geotechnical construction of tailings impoundments.

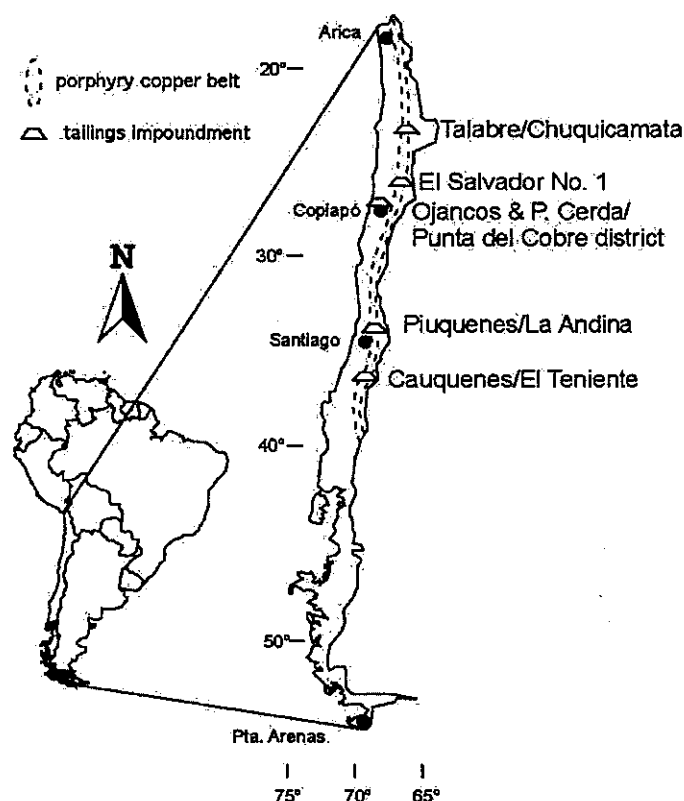


Figure 1: Overview of the studied tailings impoundments from porphyry copper deposits and Fe-oxide Cu-Au deposits in Chile.

Sulfide oxidation and enrichment processes in porphyry copper tailings

The kinetics of the initial steps of sulfide oxidation in active mine tailings are investigated by a mineralogical and geochemical study of the Talabre tailings impoundment (1-3% pyrite), Chuquicamata porphyry copper mine, Chile (Vogt et al., 2003), which is located in the hyper-arid climate of the Atacama desert. The Talabre tailings impoundment has a surface of 48 km². The spitting point of the tailings is moved periodically and before it comes back to the same point, the tailings are exposed to oxidation for a known period of time. This gives the possibility to study the kinetics and controlling parameters of sulfide oxidation in a giant "natural laboratory".

Fresh tailings show unaltered pyrite (Fig. 2A). After three months of exposure, pyrite shows clear oxidation features with the formation of a Fe(III)hydroxide coating (Fig. 2 B) due to the high pH in the tailings (pH 8). The high pH originates from the alkaline flotation process (pH 10.5). This high pH limits the mobility of the ferric iron, initiating the in-situ precipitation of

the Fe(III)hydroxides as coating. After three years a 10 cm thick low-pH (pH 4) oxidation zone has developed. The oxidized pyrite grains no longer show the Fe(III) hydroxide coating due to re-dissolution (Fig. 2C). In the oxidation zones of the tailings impoundments of Piuquenes/La Andina (alpine climate) and of Cauquenes/El Teniente (Mediterranean climate; pH 1.7 - 4), which were exposed to oxidation for 16 and 21 years, respectively, the oxidized pyrite grains show the same textures observed in Talabre/Chuquicamata after three years and only in rare examples a Fe(III) hydroxide coating is still present (Dold

and Fontboté, 2001). In general the pyrite grains are free of coating. The secondary mineralogy at Piuquenes/La Andina (1.7 wt.% pyrite equivalent and 1.4 wt.% calcite equivalent) and Cauquenes/El Teniente (1.0 wt.% pyrite equivalent and 0 wt.% calcite equivalent) is dominated in the oxidation zones by jarosite, schwertmannite, a vermiculite-type mixed-layer mineral, gypsum, as well as traces of goethite, and was determined by X-ray diffraction, differential X-ray diffraction, and/or microscopy (Dold and Fontboté, 2001).

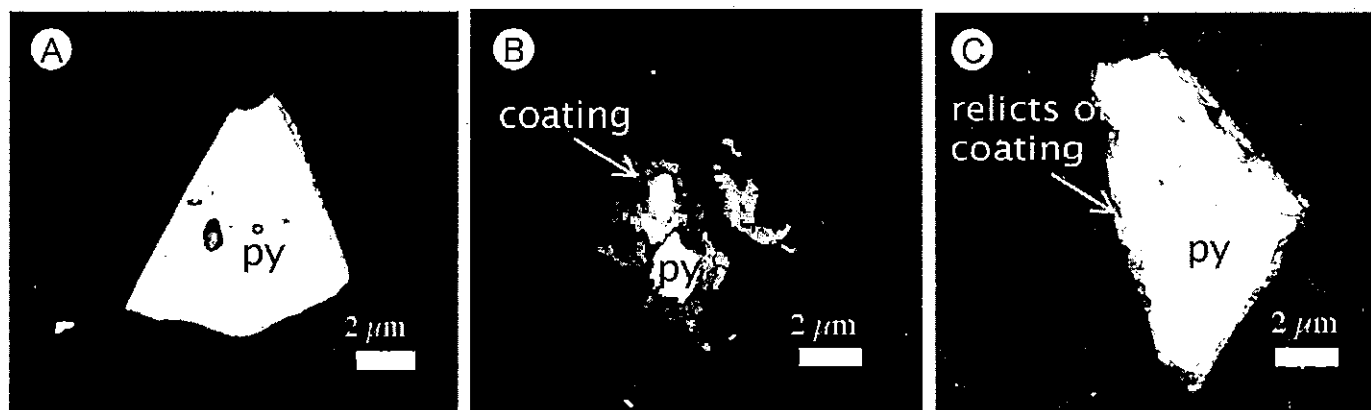


Figure 2: Polished section of pyrite grains from the Talabre tailings impoundment/Chuquicamata, Chile. A) fresh tailings (pH 10.5), B) after 3 month exposure to oxidation (pH 8), and C) after three years exposure to oxidation (pH 4).

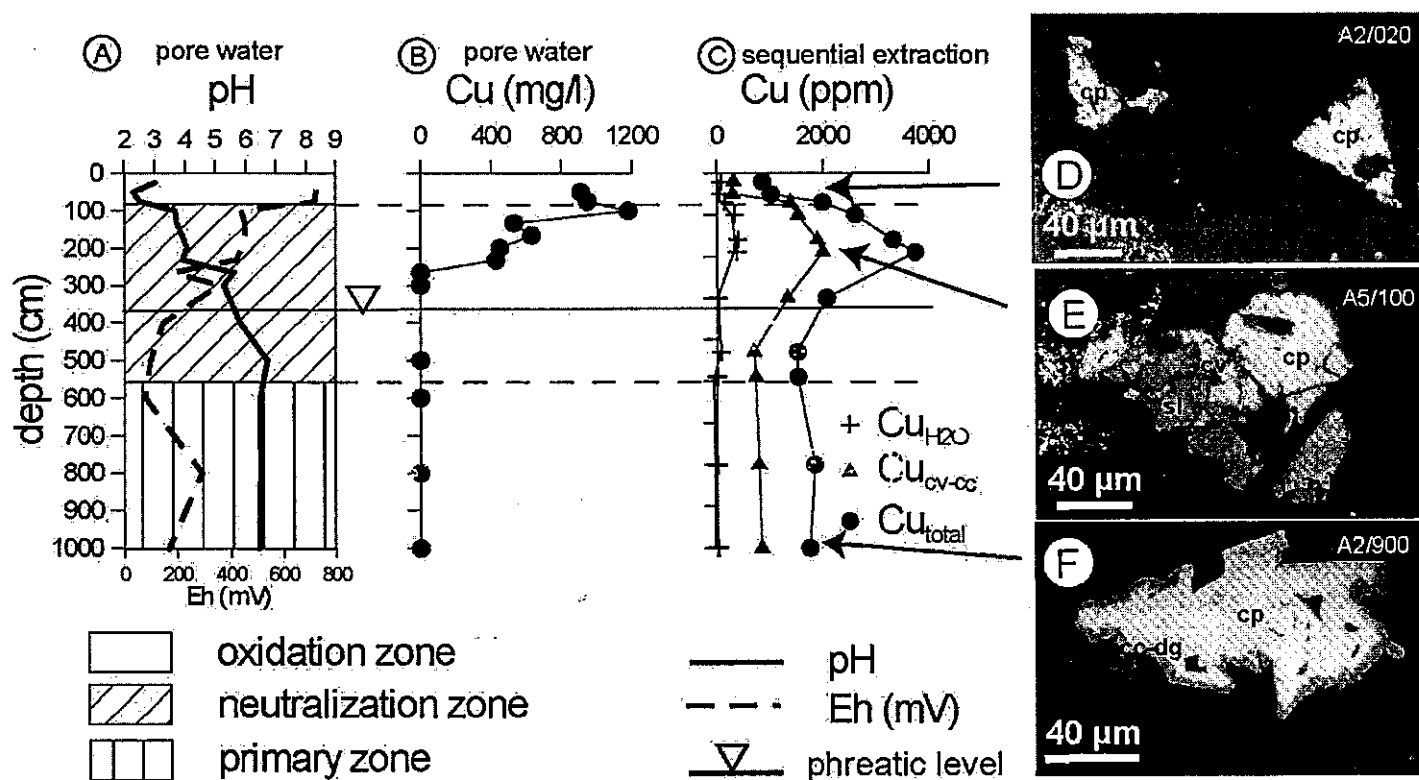


Figure 3: Distribution of A) pH, Eh, and B) Cu in the pore water through a tailings profile from the tailings impoundment of Piuquenes/La Andina mine, Chile. C) shows the results of sequential extraction: Cu_{H_2O} represents the water-soluble fraction, Cu_{cov-cc} represents dissolved secondary Cu sulfides as covellite-chalcocite dissolved in a H_2O_2 -leach, Cu_{total} is the total Cu content. D) shows relicts from oxidized chalcopyrite in the upper oxidation zone at 20 cm depth (A2/020). E) shows the enrichment of chalcopyrite by thin complete rims of covellite in the neutralization zone at 100 cm depth (A5/100). F) represents replacement of chalcopyrite by chalcocite-digenite with edges fractured by milling. This enrichment is interpreted to be primary (supergene from the ore).

Preliminary results of DNA analysis of the microbiological community in the Piuquenes tailings impoundment (Diaby et al., 2003) suggest that, at the oxidation front, *Leptospirillum spp.* is the dominant iron oxidizer, in contrast to *Acidithiobacillus ferrooxidans* usually reported in association to AMD.

Results from 7-step sequential extractions (Dold, 2003) and electron-microprobe analyses indicate that schwertmannite and jarosite play an important role in the retention of oxyanions (e.g., HMoO_4^- , H_2AsO_4^- , and SO_4^{2-}) in the low-pH oxidation zones. The bivalent cations (e.g., Cu^{2+} , Zn^{2+} , Pb^{2+}) are liberated due to sulfide oxidation and acid leach in the oxidation zone (Fig. 3A and 3B) and are mobilized downwards under the alpine climate of Piuquenes/La Andina (Fig. 3C). Below the oxidation zone, the neutralization zone is characterized by increasing pH due to neutralization reactions, which control the sorption of the bivalent cations mobilized downwards through adsorbents such as Fe(III) , Al(III) , Mn(II)

hydroxides, and/or clay minerals. Under increasingly reducing conditions, replacement processes take place, as shown by the replacement of chalcopyrite by covellite, leading to secondary Cu enrichments of potential economic interest (Fig. 3E). Only secondary replacement by covellite and not by chalcocite-digenite could be detected in this zone of enrichment in the tailings. This is consistent with the findings of Jang and Wadsworth (1994), where the replacement by covellite is the first step followed by chalcocite-digenite in an advanced stage. The replacement of chalcopyrite and bornite by chalcocite-digenite found in the primary zone of the Piuquenes tailings (Fig. 3F) is considered to be primary (supergene enrichment from the ore), because it shows fracturing from the milling process and lacks a complete rim of covellite replacement. The secondary Cu enrichment is strictly associated with the neutralization zone, where the pH is still below 5.5.

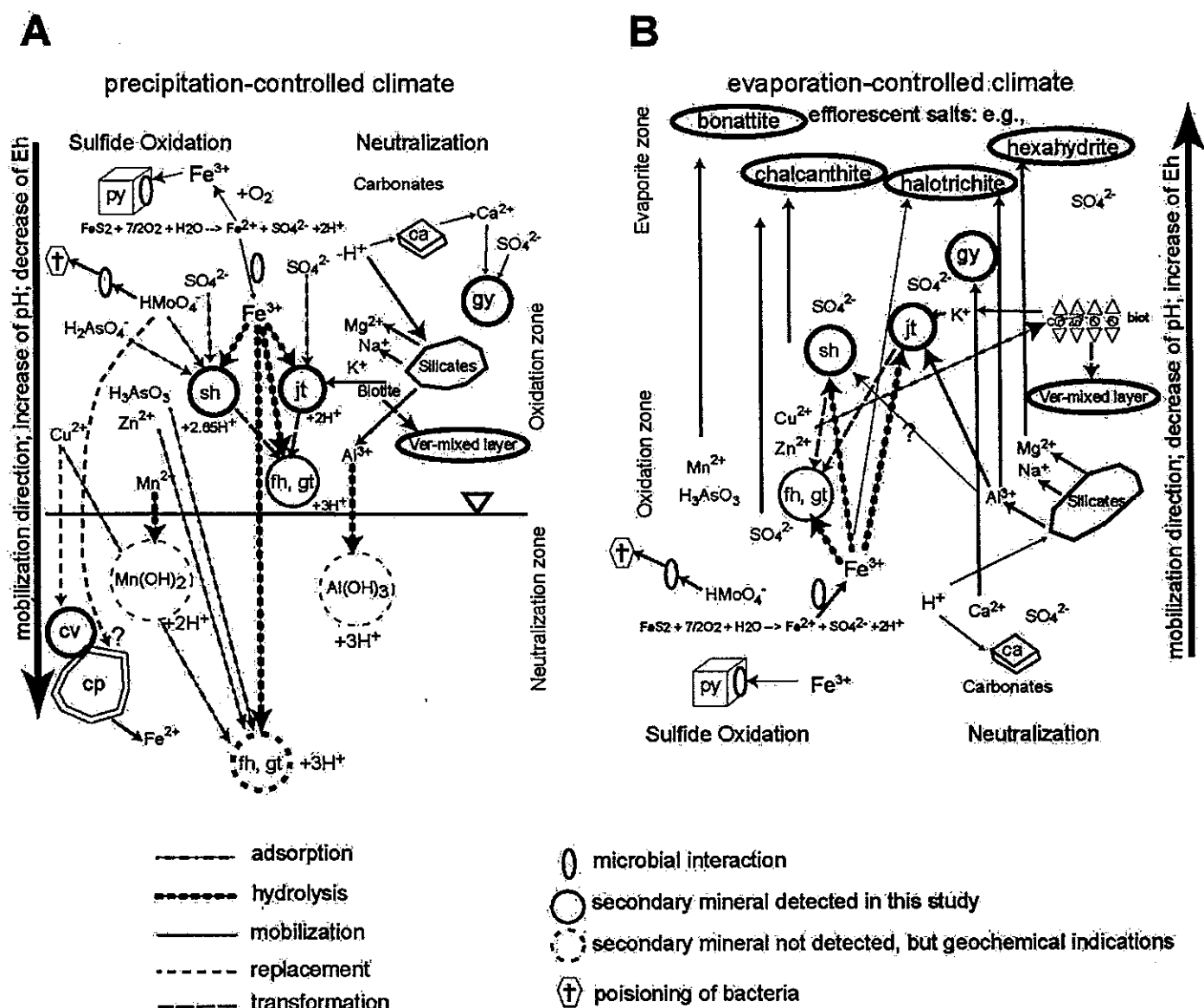


Figure 4: The proposed schematic model for element cycling in precipitation-dominated climates is shown in A and applies for the Piuquenes tailings (La Andina). In B the model for evaporation-controlled climate is presented (Cauquenes/El Teniente and El Salvador), from Dold and Fontboté (2001).

If the pH increases towards the primary zone, the mobility of Cu is controlled by the sorption processes, which is represented by a change to the adsorbed fraction in the sequential extractions data (Dold and Fontboté, 2001), and the Cu concentrations are below detection limit in the pore-water in zones with pH higher than 5.5 (Fig. 3B). Consequently, the replacement of chalcopyrite by covellite is mainly a pH-controlled process, since the pH controls the mobility of Cu. Only if the pH is below 5.5 is Cu mobile and replacement can take place. A drop of the redox (Eh) conditions from the oxidation zone to the neutralization zone (Fig. 3B) establishes the conditions where the replacement starts. The conditions for the replacement process are limited to the top of the stratigraphy by the oxidizing conditions in the oxidation zone and downwards by the pH, due to neutralization processes. Thus, the zone of potential enrichment is limited in the case of Piuquenes/La Andina to a zone of 2.3 m thickness. The processes described above are summarised in a schematic model for the element cycling subsequent to sulfide oxidation in *precipitation-controlled climates* (humid-alpine) (Fig. 4A).

At Cauquenes/El Teniente and El Salvador, i.e., in *climates where evaporation exceeds precipitation* (Model B; Fig. 4B), the water-flow direction is dominated by upwards migration via capillary forces. As a result, mobilized elements are transferred to the top of the tailings via capillary transport towards oxidizing conditions. In this case supersaturation controls the

precipitation of mainly water-soluble secondary sulfates (e.g., bonattite, chalcantite) and produces a strong metal enrichment at the top of the tailings. In the low-pH oxidation zone, due to their high ionic activity, certain mobile elements are found to substitute into secondary minerals. Examples are Al substitution for Fe in jarosite, and substitution of Cu and Zn for K in biotite, the latter resulting in a vermiculite-type mixed-layer mineral (Dold and Fontboté, 2001). The presence of metals in water-soluble form at the top of the tailings could lead to a low cost recovering technique for low ore-grade material in evaporation-controlled climates (e.g., mine tailings in the Atacama desert, Chile). In the case of Cauquenes/El Teniente, rainfall during the winter period re-dissolves the water-soluble Cu-sulfates and Cu is mobilized downwards to more reducing environments, where replacement of chalcopyrite by covellite takes place (e.g., Piuquenes/La Andina). In contrast to Piuquenes/La Andina, at Cauquenes/El Teniente an acid flotation circuit (pH 4.5) was applied. This results in pH generally below 5.5 in the tailings down to a 10 m depth (the maximum sampled depth). The low pH increases the mobility of Cu, resulting in chalcopyrite replacement by covellite towards greater depth, but the enrichment is not as strong and well defined as in the case of Piuquenes. This indicates the importance of the pH control, through neutralization processes, on the mobility of Cu and on the definition of the potentially enriched zone.

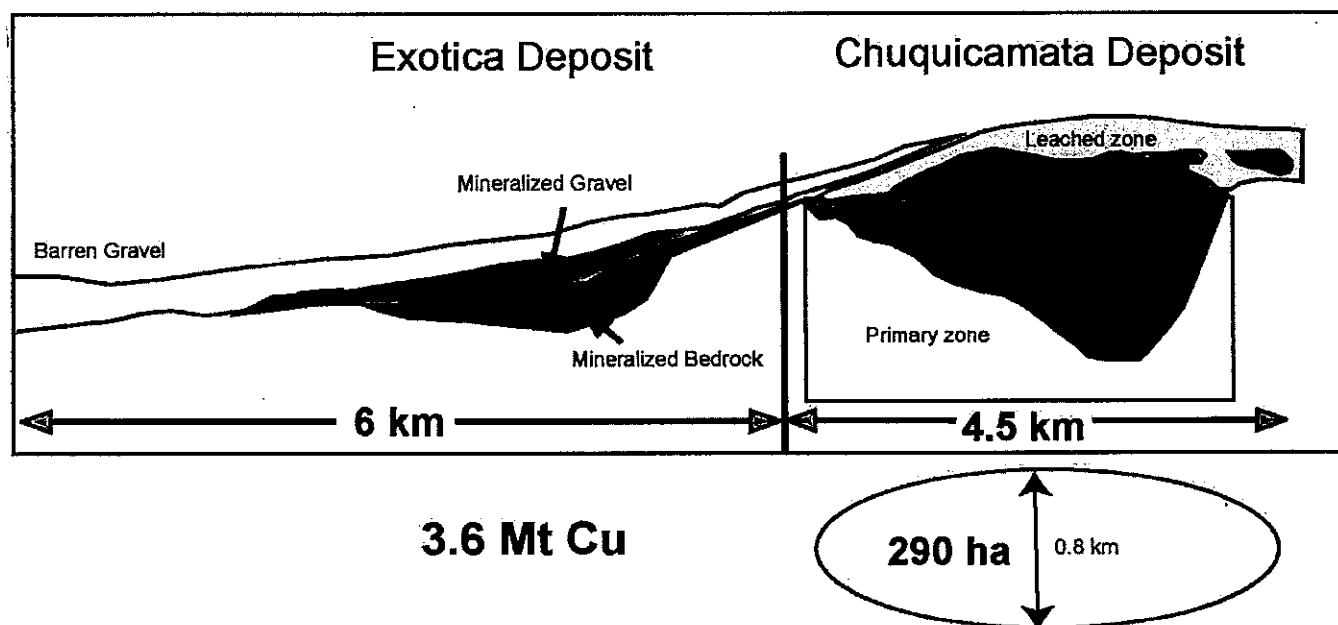


Figure 5: Overview of the supergene enrichment of the Chuquicamata porphyry copper deposit with the associated Exotica deposit, Chile. After Münchmeyer (1996).

El Salvador represents a special case, where the quantities of secondary ferric oxyhydroxide minerals are low in relation to a relatively high pyrite content (6.2 wt.%) and the low pH in the oxidation zone (paste pH = 2). The low pH led to a strong mobility of the elements and resulted in an important upwards migration towards the surface in the hyper-arid climate of the Atacama desert, where an evaporite zone, up to 50 cm thick, is present with up to 5% Cu in water-soluble form (e.g., chalcantite and bonattite). The low oxidation activity obtained

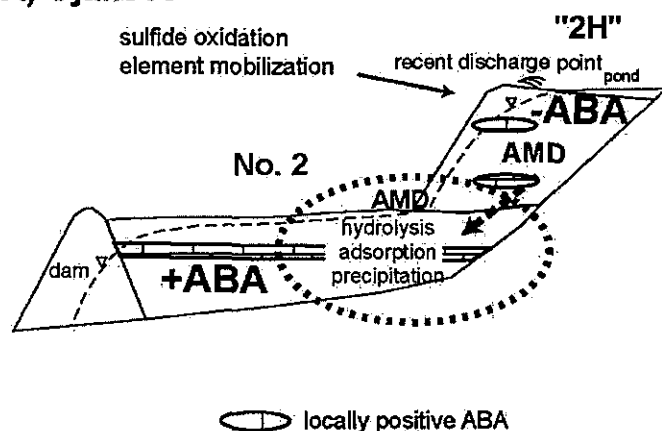
during microbiological tests and the presence of higher Mo concentrations (160 – 1000 ppm) than those of Andina and El Teniente (32 – 171 ppm), suggest that the scarcity of ferric oxyhydroxides is due, at least in part, to Mo poisoning of sulfide oxidizing bacteria such as *Acidithiobacillus ferrooxidans*. The low pH (2 – 3.5) of the El Salvador tailings is mainly attributed to the liberation of acidity by supergene (primary) jarosite, and, to a lower extent, to the slow inorganic oxidation of pyrite.

Kinetics of Cu enrichment

The time frame of the active exotic mineralization processes at El Salvador is suggested to be about 5 m.y. based on $^{40}\text{Ar}/^{39}\text{Ar}$ dating (Mote et al., 2001). To get an impression of the kinetics of these processes in oxidizing mine tailings compared to ore forming processes, the mass of mobilized Cu was calculated as a function of the time that the tailings systems took to develop the oxidation and enriched zone after closure. In the case of Piuquenes/Andina, 2455 tonnes of Cu were mobilized in 16 years on a 87 ha exposed surface and in the case of Cauquenes/El Teniente, 64384 tonnes of Cu were mobilized in 21 years on a 640 ha surface. This mobilized mass of Cu was compared to the 3.6 Mt of Cu which form the Exotica deposit (Fig. 5), resulting from the lateral flow of the acid solution formed during the supergene enrichment on a 290 ha surface at Chuquicamata (Münchmeyer, 1996). The calculation was done with the major simplification that the permeability of the tailings systems ($K = 2 \times 10^{-7}$ to 2×10^{-8} m/s, flow as in a sandy aquifer) is the same as the fracture rock system of

Chuquicamata. The results indicate that the 3.6 Mt of Cu of Exotica could be mobilized in 14230 years under the conditions of Piuquenes/Andina (Alpine climate) and in 2650 years in the case of Cauquenes/El Teniente (Mediterranean climate). This indicates that the Cu mobilization is very fast and seems not to be the limiting parameter for the kinetics for the ore forming process. Other parameters such as the kinetics of the groundwater drop (to form the necessary unsaturated conditions), the diffusion of oxygen into the system (sulfide oxidation and the subsequent acid formation), and neutralization processes (control of the pH and subsequent control of the Cu mobility) are more likely to control the real timeframe of supergene enrichment. Thus, the formation of exotic deposits may be seen as the result of event-controlled systems characterized by the periodical alternation of dry and humid cycles, in which dry cycles increase the sulfide oxidation and formation of metal sulfates whereas the high water supply during rainy events may lead to enhanced metal mobilization.

A) Ojancos



B) P.Cerda

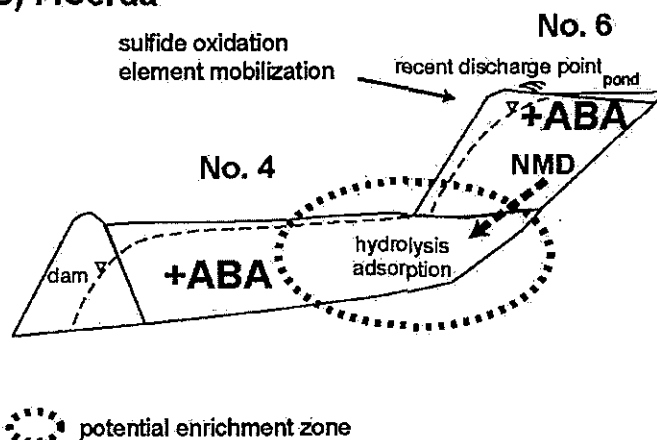


Figure 6: Proposed model of the influence of carbonate distribution and secondary enrichment processes as a result of impoundment construction with the potential enrichment zone (from Dold and Fontboté, 2002). Abbreviations: ABA: acid base accounting (-ABA = excess of acid potential, +ABA excess of neutralization potential); AMD: acid mine drainage; NMD: neutral mine drainage.

Enrichment processes controlled by geotechnical construction of tailings impoundments

An usual practice of tailings deposition in mountainous areas such as in Chile or Peru, is to deposit the tailings in valley dam impoundments and, once they are filled, to deposit new tailings upstream (Model C; Fig. 6). As a result, high quantities of seepage migrate downstream into the older tailings impoundment. Two flotation tailings sites with these characteristics (Ojancos and P. Cerda) from the Fe-oxide Cu-Au Punta del Cobre belt, south of Copiapó in the Atacama desert of northern Chile, are compared geochemically (largely using sequential extractions) and mineralogically (Dold and Fontbote, 2002). Main ore minerals are pyrite, magnetite and/or hematite, and chalcopyrite. The gangue consists dominantly of calcite and minor quartz. At Ojancos, the recent upstream tailings have excess acid potential (7.1 wt.% calcite and 3.5 wt.% pyrite, i.e. negative acid base accounting ABA), whereas the older downstream tailings are characterized by alternations of several meter thick intervals with high neutralizing potential (about 40

wt.% calcite and 2 wt.% pyrite; +ABA) and intervals with high acid potential (about 3 wt.% calcite and 4 wt.% pyrite, -ABA). Acid mine drainage (AMD), with the precipitation of schwertmannite (pH 3.15) and chalcoalumite (pH 4.9), flows out at the interface between the uphill and downstream tailings. Strong downstream element transport is taking place and contributes to the formation of the cementation zone (mainly gypsum, ferrihydrite, and goethite, and locally jarosite) in the older downstream impoundment. The cementation zone (pH = 4) shows strong enrichment of heavy metals (e.g., up to 6800 ppm Cu, 680 ppm Zn, 1100 ppm As), mainly adsorbed to Fe(III)hydroxides and as secondary sulfides (e.g., covellite). The presence of covellite indicates that Cu was mobilized in an acid flow and precipitated in the more reducing conditions in the nearly saturated older downstream tailings impoundment. In contrast, at the P. Cerda tailings impoundments, carbonates are homogeneously distributed and the overall neutralization potential exceeds the acid potential (average of about 10 wt.% calcite and up to 2.5 wt.% pyrite). The up to 5 m thick oxidation

zones (paste pH = 6.9 - 8.3) at P. Cerda are characterized by interlayering of coarser dark gray un-oxidized layers with fine grained, Fe(III) hydroxide-rich, ochre to red-brown colored horizons. The hyper-arid climate dries out first the coarse, sulfide-rich horizons of the tailings and therefore limits the oxidation which is restricted to the fine-grained material due to their higher moisture retention capacity. Results, however, indicate that, during operation, an important element transfer from the younger upstream tailings to the older downstream tailings impoundment took place, possibly by sorptive transport as ferric polymers or colloids in form of neutral mine drainage (NMD). This explains the metal enrichment in the cementation zone, which is mainly associated with the exchangeable fraction and not with secondary sulfides. This results in both cases (in Ojancos mainly as AMD and in P. Cerda mainly as NMD) in Fe(III) input as ferric cation, as ferric polymer, or CO₃-complexes to the downstream impoundment. This constitutes a very effective acid potential transfer to the older downstream material because oxidation, via input of external Fe(III), produces 16 moles of protons per mole FeS₂, i.e., eight times more than via oxidation with oxygen (equation 4). In addition, the acidity created favors dissolution of the abundant Fe-oxides magnetite and hematite of this ore deposit type thereby providing additional Fe(III) for sulfide oxidation.

Conclusions

The study of element cycling and associated enrichment processes in oxidizing sulfide mine tailings gives insight into the controlling parameters of secondary enrichment processes. The mobility and therefore the enrichment process of Cu is mainly pH- and Eh-controlled. The enrichment can take place below the leached oxidation zone in a more reducing environment if the pH is still below 5.5. If the pH increases, the enrichment will be due to neutralization processes, Cu will be adsorbed and no replacement of chalcopyrite by covellite will take place. Thus, the neutralization capacity of the underlying material controls the mobility of Cu and therefore the thickness of the zone in which replacement can take place.

The kinetics of these enrichment processes are fast in mine tailings. Extrapolation of the same kinetics to the formation of exotic deposits indicates that the mobilization of the Cu to form, for example, Exotica at Chuquicamata could be realized in the frame of some thousands of years. Thus, the formation of exotic

deposits may be seen as event-controlled systems in which periodic alternation of dry cycles increase sulfide oxidation and formation of metal sulfates, while high water supply during rainy events may lead to enhanced metal mobilization.

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GEOCHIM 2003: Geochemical prospecting methods and their environmental applications

September 1-15 2003, Dolní Rozínka and Prague, Czech Republic

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INTRODUCTION

It has been tradition to organize very successful UNESCO Postgraduate Courses on Geochemical Prospecting Methods in the former Czechoslovakia from mid 70's. The first certificated course - GEOCHIM PRAHA UNESCO 1975 was launched on September 5, 1975 and lasted till October 25, 1975. Since that time this course has been organized biannually by the Czech Geological Survey in Prague together with the Dionýz Štúr Geological Survey in Bratislava and sponsored by the Division of Earth Sciences (UNESCO/Paris) and the International Association of Geochemistry and Cosmochemistry (IAGS). The course was specialized on both theoretical and practical training in classical geochemical prospecting methods.

The major political and economic changes initiated in 1989 and which led to a split up of the former Czechoslovakia into two independent countries - the Czech and Slovak Republic have had a significant impact on the evolution of earth sciences and related mining activities. Following decades of extensive exploration programmes and also underground and surface exploitation, new policies have been formed which will result in a more responsible approach to the environment.

A very old and famous prospecting and mining tradition, coupled with a strong emphasis on environmental issues, are reflected in the character of a newly recovered certificated GEOCHIM Postgraduate Training Course. Our new group intends to offer more complete view, showing how these classical geochemical prospecting methods can be successfully used in the solution of various environmental problems.

The GEOCHIM 99 was held in Prague and Dolní Rozínka (Czech Republic) from September 6-20, 1999 and 12 scientists, representing 8 developing countries were trained both theoretically and practically in the geochemical exploration methods and their environmental applications.

The GEOCHIM 2000 was held in Prague and Dolní Rozínka (Czech Republic) from September 4-18, 2000 and 13 scientists, representing 9 developing countries were trained both theoretically and practically in the geochemical exploration methods and their environmental applications.

The GEOCHIM 2001 was held in Prague and Dolní Rozínka (Czech Republic) from September 3-17, 2001 and 12 scientists representing 7 countries were trained both

theoretically and practically in the geochemical exploration methods and their environmental applications.

The GEOCHIM 2002 was held in Prague and Dolní Rozínka (Czech Republic) from September 2-16, 2002 and 14 scientists, representing 9 countries were trained both theoretically and practically in the geochemical exploration methods and their environmental applications similarly as during 1999, 2000 and 2001 courses.

GEOCHIM 2003

This, already fifth anniversary, course was held in Prague and Dolní Rozínka (Czech Republic) from September 1-15, 2003 and fifteen participants (**of which 7 were female**) from *Brazil, Bulgaria, Burkina Faso, Cameroon, Croatia, Egypt, India, Namibia, Senegal, Slovakia, Sri Lanka, and Russia* were trained both theoretically and practically in the geochemical exploration methods and their environmental applications similarly as during previous years. The course was organized by the Czech Geological Survey and Society for Geology Applied to Mineral Deposits (SGA) under the auspices of the Ministry of the Environment, Czech Republic, Czech Commission for UNESCO and the Czech IGCP National Committee and financially sponsored by the Czech Government (through the Program of Technical Assistance of the Czech Republic to developing countries), Czech Geological Survey in Prague, Division of Earth Sciences - UNESCO/Paris, and the Society for Geology Applied to Mineral Deposits (SGA).

It should be noted that the course was officially launched on September 2nd, 2003 in the headquarters of the Czech Geological Survey in Prague by opening speeches delivered by Mr. M. Ružicka (Director of the Czech Geological Survey), Mr. M. Pastvinský (Director, Department of Global Relations, Ministry of the Environment, Czech Republic), Mr. Z. Venera (Director, Geology Department, Ministry of the Environment, Czech Republic), Mr. J. Blazek (Executive Secretary of the Czech Commission for UNESCO) and Mr. J. Pasava (Chairman of the Czech IGCP National Committee, SGA Executive Secretary and Director of the GEOCHIM Courses).

Lectures, seminars and practical field training started on September 3rd, 2003 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 HM concentrates with environmental applications, (5) Stream sediment prospecting with environmental applications, (6) Soil prospecting with environmental applications, (7) Biogeochemical prospecting with environmental applications, (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.

Individual lectures covering various geochemical methods which were presented during morning sessions 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 following special textbooks were prepared for the purpose of the GEOCHIM Postgraduate Training Course on the Geochemical Prospecting Methods and Their Environmental Applications:

Pasava, J. and Kríbek, B., (eds.), 2003, *Geochemical prospecting methods and their environmental applications*. Special Publication, 144 p., Czech Geological Survey, Prague, ISBN 80-7075-602-0.

Geochim 2003 Postgraduate Training Course - Field trip guide to the North Bohemia (2003). Czech Geological Survey, 12 pages.

CONCLUSIONS

It is apparent that GEOCHIM Courses have become very popular among geoscientists from especially developing countries. Many participants very highly appreciated both organization and scientific level of the course through their personal letters mailed either to organizers or to Mr. W. Eder, Director, Division of Earth Sciences, UNESCO, Paris. The organizers have already received several applications for GEOCHIM 2004, which should be organized jointly with SGA and UNESCO from September 6 to September 20, 2004.

ACKNOWLEDGEMENTS

On behalf of the Organizing Committee, I wish to extend best thanks to the following sponsors for their financial and/or moral support:

Government of the Czech Republic, Czech Geological Survey in Prague, Czech Commission for UNESCO, Division of Earth Sciences, UNESCO (Paris), Society for Geology Applied to Mineral Deposits (SGA) and Czech IGCP National Committee.

It would not have been possible to organize this course without efforts of members of the Organizing Committee (D. Masek, R. Cadská, V. Bláha and J. Tesar from the Czech Geological Survey in Prague) as well as considerable understanding of the management of the DIAMO/GEAM State Enterprise in Dolní Rozínka. The management of the North Bohemian Mines j.s.c. helped with the organization of the field trip to North Bohemia. Mr. W. Eder and Mrs. D. Piuze from the Department of Earth Sciences/UNESCO helped to get the course funded through the UNESCO administration. Last, but not least I wish to thank all authors who contributed to the textbook and to all lecturers.

More information is available at <http://www.geology.cz> or from pasava@cgu.cz or masek@cgu.cz



Participants to Geochim 2003



Training Course in Exploration and Environmental Geochemistry

Geochem

postgraduate course

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



Prague and Dolní Rozínka
Czech Republic
September 6-20, 2004

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. The organizers will cover accommodation, travelling and meals during the course so that no per diems are provided. International travelling to Prague is not included. A diploma will be awarded to each successful participant.

Insurance

No travel insurance will be organized for any of the course participants. All participants are reminded that they should organize their own personal insurance for all aspects of the course and field excursions. The organizers shall accept no responsibility whatsoever for any damage, loss, personal injury or death suffered by any participant during the course and associated field excursions.

Place

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

Duration

6 - 20 September 2004

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 later than March 15, 2003. Letter of acceptance with detailed programme, travel and payment instructions will be sent to selected applicants during May 2004.

Deadline for application: March 15, 2004

Contact address:

GEOCHIM 2004
Dr. Jan Pasava
Czech Geological Survey
Geologická 6
152 00 Prague 5 - Barrandov
phone: +420-2-51817390
fax: +420-2-51818748
e-mail: pasava@cgu.cz
masek@cgu.cz

GEOCHIM 2004

Training Course in Geochemical Exploration Methods and their Environmental Applications

Prague and Dolní Rozínka, Czech Republic
September 6-20, 2004

APPLICATION FORM

Name:

Surname:

Date of birth:

Passport N.:

Obtained degree(s):

Present position:

Institution:

Contact Address:

Phone:

Fax:

E-Mail:

Home address:

Male ☐ Female ☐ (please tick)

Date:

Signature:

Return by March 15, 2004

FORTHCOMING EVENTS

★ marks a new entry

2004

★ January 5-7

THE MINERALOGICAL SOCIETY OF (GREAT BRITAIN AND IRELAND) WINTER MEETING, Assembly Room, Bath, Great Britain – Contact address: Dr. N. Petford. E-mail: info@minersoc.org; web-site: <http://www.minersoc.org/pages/meetings/geothermal.htm>

★ January 26-30

OCEAN SCIENCES, INTERNATIONAL MEETING, Portland, Oregon, USA – Contact address: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 USA; phone: +1 202 462 6900; fax: +1 202 328 0566; e-mail: meetinginfo@agu.org; web-site: <http://www.agu.org/meetings>

★ February 4-7

INTERNATIONAL CONFERENCE ON COOPERATION AND INNOVATION IN THE GEO-INDUSTRY, Orlando, FL, USA – Contact address: Geo-Institute and ADSC: The International Association of Foundation Drilling, Ted Ledgard, P.O. Box 550399, Dallas, TX 75355, USA; phone: +1-214-343-2091; e-mail adsc@adsc-iafd.com; web-site: www.geo-support2004.com

★ February 8-13

17TH AUSTRALIAN GEOLOGICAL CONVENTION - Past, Present and Future, Hobart, Tasmania – Contact address: Conference Design, P.O. Box 342, Sandy Bay Tasmania 7005; phone: +61-3-62243773; fax: +61-3-62243774; e-mail: 17thagc@gsa.org.au; web-site: <http://www.17thagc.gsa.org.au>

February 23-25

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

★ March 7-10

PROSPECTORS & DEVELOPERS ASSOCIATION OF CANADA, International Convention, Trade Show & Investors Exchange, Toronto, Ontario, Canada – Contact address: Lisa McDonald, Convention Manager; e-mail: lmcdonald@pdac.ca; web-site: <http://www.pdac.ca/pdac/conv/index.html>

★ March 28-31

IM17 - 17TH INDUSTRIAL MINERALS INTERNATIONAL CONGRESS, Hotel Arts, Barcelona, Spain – Contact address: Mike O'Driscoll, Editor; phone: +44-20-78276444; fax: +44-20-78276441; e-mail: modriscoll@indmin.com; Registration: Hayley Ward, Metal Bulletin Plc, 16 Lower Marsh, London, SE1 7RJ, UK; phone: +44-20-78279977; fax: +44-20-78275292; e-mail: conferences@indmin.com; web-site: www.indmin.com

★ March 28 - April 1

SYMPOSIUM ON MICROBIALY MEDIATED MANGANESE AND IRON OXIDATION IN THE BIOSPHERE, 227th ACS National Meeting, Anaheim, California, USA – Contact address: <http://membership.acs.org/g/geoc/upcoming.html>

★ March 29-31

EURADWASTE '04: SIXTH EUROPEAN COMMISSION CONFERENCE ON THE MANAGEMENT AND DISPOSAL OF RADIOACTIVE WASTE, COMMUNITY POLICY AND RESEARCH INITIATIVES, Luxembourg – Contact address: Christophe Davies, European Commission, Office MO75-5/42, B-1049 Brussels, Luxembourg; fax: +32-2-2954991; e-mail: christophe.davies@cec.eu.int

★ April 4-7

TENTH INTERNATIONAL SYMPOSIUM ON EXPERIMENTAL MINERALOGY, PETROLOGY AND GEOCHEMISTRY (EMPG X), Frankfurt, Germany – Contact address: EMPG X Organizing Committee, Institute of Mineralogy, Johann Wolfgang Goethe, University Frankfurt, Senckenberganlage 28, D-60054 Frankfurt, Germany; phone: +49-69-79822111 (Gerhard Brey), +49-69-79822549 (Heidi Höfer); fax: +49-69-79828066; e-mail: empgX@uni-frankfurt.de; web-site: www.empgX.uni-frankfurt.de

★ April 25-30

MINERALS OF THE OCEAN - Integrated Strategies, St. Petersburg, Russian Federation – Contact address: M. Torokhov, VNIIOkeangeologia, Angliysky Ave. 1, St. Petersburg 190121 Russia; phone: +7-812-1141485; fax: +7-812-1141470; e-mail: geotour@mail.ru

★ April 25-30

14TH INTERNATIONAL ZEOLITE CONFERENCE, Cape Town, South Africa – Contact address: fax: +27-21-6897579; e-mail: izc@chemeng.uct.ac.za; web-site: <http://www.14izc.org.za>

★ May 9-12

EDMONTON 2004, Canadian Institute of Mining and Metallurgy, Annual General Meeting (CIM-AGM), Mining Industry Conference and Exhibition, Workshops, Short Courses, Oral & Poster Sessions, Field Trips, and more – Contact address: web-site: www.cim.org

★ May 10-11

SPECIAL SESSION AND SHORT COURSE ON RARE-ELEMENT GEOCHEMISTRY AND ORE DEPOSITS at the St. Catharines 2004 GAC-MAC meeting, Ontario, Canada (<http://www.stcatharines2004.ca>). Post-meeting field trip to visit pegmatites in southern Ontario – Contact address: <http://www.science.uwaterloo.ca/earth/faculty/linnen/rare%20element%20brochure.pdf>; e-mail: Bob Linnen at rlinnen@uwaterloo.ca

★ May 12-14

49TH ANNUAL MEETING OF THE GEOLOGICAL ASSOCIATION AND THE MINERALOGICAL ASSOCIATION OF CANADA, St. Catharines, Ontario, Canada – Contact address: St. Catharines 2004, c/o Department of Earth Sciences, Brock University, St. Catharines, Ontario, L2S 3 A1, Canada; phone: +1-905-688-5550 x3526; fax: +1-905-682-9020; e-mail: gacmac04@brocku.ca; web-site: www.stcatharines2004.ca/

May 17-21

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

★ May 17-29

8TH INTERNATIONAL SYMPOSIUM ON ENVIRONMENTAL ISSUES AND WASTE MANAGEMENT IN ENERGY AND MINERAL PRODUCTION, SWEMP 2004, Antalya, Turkey – Contact address: Türkan Erbay Yilmaz, Faculty of Engineering; e-mail: terbay@atilim.edu.tr; web-site: <http://swemp.atilim.edu.tr>

★ June 6-12

14TH V.M. GOLDSCHMIDT CONFERENCE, Copenhagen, Denmark – Contact address: Goldschmidt 2004, Geological Institute, University of Copenhagen, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark; fax: +45-33-148322; e-mail: goldschmidt@geol.ku.dk; web-site: <http://www.goldschmidt2004.dk/>

★ July 6-8 *SGA-Cosponsored*

MORE-SGEG CONFERENCE, Orange, NSW, Australia – Contact address: Frank Bierlein or Andy Wilde, School of Geosciences, Monash University VIC 3800, Australia; phone: +61 3 9905 4879; fax: +61 3 9905 4903; e-mail: bierlein@mail.eearth.monash.edu.au; wilde@mail.eearth.monash.edu.au; web-site: <http://www.eearth.monash.edu.au/seminars/MORE-Conference-2004.html> (see also p. 21)

★ August 15-19

ASEG-PESA, INTEGRATED EXPLORATION IN CHANGING WORLD, Sydney, Australia – Contact address: Loise Pitney, Conference Action Pty Ltd, P.O. Box 576, Crows Nest NSW 1585 Australia; phone: +61-2-94379333; fax: +61-2-99014586; e-mail: aseg-pesa2004@conferenceaction.com.au; web-site: www.aseg-pesa2004.org.au

August 18-28

32ND INTERNATIONAL GEOLOGICAL CONGRESS, Florence, Italy – Contact

address: Matteo Moscatelli or Erica Galli, Newtours SpA, Via San Donato 20, I-50127 Florence, Italy; phone: +39 055 33611; fax: +39 055 33611250/350; e-mail: newtours@newtours.it; web-site: <http://www.newtours.it> or <http://www.32igc.org>

August 18-28 **SGA-Cosponsor**

GLOBAL AND CONTINENTAL-SCALE MINERAL RESOURCE ASSESSMENT, 32ND INTERNATIONAL GEOLOGICAL CONGRESS, Florence, Italy, T-09.07 Session, Florence, Italy (see also p. 21)

September 11-19

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

★ September 19-22

8TH INTERNATIONAL CONGRESS ON APPLIED MINERALOGY (ICAM 2004), Aguas de Lindoia, Sao Paulo, Brazil – Contact address: Henrique Kahn; phone: +55 11 3818-5787; fax: +55 11 3815-5785; e-mail: henrkahn@usp.br; web-site: <http://www.appliedmineralogy.org/icam.htm> or Dogan Paktunc, 555 Booth Street, Canada; phone: +1-613-947-7061; fax: +1-613-996-9673; e-mail: dpaktunc@nrcan.gc.ca; web-site: <http://www.icam2004.org>

★ September 27-30

MINEXPO INTERNATIONAL 2004, The National Mining Association, Las Vegas, Nevada, USA – Contact address: National Mining Association 1130, 17th Street NW, Washington, DC 20036, USA; phone: +1-202-4632626; fax: +1-202-4636152; e-mail: rmaddalena@nma.org; web-site: <http://www.nma.org>

★ September 27 – October 1 **SGA-Cosponsor**

SEG: PREDICTIVE MINERAL DISCOVERY UNDER COVER, Perth, Western Australia – Contact address: Susan Ho, P.O. 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://www.cgm.uwa.edu.au/geoconferences/index.asp>

October 10-15

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

★ November 7-10

GEOSCIENCE IN A CHANGING WORLD: GSA (Geological Society of America) Annual Meeting, Denver, CO, USA – Contact address: GSA Meetings; phone: +1-303-447-2020; fax: +1-303-357-1072; e-mail: meetings@geosociety.org; web-site: <http://www.geosociety.org/meetings/2004/>

★ November 22-23

GEOSUR 2004 - International Symposium on the Geology and the Geophysics of the Southernmost Andes, the Scotia Arc and the Antarctic Peninsula, Buenos Aires, Argentina – Contact address: Angela Marchetto, OGS, Borgo Grotta Gigante 42c - 34010 SGONICO TS, Italy; phone: +39 040 2140339; fax: +39 040 327040; e-mail: amarchetto@ogs.trieste.it; web-site: <http://www.ogs.trieste.it/GeoSur2004/GeoSur2004.html>

2005

★ February 28 – March 3

SME Annual Meeting and Exhibition, Denver, Colorado, USA – Contact address: Society for Mining, Metallurgy & Exploration; phone: +1-303-9739550; fax: +1-303-9793461; web-site: <http://www.smenet.org>

★ April 3-7

INTERNATIONAL CONFERENCE ON THE BIOGEOCHEMISTRY OF TRACE ELEMENTS (ICOBTE), Adelaide, Australia – Contact address: e-mail: 8thICOBTE@csiro.au; web-site: <http://www.clw.csiro.au/conferences/8thicobte/>

May 20-24 **SGA-Cosponsor**

GOLDSCHMIDT CONFERENCE 2005, University of Idaho, Moscow, Idaho, USA – Contact address: gold2005@uidaho.edu; web-site: www.gold2005.uidaho.edu (see also p. 21)

★ August 7-11

10TH INTERNATIONAL PLATINUM SYMPOSIUM: "Platinum-Group Element - from Genesis to Beneficiation and Environmental Impact, Oulu, Finland – Contact address: Congress Oulu, P.O. Box 56, Fin-90015 Oulun kaupunki, Finland; e-mail: congressoulu@ouka.fi; web-site: www.congressoulu.fi and <http://platinumsymposium.oulu.fi/>

★ October 16-19

GEOLOGICAL SOCIETY OF AMERICA: ANNUAL MEETING, Salt Lake City, Utah, USA – Contact address: GSA Meetings Department, P.O. Box 9140, Boulder, CO 80301-9140, USA; phone: +1 303 447 2020; fax: +1 303 447 0648; e-mail: meetings@geosociety.org; web-site: <http://www.geosociety.org/meetings/index.htm>

THE NEW SGA HOMEPAGE ON INTERNET

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

<http://www.e-sga.org> Microsoft Internet Explorer

<http://www.e-sga.org/>

WELCOME
to the



HOMEPAGE OF THE
SOCIETY FOR GEOLOGY APPLIED
TO MINERAL DEPOSITS

ANNOUNCEMENTS

MEETINGS, CONFERENCES, FIELD TRIPS AND SHORT-COURSES

MORE-SGEG CONFERENCE

Orange, NSW, Australia

July 6 - 8, 2004

SGA-COSPONSORED

The Monash Ore Deposits Research Group, in collaboration with the Australian Geological Society's Specialist Group in Economic Geology and the Society of Geology Applied to Mineral Deposits, is organising a conference in Orange, NSW, on July 6 - 8, 2004. The theme of the meeting, which will comprise one day of (invited) presentations, a conference dinner at a nearby winery, and two days of field trips to Cu-Au deposits and exciting, new discoveries in the region (Lake Cowal, Cadia, Wyoming, Cargo, and possibly Peak Hill), will be 'Tectonics to Minerals Discovery - Deconstructing the Lachlan Orogen'.

It has been almost ten years since the first synthesis on aspects of metallogeny and tectonics of the Lachlan Orogen (published in 1995 as a special issue of Economic Geology vol. 90). The last decade has seen considerable progress and major contributions, especially in the fields of geodynamic and tectonic evolution of the orogen, geochronology, ore deposit studies, and geophysical interpretations. We feel that it is appropriate to highlight these advancements by organising a forum at which to showcase and discuss the current state of knowledge and understanding.

The Organising Committee is assembling a well-rounded mix of 14 thirty-minute presentations by representatives from industry, universities and government organisations on the first day of the meeting, with all talks grouped into three sessions, namely Metallogenesis, Tectonics, and Deposit Studies. Confirmed speakers include Bill Collins (University of Newcastle), Ian Chalmers (Alkane Exploration), David Cooke (CODES), Jon Dugdale (MPI Stawell Gold Mines), Martin Hughes (Consultant & University of Ballarat), Russell Korsch (Geoscience Australia), Steve Olsen (Ballarat Goldfields), Stuart Smith (GeoDiscovery), John Walshe (CSIRO), and Clive Willman (Geological Survey of Victoria). We also plan to have a (student) poster session during the lunch break and/or after the last talk during which other attendees will have an opportunity to advertise/present their work. The meeting will be held back-to-back with a Monash University SEG Student Chapter field trip and as such, we are hoping to have a strong post-graduate student presence at the meeting.

The meeting will be accompanied by a proceedings volume with extended abstracts and a field guide, and we are also aiming at publishing a special issue of Mineralium Deposita in 2005 (subject to obtaining a sufficient number of high-quality submissions from contributors by the end of June 2004).

A first circular of the conference can be found at

<http://www.earth.monash.edu.au/lib/MORE-Conference-2004.pdf>

Check this site frequently for updates. For further information and to register your interest, please contact:

Frank Bierlein or Andy Wilde
School of Geosciences
Monash University VIC 3800
tel: +61 3 9905 4879
fax: +61 3 9905 4903

bierlein@mail.earth.monash.edu.au
wilde@mail.earth.monash.edu.au

32nd INTERNATIONAL GEOLOGICAL CONGRESS

Florence, Italy

August 18-28 2004

Global and Continental-Scale Mineral Resource Assessment
Session T-09.07

SGA-SPONSORED

Web-site: <http://www.32igc.org>



SGA-COSPONSORED

Moscow, ID, USA

May 20-24, 2005

Web-site: www.uidaho.edu/gold2005

University of Idaho and Washington State University.

The Goldschmidt Conference is the premier annual meeting in geochemistry and mineralogy. As did past conferences, the meeting in Idaho will cover the full range of geochemistry from cosmochemistry to the origin of life. However, this conference will be special because 2005 is the 50th Anniversary of the Geochemical Society - come celebrate this anniversary in the foothills of the Rocky Mountains! The conference also takes place during the bicentennial of the Lewis and Clark expedition - the Corps of Discovery. The Local Organizing Committee invites you to come on a voyage to discover the latest in the fields of geochemistry and mineralogy, and the superb geology and unparalleled opportunities for outdoor recreation in the Inland Northwest. To register interest, log on to the web site above or e-mail: gold2005@uidaho.edu.

SEG 2004: Predictive mineral discovery under cover

Pert, Western Australia

27 September – 1 October 2004

Pre- and post-meeting excursion to mineral districts in Australasia

Sessions: Targeting, Models & Exploration, Exploration & Commercial Opportunities, Mineral System Footprints & Recognition Under Cover

and day 4 – Session 5

SGA-SPONSORED

Cutting-edge Developments in Economic Geology

Keynote address: Prof. Jeff Hedenquist

Contributions are invited for either oral or poster presentations on up-to-date, cutting-edge, process-oriented studies or methodology for studies in Economic Geology. Topics include, but are not restricted to:

- Lithospheric and/or tectonic processes and mineralization
- Basin analysis and mineralization
- Geophysical, geochemical and/or numerical modeling of mineralizing systems
- Geochronology and duration of mineralizing systems
- Fluid dynamics and evolution in mineralizing systems
- Experimental studies on ore systems

Initial abstract of one A4 page to be submitted before 1st February 2004

Full details on the program, fieldtrips, workshops, sponsorship and registration available at

www.cgm.uwa.edu.au/geoconferences

RESEARCH CHAIR

DEPARTMENT OF GEOLOGICAL SCIENCES AND GEOLOGICAL ENGINEERING QUEEN'S UNIVERSITY, KINGSTON, CANADA

The Department of Geological Sciences and Geological Engineering, Queen's University at Kingston, one of Canada's premier earth-science departments, seeks exceptional researchers to apply for a Tier 2 Canada Research Chair in the field of solid-earth materials, with a focus on the nature of these materials, the processes by which they are cycled within the earth, and the resulting petrological and/or resource implications. The successful candidate must have a Ph.D. and an outstanding research record in order to fulfil the criteria for Tier 2 Canada Research Chairs (see www.chairs.gc.ca). It is expected that the Chair holder will supervise graduate students at the M.Sc. and Ph.D. levels, contribute actively to undergraduate and graduate teaching, undertake vigorous externally funded research, and collaborate with departmental colleagues. For information about the Department, visit www.geol.queensu.ca.

Queen's University is committed to employment equity and welcomes applications from all qualified men and women, including visible minorities, aboriginal people, persons with disabilities and persons of a diversity of sexual orientation. All qualified candidates are encouraged to apply; however, Canadian citizens and Permanent Residents will be given priority. Academic staff at Queen's University are governed by a collective agreement, the details of which are posted at <http://www.queensu.ca/qufa>. In accordance with the Queen's guidelines for the assignment of Canada Research Chairs, applications from qualified women are particularly encouraged for this position.

Applicants should send a current curriculum vitae, a statement of research interests and future plans, a statement of teaching experience and interests, and samples of research writing to the following address. Applicants must arrange for at least three individuals of international standing to send confidential letters of reference. Review of completed applications will begin on January 15, 2004.

Robert W. Dalrymple, Head,
Geological Sciences and Geological Engineering,
Queen's University,

Kingston, ON K7L 3N6
Canada

SGA SUBSIDIZED SUBSCRIPTION PROGRAM

The SGA Council offers a limited number of free subscriptions to *Mineralium Deposita* to Institutions and, under special circumstances, also to individuals in an economically challenged situation. The grant period is for 2 years.

Please send a letter of justification for the need and specify how the journal will be used. The written request including contact details of two SGA members supporting this request should be sent to the SGA Executive Secretary, Czech Geological Survey, Klárov 131/3, 118 21 Praha 1, Czech Republic, EUROPE.

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 € (~65 US\$)

Regular

☐ 10 € (~10 US\$)

Student (up to Ph. D., max. 4 years)*

☐ 45 € (~45 US\$)

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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.

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