SGA News
June 2012
Number 31

# Lousal, Portugal: a successful example of rehabilitation of a closed mine in the Iberian Pyrite Belt

**Jorge MRS Relvas1, Álvaro MM Pinto2 and João MX Matos3**

*1 CREMINER/LARSyS, Faculty of Science, University of Lisbon, Ed. C6, Campo Grande, 1749-016 Lisboa, Portugal*
*2 CREMINER/LARSyS, Museum of Natural History and Science, R Escola Politécnica, 56, 1250-102 Lisboa, Portugal*
*3 LNEG - Laboratório Nacional de Energia e Geologia, Rua Frei Amador Arrais, R/C, 7801-902 Beja, Portugal*

## 1. INTRODUCTION

Historically, mines in the Iberian Pyrite Belt were, and still are, important primary providers of employment, services and income. Thus, the closure of a mine always had significant impacts on the local economy and on the well being of the community. Unfortunately, in most cases in the past, both in Portugal and Spain, when mining operations ceased, mines were boarded up and abandoned. The safety, environmental and social risks arising from badly conducted mine closures resulted in severe distress for communities due to environmental, social and economic collapse. Furthermore, mining activities have often resulted in destruction of, or radical alterations to, ecosystems, implying now large clean-up costs for governments and regional authorities.

Presently, it is accepted that mine closure requires the return of land to a viable post-mining use, and that the socio-economic impacts of the closure must be assessed and managed. However, that concern did not exist in the past and thus most old mines of the Iberian Pyrite Belt, either abandoned or closed, still remain as a problem to be solved. Each case requires an individual response, as the situations identified are manifold. In favourable cases, there are ways in which closed mines can even create socio-economic development opportunities for local communities. Economic benefits from those activities provide a context favourable to investments in human resources and infrastructures that can meet local/regional development needs and create mechanisms for sustainable economic growth in a post closure situation.

The Lousal mine was an important massive sulphide deposit of the Iberian Pyrite Belt, one of the major metallogenic provinces worldwide, extending for nearly 300 km from the Southwestern coast of Portugal (near which Lousal is located) to the Guadalquivir basin, in Spain (Fig. 1). The mine was active between 1900 and 1988 and part of its surface infrastructures are rather well preserved. The Lousal mining village is currently being rehabilitated not only as a geological and mining heritage site, but also as a centre for education for science and technology and a destination for tourism of nature, culture and patrimony. In this article we briefly describe the major components of this on-going project, which is already envisaged by many as a successful case study in Europe.

*page 6* ▶

CONTENTS



MAIN FEATURES

# News of the Society

## SGA Ordinary Council Meeting, April 17-18, 2012, Uppsala, Sweden

**J. Pašava (SGA Executive Secretary), Czech Geological Survey, Prague, jan.pasava@geology.cz**

P. Weihed welcomed Council Members (G. Beaudoin, N. Bortnikov, P. Eilu, H. Frimmel, A. Cheilletz, B. Lehmann, J. Pašava, S. Roberts, A. Vymazalová, P. Williams and J. Wilkinson) and briefly introduced host organization – the Swedish Geological Survey (SGU).

**Minutes of Previous Council Meeting (September 25, 2011, Antofagasta, Chile)**
The Minutes were unanimously approved.

**Reports of Officers on Council (to be received prior to meeting) and Matters Arising from These Reports**
Reports were submitted by the SGA Executive Secretary, Treasurer's Office, Chief Editor of SGA website , and Regional VP for Oceania. SGA Annual Report for 2011 was highly appreiated by IUGS. In 2011 SGA reached a new membership record (1215 paying members).
After discussion, Council approved the reports and the following motions:
P. Weihed to create a Nomination Committee to start looking in collaboration with Council and general SGA membership for suitable candidates for Council positions for 2013 election.
P. Weihed to write a letter to RVP´s to encourage them to submit a concrete plan of activities for 2012-2013 in their regions.
P. Eilu to write to Dave Houston to find out if he is willing with other SGA Council members to organize possibly in collaboration with Springer (Ch. Bendall from Springer needs to be contacted) SGA promotion at the 34th IGC in Brisbane.
D. Houston to prepare a call for nominations for SGA-Newmont Gold medal and SGA-Barrick Young Scientist award (for both website and upcoming SGA News)
G. Beaudoin to contact F. Robert on Barrick future participation in the SGA-Barrick Young Scientist Award (wait for appropriate timing).
Hartwig Frimmel to organize corporate credit card for SGA Treasurer.
To reserve a part of a profit from the First African Metallogeny Course) to SGA Educational Foundation.
G. Beaudoin in collaboration with D. Layton-Matthews to plan improvement of SGA website.
All Council members are asked to help M. Chiaradia in identifying potential contributors for the main articles in SGA Newsletter.
E. Ferrari to provide more information on the planned field course SGP-SGA on the Central Andes Deposits.

**Editorial matters (B. Lehmann, P. Williams)**
The report was presented by B. Lehmann and P. Williams. Journal The report was given by P. Williams. The journal continues to attract a high level of submissions and the Chief Editors agreed to increase the number of pages per volume to the maximum allowed (1000) under the current agreement with the Springer Publishing House. Council approved the report with great thanks and also highly appreciated editorial work of P. Williams who will retire from his position from 1st July 2012.
Action: All Council members are encouraged to suggest nominations from within Council and also other nominations to B. Lehmann and P. Williams by May 8, 2012. These nominations have to be approved by the nominees. The description of duties of the Chief Editor, MD is available from B. Lehmann and P. Williams.

**Status of SGA Guidebook series and update on revival of SGA Special Publications (J. Slack)**
After a brief summary by J. Pašava, presentation of J. Slack and discussion Council approved the following motions:
J. Slack with P.Weihed to negotiate with Ch. Bendall (Springer) better conditions for publishing SGA Special Publications.
J. Slack to find out from Ch. Bendall what publications (if any) are available for a series of SGA Special Publications.
J. Pašava to send Minutes of Budapest (2010) and Madrid (2011) Council meetings with relevant enclosures dealing with SGA Publications to J. Slack.

**Status of planning for the 12th SGA Biennial Meeting to be held in 2013 in Uppsala (P. Weihed)**
This item was discussed separately with members of the LOC on April 18, 2012 from 11.00 to 16.00 (including a visit to SGA 2013 Meeting venue). The meeting "Mineral Deposit Research for a High-Tech World" (August 12–15, 2013, Uppsala, Sweden) will be organized by the Swedish Geological Survey in collaboration with Nordic countries. More info is available at www.akademikonferens.uu.se/sga2013. After a brief introduction of all present members of SGA Council and LOC and discussion the following motions we approved:
J. Pašava to prepare and send to P. Weihed a draft of MOU between SGA and LOC which will be signed by both sides.
P. Weihed to serve as Technical liaison between SGA Council and LOC.
P. Eilu and H. Frimmel to become members of the Sponsorship Committee.
A Conference profit/loss will be shared 50:50 between SGA and LOC.
P. Weihed to write an official letter to SEG and IAGOD to suggest their activities (a subject of approval by SGA Council).
J. Slack to work jointly with SGA 2013 Field trip coordinator to identify as many field trips as possible for publishing Field trip Guidebook.
LOC to submit a written report summarizing the progress of the meeting's organization to J. Pašava (by May 15, 2012).
LOC to revise originally proposed budget including registration fee (below 500 EUR).
LOC to adapt technical program including proposals for session chairs.
LOC to revise important deadlines.
LOC to specify field trips including fees.
LOC to submit a draft of the Second Circular to J. Pašava for Council approval by September 15, 2012.

**Status of call for SGA 2015 Biennial Meeting (J. Pašava)**
J. Pašava briefly informed about a status of received bids. SGA Council received two bids – one prepared by a group from Brazil and the second one prepared by a French-German-Belgian consortium. At the moment, both groups are working on replies to additional questions, which were raised by Council members. After the receipt of both materials the complete bids will be emailed to SGA Council members for an electronic vote.
Action: J. Pašava to organize electronic vote possibly by May 15, 2012.

**Progress report on the creation of SGA Educational Foundation (J. Pašava et al.)**
After presentation of a summary report by J. Pašava and discussion Council approved the following motions:
G. Beaudoin (coordinator) with P. Weihed, J. Pašava and H. Frimmel to set up the SGA EF either in Switzerland or in any other country.
J. Pašava to inform D. Groves about the importance of the preparation of the 8-days training course in Mokrsko, Czech Republic as suggested in his letter to mining companies.
Council greatly appreciated recent voluntary effort of D. Groves and his wife Sue which resulted in confirmed commitments from several mining companies over a period of 5 years.

**Progress report on membership drive from the last SGA Council meeting (P. Eilu, J. Pašava, A. Vymazalová)**
The report was presented by P. Eilu. In 2011 SGA had 1163 paying members and to date our membership grew to a new record of 1215 paying members. Unfortunately, the loss of members remains a serious problem. Sabine Lange recently distributed an excel file listing members who haven´t paid their fees (since 2010 we have 403 members who haven't paid their fees). Council approved the report with great thanks and recommended the following actions:
All RVP´s in collaboration with Council members should contact the members who haven´t paid their fees.
S. Lange to prepare a next list of people who didn't renew SGA membership and send it to all Council members by July 5, 2012 so that individual Council members and Regional Vice-Presidents could contact individual people.
S. Lange to email reminders to all who didn't renew SGA membership at least 3 times a year (every 4 months).

**Status of development of SGA Student and Young Scientist network – Reports from Prague, Baltic and Novosibirsk Chapters (A. Vymazalová and J. Relvas)**
The report was presented by A. Vymazalová. After discussion Council approved all reports with great thanks and the following budgets for 2012 activities (Baltic Chapter – EUR 2500, Novosibirsk Chapter – EUR 1000), Prague Chapter – EUR 2500).

**Past activities**
- Geological Society of Bolivia Anniversary Meeting (October 3–4, 2011 La Paz, Bolivia) – B. Lehmann – one of keynote speakers – received a letter of thanks from President of the Bolivian Geological Society with a request for continuing SGA support
- Baltic Student Chapter Meeting (December 6–9, 2011 Cracow, Poland) – requested EUR 660 to cover part of expenses for 15 participants – M. Sosnicka et al.
- African Metallogeny Course (March 12–18, 2012 Ouagadougou, Burkina Faso) – H. Frimmel et al.

Council greatly appreciated efforts of all organizing teams who contributed to successful SGA promotion. African Metallogeny Course was highly appreciated by the President of IUGS.

Council greatly appreciated efforts of all organizing teams who contributed to successful SGA promotion.

**Future activities**
- The 6th International Siberian Early Career GeoScientists Conference – (June 9–23, 2012 Novosibirsk, Russia) - organized by a newly forming SGA Novosibirsk Chapter – J. Relvas (SGA keynote speaker)
- Ophiolites and related ores and industrial minerals (16–22 May 2012 Trabzon, Turkey) – SGA sponsored workshop – organized by I . Uysal et al.
- Session "Trace elements in oxides minerals from ore deposits…." (within Theme 9-Earth´s Resources: Origin, Evolution, Sustainable Exploitation and Remediation of the 22nd Goldschmidt Conference – June 24–29, 2012 Montreal, Canada – Brenan et al. – approved EUR 1000 for 4 students (SGA members).

SGA News

No. 31 June 2012
EDITORS
Massimo Chiaradia[1], Chris Heinrich[2]
[1]Department of Mineralogy
University of Geneva
Geneva
SWITZERLAND
[2]ETH Zurich
SWITZERLAND

SGA News is a publication of SGA (Society of Geology Applied to Mineral Deposits) and appears twice a year.

SGA News can be also read in the SGA homepage on Internet:
http://www.e-sga.org

CONCEPT AND PRINTING
WMXDesign GmbH
Heidelberg, Germany

LAYOUT
Massimo Chiaradia, Geneva, Switzerland

INFORMATION FOR CONTRIBUTORS
Items for publication may be sent to:
SGA News (see address below)
Manuscripts should be sent by e-mail using Microsoft Word for text and Jpeg or Tiff formats for pictures and figures (the latter must be in grey level tones, not colour!). Please always send a paper copy and indicate the format you are using.

DEADLINE FOR SGA NEWS NO. 32
31 October 2012

SGA NEWS – MAILBOX
Dr. Massimo Chiaradia
Department of Mineralogy
University of Geneva
Rue des Maraîchers 13
CH-1205 Geneva
Fax: +41 22 379 32 10
e-mail: editor-sga-news@e-sga.org
Massimo.Chiaradia@unige.ch

- Session "Black shale-hosted mineral resources: deposit characterization, geochemical controls, and exploration potential" (Theme 9) of the 22nd Goldschmidt Conference – June 24–29, 2012 Montreal, Canada – Slack et al. – approved EUR 1000 for 4 students (SGA members)
- Freiberg Short Courses in Economic Geology (organized annually by J. Gutzmer) – SGA sponsorship (student´s participation) – at the moment no funding requested
- 34th IGC (August 5-10, 2012 Brisbane, Australia) – 2 SGA sessions and 1 SGA co-sponsored session and SGA Council Meeting – D. Houston et al. – reservation for SGA Council meeting had to be cancelled due to insufficient presence of SGA Councillors, possible SGA promotion in discussion.
- 2nd Short Course on African Metallogeny (the Central African Copperbelt, 2013, locality and dates still to be decided) – S. Roberts et al.
- 12th SGA BIENNIAL MEETING (August 12–15, 2013 Uppsala, Sweden – www.akademikonferens.uu.se/sga2013) – P. Weihed et al.

**Requests for sponsorship**

- Black shales and ore deposits (SGA sponsored session at the 29th IAS Meeting, September 10-13, 2012 Schladming, Austria) – B. Lehmann and J. Pašava (requested EUR 1000 for sponsoring SGA student participants) – there are two other MD sessions and J. Raith asked if SGA would consider sponsoring also SGA student participation in his session – on Sediment hosted base metal deposits - approved
- EMC 2012 (September 1–7, 2012 Frankfurt am Main, Germany) – MD sessions:

  8a – Ore belts in Europe,
  8b PGM and related accessory minerals in mafic-ultramafic rocks and unconventional deposits,
  8c Ore-forming hydrothermal processes
  8d Critical raw materials for Europe

  SGA sponsorship to all MD session suggested by J. Pašava and approved by session chairs – requests for sponsorship indicating type of presentation accepted by LOC, amount of money requested and purpose of money use should be directed to session chairs by July 15, 2012. The recipients of the grants will be selected and approved by SGA and session chairs will be informed of a decision by August 15, 2012 (only for SGA student members) – EUR 2000 for all four sessions (4x500 EUR) – approved
- "re deposits models and exploration" workshop traditionally held in China (dates under discussion – between October 22 and November 17, 2012 Guangzhou, China) – requested USD 1500 for SGA keynote D. Leach – already approved by SGA EC
- XX Congreso Geologico Boliviano (1–4 October 2012 La Paz, Bolivia) – request for SGA keynote speakers – O. Arce (President, BGA)

  Action: P. Weihed to ask E. Ferrari and K. Kouzmanov to act as SGA keynote speakers (SGA would cover economy air fare) and to inform O. Arce.
- Requests from SGA Chapters (Prague – 2500 EUR, Baltic - 4030 EUR, Novosibirsk – 1000 EUR) – approved 2500 EUR for Prague, 2500 EUR for Baltic and 1000 EUR for Novosibirsk.

**Any other business**

*Electronic "Talk list" (J. Slack)*

The concept was presented by J. Slack (Item 15-1). Council approved the document with great thanks. Action: G. Beaudoin to initiate a new on-line SGA Talk Listserv through SGA website.

*Insurance for SGA (update by H. Frimmel)*

A contract on corporate third party insurance for SGA has been finalized with Zürich and is in effect since beginning of September 2011.

*SGA award for recognition of special services to the society – update (H. Frimmel)*

H. Frimmel informed Council that the proposal is under preparation by D. Houston (Chair of Award Committee).

*Report of the Technical Liason on the SGA Biennial Meeting held in Antofagasta in September 2011 (F. Tornos)*

The report was presented by J. Pašava (Item 15–3). Council greatly appreciated the report and provided its copy to K. Lax – chair of the SGA 2013 Meeting.

**Date and Place of the Next Council Meeting**

To be decided and announced at a later date.


## REDUCED PRICES FOR SGA PROCEEDINGS

BEIJING (2005) – Mao and Bierlein (eds) – Mineral Deposit Research: Meeting the Global Challenge, 2 Volume, over 1600 pages incl. CD-ROM
***NOW available for 30 EUR plus shipping costs***

DUBLIN (2007) – Andrew et al. (eds): Digging Deeper, 2 Volumes, over 1600 pages incl. CD-ROM
***NOW available for 50 EUR plus shipping costs***

Please contact Sabine Lange, Rixenweg 2, D-24222 Schwentinental- OT Klausdorf, GERMANY, phone +49-431-7993303, fax +49-431-7993420, email: sabine-klausdorf@t-online.de





## SGA COUNCIL 2012

| | |
|---|---|
| President | P. Weihed (Sweden) |
| Vice-President | G. Beaudoin (Canada) |
| Executive Secretary | J. Pasava (Czech Republic) |
| Treasurer | H. Frimmel (Germany) |
| Promotion Manager | P. Eilu (Finland) |
| Chief Editors | B. Lehmann (Germany) - MD<br>European Office<br>P. Williams (Australia) - MD<br>Australian Office<br>M. Chiaradia, C. Heinrich<br>(Switzerland) - SGA News<br>D. Layton-Matthews (Canada)<br>- SGA website |
| Student Represent. | A. Vymazalová (Czech Rep.) |

Regional Vice-Presidents

| | |
|---|---|
| Asia | Z. Hou (China) |
| Australia/Oceania | D. Huston (Australia) |
| Europe | A. Cheilletz (France) |
| N. Africa-Mid. East | S. Bouhlel (Tunisia) |
| North America | A. Conly (Canada) |
| South Africa | J. Kabete (Tanzania) |
| South America | E. Ferrari (Peru) |

Councillors: term ending on December 31, 2013

S. Roberts (U.K.)
S. Diakov (Canada, East Asia)
P. Eilu (Finland)
A. Piestrzynski (Poland)
F. Hongrui (China)
J. Relvas (Portugal)
R. Smith (Australia, China)
E. Campos (Chile)

Councillors: term ending on December 31, 2015

F. Bierlein (Australia)
N. Bortnikov (Russia)
J. Gutzmer (Germany)
K. Kelley (U.S.A.)
J. Richards (Canada)
J. Wilkinson (U.K.)

Ex officio Members, SEG

| | |
|---|---|
| President | L. Fontboté (Switzerland) |
| Executive Director | B. G. Hoal (USA) |

Ex officio Members, IAGOD

| | |
|---|---|
| Secretary General | S. Cherkasov (Russia) |
| Publication Manager | R. Seltmann (U.K.) |


## LIST OF NEW SGA MEMBERS (October 27, 2011-March 27, 2012)

**35 Regular, 25 Student and 1 Corporate Members applied for membership (27/10/2011–27/03/2012)**

### REGULAR MEMBERS

Dr. Diana Irene MUTTI Lebensohn 1526(1661) Bella Vista, Buenos Aires ARGENTINA
Mr. Doug MENZIES 16 Cullen Drive Kiama Downs NSW 2533 AUSTRALIA
Mrs Melissa SAY 21 Orange Grove Essendon North Victoria 3041 AUSTRALIA
Mr. Jonas Mota e Silva SQN 408, Bloco N, apto 307 – Asa Norte Brasília – DF, 70856-140 BRAZIL
Dr. Ghislain TOURIGNY 91 Place du Kilimanjaro, villa A04 Ouaga 2000, 11 B.P. 818 CMS Ouagadougou BURKINA FASO
Dr. Jim OLIVER 4377 Karindale Road Kamloops V2B 8N1 British Columbia CANADA
Mr. Matthew ROSALES Teck Resources Ltd 3300-550 Burrard St. Vancouver, BC V6C 0B3 CANADA
Mr. Laurence SOOKOCHOFF Suite 120 125A 1030 Denman Street Vancouver BC, V6G 2M6 CANADA
Mr. Zhang HONG Northwest University Xian, P.R. CHINA
Mr. Mingxing LING No 511, Kehua Street Wushan, Tianhe District Guangzhou P.R. CHINA
Mr. Meizhen ZHAN No 511, Kehua Street Wushan, Tianhe District Guangzhou P.R. CHINA
Mr. Freddy QUIJANO Urbanizacion Camino de los Eucaliptos, Calle B Casa 804. Sector Carretas, Quito ECUADOR
Ms Anne-Sylvie ANDRE-MAYER 6 Résdidence du Parc 54 670 Malleloy FRANCE
Dr. Benjamin BRIGAUD Universite Paris-Sud Bat 504 91405 Orsay FRANCE
Dr. Cyril DURAND FRE 3298 Geosystemes Université Lille 1 59 655 Villeneuve d´Ascq Cedex FRANCE
Mr. Aurelien EGLINGER 25 route de Valdoie 90 300 Eloie FRANCE
Dr. Philippe GONCALUES 6 rue lucien pilbt 25 000 Besancon FRANCE
Mr Jean LESCUYER 108 route de Darvoy – Cherelle 45150 Jargeau FRANCE
Mr Jean Pierre MILESI 21 Rue Gerard de Fontenay 45240 Ligny le Ribault FRANCE
Dr. Pierre TRAP 22 Grande rue 70 150 ETUZ FRANCE
Mr. Jean-Philippe URSUCE 2 Allée des Chenes Verts 31 780 Castelginest FRANCE
Dr. Klaus FREYMANN Deutsches Museum 1 D - 80538 Munchen GERMANY
Dr. Hossein KOUHESTANI Department of Geology Faculty of Sciences, Zanjan University Zanjan 45195-313 IRAN
Mr. Olawale Kayode AROMOLARAN Departmen of geology University of Ibadan Ibadan NIGERIA
Mr. Luis TEJADA ALVAREZ Av.Alfonso Ugarte 304, Casilla 299 Arequipa PERU
Mr. Reynaldo C. ESTACIO 7 Cosmos St., Amparo Heights Baguio City, 2600 PHILIPPINES
Ms Mircea NEGULICI Str. Doctor Clunet Nr. 3, Etaj 1, Sector 5 Bucuresti 050527 ROMANIA
Dr. Peter KODERA Dept of Geology of Mineral Deposits Faculty of Natural Sciences, Comenius University 842 15 Bratislava SLOVAKIA
Mr. Michael S. CRONWRIGHT P.O. Box 2137 Xanadu Crossing, Hartbeespoort North West 0279 SOUTH AFRICA
Mr. Chris JACKSON 51 St.David`s Road Claremont, 7708 Cape Town SOUTH AFRICA
Mr Roman HANES Dragon Mining Sweden AB Pautrask 100 SE-923 98 Storuman SWEDEN
Mrs Gulseda GUNGOR 2432 Cadde Prof Dr. Altan Gunalp Sitesi 10/8 Cayyolu/Ankara TURKEY
Mr. Federico Gonzales RAMOS Joaquin Suarez 3571/604 117 00 Montevideo URUGUAY
Mr. Matthew BIDWELL Royal Gold Inc. 1660 Wynkoop St., Suite 1000 Denver, CO 80202 USA
Prof. John L. NOLD Dept. of Earth Science U. of Central MO – 107 WCM Warrensburg, Missouri USA

### STUDENT MEMBERS

Mr. Akumbom VISHITI University of Buea Faculty of Science P.O. Box 63 Buea, South West Province CAMEROON
Mr. Shuang LI No 511, Kehua Street Wushan, Tianhe District Guangzhou P.R. CHINA
Mr. Jia SUN Hai Dian District Xueyuan Road No 2P 100083 Beijing P.R. CHINA
Mr. Saijun SUN 511Kehua Street No 511, Kehua Street Wushan, Tianhe District Guangzhou P.R. Mr. Junxing ZHAO P.O.Box 9825 100029 Beijing P.R. CHINA
CHINA
Mr. Jakub KRYL Komenského nám 215 261 01 Příbram CZECH REPUBLIC
Mr. Filip PODOLSKÝ Fáborského 965 516 01 Rychnov nad Kněžnou CZECH REPUBLIC
Mr. Michal RAISIGL Pazderkova 867 460 06 Liberec 6 CZECH REPUBLIC
Mr Lukáš ZAHRADNÍČEK Na Vyhlídce 499 Kutná Hora 284 01, CZECH REPUBLIC
Mr Gregory BALLAS 24 Rue de l`Amandier 34 000 Montpellier FRANCE
Mr Mosgeme GIGOUY 133 Rue des Blains 92 220 Bagneux FRANCE
Mr. Wilfried TOE 85 Rue des Cherevieres 54 600 Villers les Nancy FRANCE
Ms. Sibylle SCHEDEL Gruben 3 96272 Hochstadt GERMANY
Mr. Ali SHOLEH No 24, No 6, Nohom Sharghi Laleh Shomali, Ferdows Gharb Blv. Tehran IRAN
Miss Urszula JANICKA Ul. Cechowa 47a 30-614 Krakow POLAND
Miss Paulina KOLARZ Ul. Pachonskiego 6/245 31-223 Krakow POLAND
Miss Joanna KOLODZIEJCZYKUl. Na Blonie 11/8 30-147 Krakow POLAND

Mr. Maatla LETSHOLO AGH-University of Science and Technology 30-072 Budryka 2 Krakow POLAND
Mr. Pawel LYDEK 30/2 Strazacka Street 42-450 Grabowa POLAND
Ms. Lisa ANDERSSON Professorsvagen 33 97751 Lulea SWEDEN
Mr. Peter KARLSSON Dokkas 74 982 92 Gellivare SWEDEN
Miss Sanna NAALISVAARA Vanortsuagen 12 97754 Lulea SWEDEN
Ms. Carolin RYR Ringgatan 6j 752 17 Uppsala SWEDEN
Mr. Anders ZETTERGREN Professorsvagen 33 97751 Lulea SWEDEN
Mr. Brett DAVIDHEISER Flat 2/1, 45 Edgemont st Glasgow UK

**CORPORATE MEMBERS**

BARRICK Australia Pacific LTD Exploration Librarian Locked Bag 12 Cloisters Square, Perth AUSTRALIA

**APPLICATIONS** to SGA for meeting sponsorship must be submitted to Jan Pašava, SGA Executive Secretary, on appropriate forms available at the SGA home page on Internet: www.e-sga.org

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

**Dr. Jan Pašava**
SGA Executive Secretary

Czech Geological Survey
Tel.: +420 2 5108 5506
Klárov 131/3
Fax: +420 2 518 18 748
CZ-118 21 Prague 1
e-mail: jan.pasava@geology.cz
Czech Republic

*>>> page 1 Lousal, Portugal: a successful example of rehabilitation of an old mine at the Iberian Pyrite Belt*

## 2. GEOLOGICAL SETTING

The Iberian Pyrite Belt embraces a large amount of volcanic-hosted massive sulphide deposits, with a pre-mining total tonnage that exceeds 1750 Mt of sulphides, enclosing 22 Mt of copper, 34 Mt of zinc and 12 Mt of lead metals (Tornos, 2006). The province has been mined continuously since the Chalcolithic era. The Rio Tinto deposit in Spain is acknowledged as being the largest deposit of its class ever to form, with over 500 Mt of sulphide ores (Leistel et al., 1998). The Aljustrel and Neves Corvo deposits in Portugal, and the Las Cruces deposit in Spain are among the world's richest deposits of their class (Carvalho et al., 1999). In the Iberian Pyrite Belt, the massive sulphide mineralization is hosted by a submarine sedimentary and volcanic, felsic dominated, succession that constitutes the Upper Devonian to Lower Carboniferous Volcanic-Sedimentary Complex (VSC; Silva et al., 1990; Oliveira et al. 2006; Pereira et al. 2008). This unit overlies the Phyllite-Quartzite Group (PQ; Upper Devonian, base unknown) and is overlain by the Baixo Alentejo Flysch Group (BAF; Lower to Upper Carboniferous).

The Lousal mine is located in the northwestern part of the Iberian Pyrite Belt, a sector limited to the N, E and S by the Tertiary sediments of the Alvalade basin (Strauss, 1970; Schermerhorn et al., 1987; Matos and Oliveira, 2003). The Lousal mine sequence consists of mudstone and quartzite in the lower part of the succession (PQ), over which a thick VSC succession occurs. To the SW, the flysch sediments (BAF; Mértola Formation) cover the ore-bearing VSC. From base to top, the VSC is formed by rhyolitic lavas, basic volcanic rocks (spillites), a thick sequence of black and grey shales, which were intruded by a rhyolitic sill and host the massive sulphide mineralization, and finally a thick interval composed of mudstone and two intervening basaltic units. The Lousal structure is characterized by SW-verging Hercynian folding and faulting, which was overprinted by late-Hercynian N-S normal faults that cut the sequence and vertically displace and tilt the resulting blocks (Fig. 2; Rosa et al. 2010; Matos et al. in prep). The ore-bearing facies are predominantly fine-grained volcaniclastic units and black shales (Rosa et al., 2010). The massive sulphide mineralization occurs in close dependence to felsic volcanic centres, where intense ore-forming hydrothermal activity led to extensive chloritic/sericitic alteration and stockwork mineralization (Fernandes, 2011).

The Lousal deposit consists of several ore lenses that are lined up along 1.5 km length in strike (Strauss, 1970). Two groups of lenses were distinguished: the western group formed by three ore lenses (Extreme South, South and West), and the eastern group formed by seven ore lenses (Central, Miguel, José, Fernando, North, Northeast and António) (Matos and Oliveira 2003). The deposit was mainly exploited for pyrite and consisted of about 50 Mt of ore at 1.4% zinc, 0.8% lead and 0.7% copper (Strauss, 1970). The ores have long been known to contain significant amounts of gold, which was sporadically exploited as a by-product. Recently, Reiser et al. (2010) and de Oliveira et al. (2011) addressed the fact that some ores contain significant amounts of Ge and In, respectively.

## 3. THE LIFETIME OF THE MINE

The chronology of the lifetime of the Lousal mine is relatively simple (Rodrigues, 2005; Vidas na Mina – Memórias, Percursos e Identidades). Although the area shows several signs of mining activity since the Bronze age (ca. 3300 BC), with particular emphasis on constructions probably built for defence as well as for ore storage, the "modern" discovery of the deposit only took take place in 1882 by a local farmer - António Manuel – who required from the Portuguese "Ministry of Public Works and Mines" an official document dated from that year recording the discovery of the Lousal gossan. He was granted a temporary lease in 1885, but lost it in 1899 for not having submitted an exploitation plan to the authorities. Between 1900 and 1934, the exploitation rights were property of several individual persons and companies, including the company Henry Burnay & Cia, which exploited the mine for about one decade. In 1934, the mining lease became property of the Société Anonyme Belge des Mines d'Aljustrel, which ran both mines (Lousal and Aljustrel) for two years. Finally, in 1936, the Belgian corporation Société Anonyme Mines et Industries S.A., which preceded SAPEC, became the owner of the Lousal mine. SAPEC still owns the mine despite the shut down of the operation in 1988.

In 1911, the Lousal village had just 167 inhabitants. However, the boom of mining activity, which followed the purchase of the mine by the Société Anonyme Mines et Industries, SA, in 1936, caused a rapid population expansion: in 1940 there were 1273 inhabitants, and in 1960 this number had increased to 1906. With the onset of mechanised production, less people were employed in the mine, with consequent fall in local population numbers: 1252 inhabitants in 1970; 957 in 1981; and as few as 734 in 2001, when the mine was already shut down. According to the last demographic survey, in 2011, the population amounted to just 401 inhabitants. The urban structure of the Lousal village is centred on the buildings related to the mining activity – headframes, workshops, stores and laboratories – and presents a uniform volumetry, with buildings spread out over all the mining perimeter. Besides the mining buildings, there are two other groups of structures in the area: the social support buildings – medical ward, school, church and market – and the housing buildings, including accommodation for the miners and for the technical personnel, and the administration building.

The exploitation methods and equipment available changed considerably along the lifetime of the mine; the same was true for the ore-processing procedures. Mechanised production progressively replaced manual work (Fig. 3). Working conditions and safety inside the mine were also much improved, namely by the use of safety gear (helmets, steel-tipped boots, face-masks with filters, personal battery-powered lamps) and by the onset of stricter regulations concerning fresh-air circulation inside the mine. The underground mining works reached about 500 m depth. After the early 1950's, pyrite ore went out through the mineshaft and was processed in a crushing plant on surface. The treatment of pyrite ore began with a preliminary granulometric selection (sieving), followed by successive crushing and grinding operations, and finally handpicked by women (Silva, 1968). The ores were sold on the national market and exported to Belgium. Pyrite was used to produce sulphuric acid to which phosphorite from Morrocco was added to make super-phosphate fertilizers used for agriculture.

In 1958, Frédéric Velge, son of Antoine Velge, the main holder of Société Anonyme Mines et Industries, SA, became director of the Lousal Mine and opened an epoch of great expansion for the mine. With the help of the on-site geologist Günter Strauss,

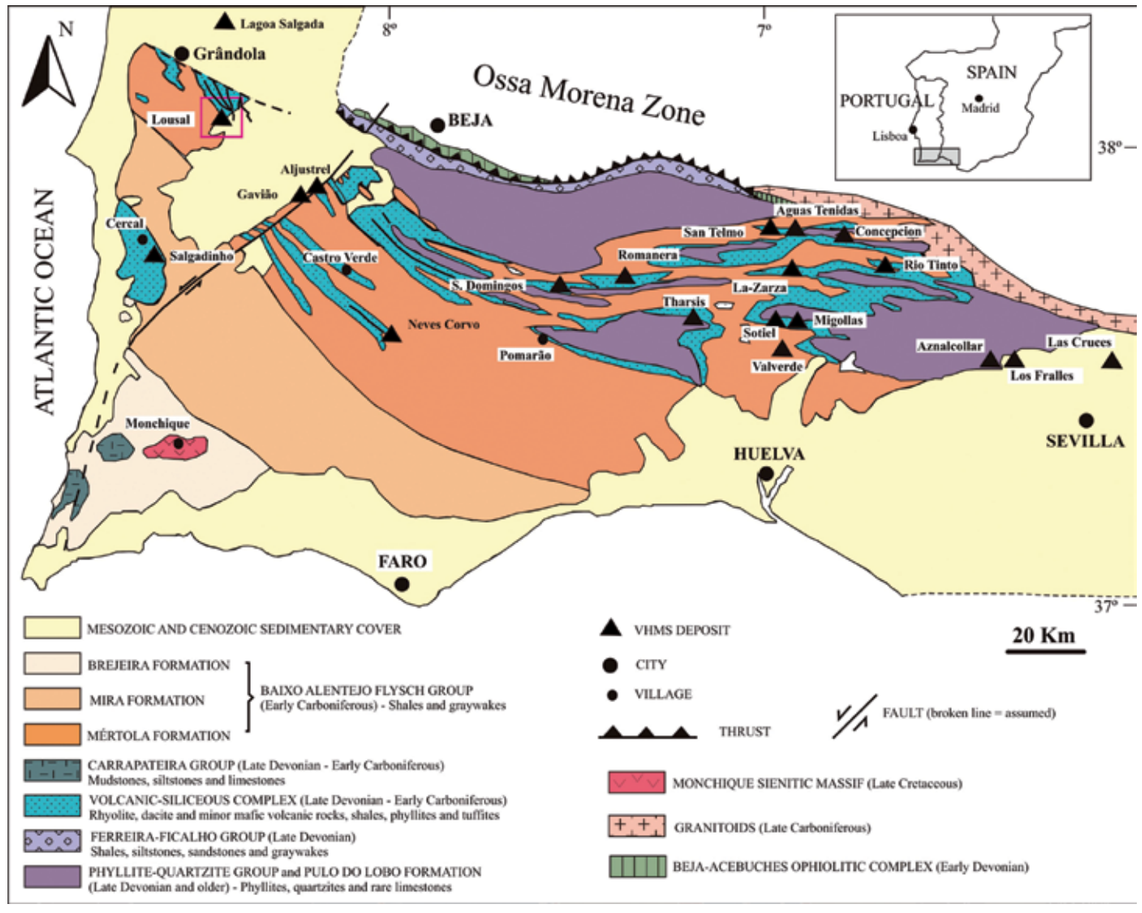



*Figure 1. General geology of the Iberian pyrite belt and location of the Lousal deposit and other massive sulfide deposits (modified after Carvalho et al., 1999 and Huston et al., 2011).*

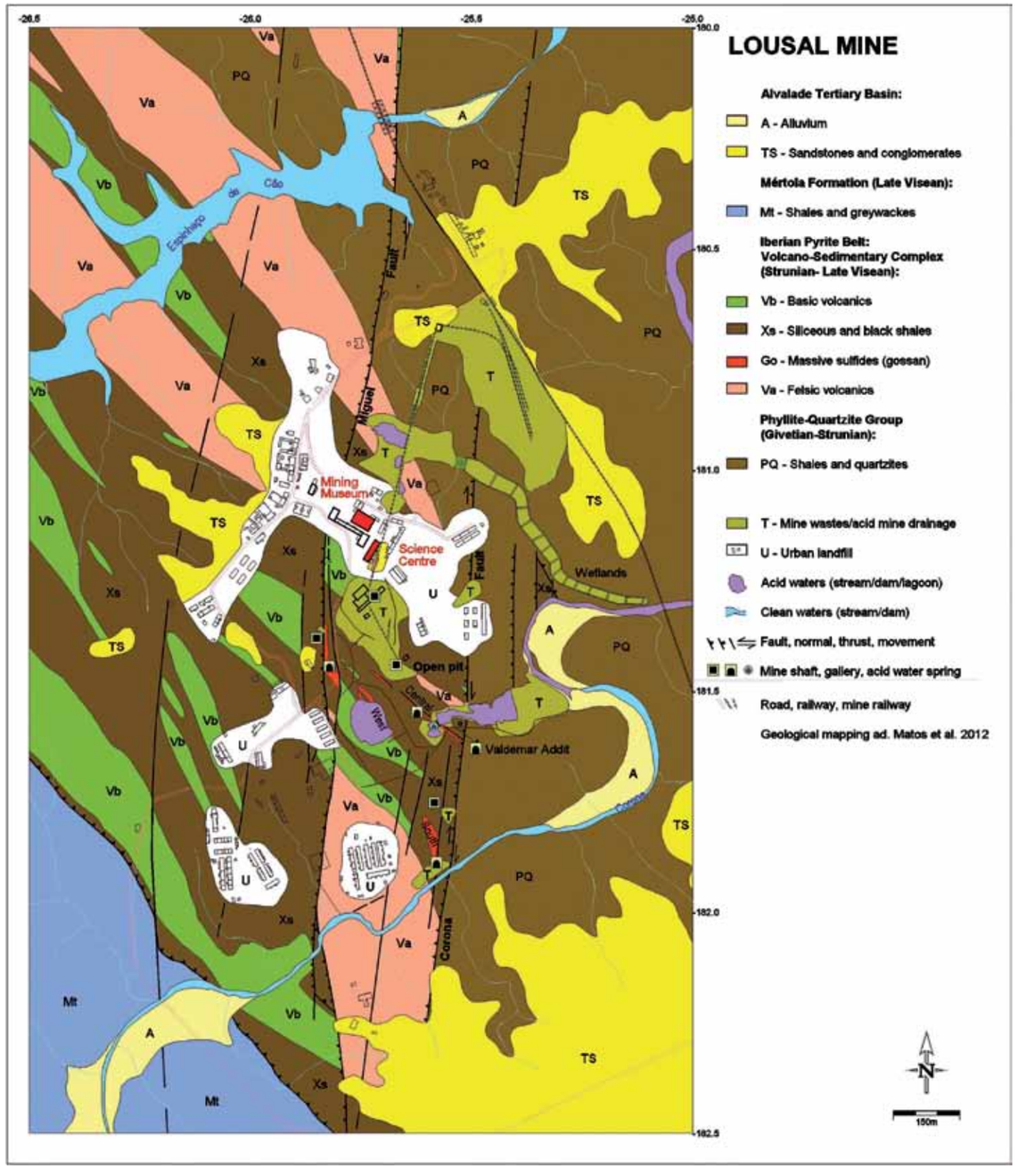



*Figure 2. Geologic map of the Lousal mine area (simplified after Matos et al., in prep.)*

he modernized the management and introduced new methods of mechanised mining production. During the 60's and the 70's, the Lousal mine was an example of innovation and modernity in the Iberian Pyrite Belt. By that time, the annual production of the mine reached 250 000 tons of mined ore. Simultaneously, living conditions in the Lousal village also knew progressive improvement: water- and electricity-equipped housing for miners and other mine-employees, a hospital, church, bakery, recreation hall and other amenities. Besides his investment in mechanised production, it can be said that the social awareness of Frédéric Velge was part of the reason for the enormous success of the mine and the extraordinary increase in its productivity. The closure of the Lousal Mine, in 1988, was not an isolated case in the Iberian Pyrite Belt. The low copper and zinc contents of the mined ores compromised their economic viability following the present-day unsustainability of sulphur extraction from pyrite.

## 4. THE "RELOUSAL" REHABILITATION PROGRAM

The name RELOUSAL stands for REvitalization, REnewing, REcovery and REhabilitation of community life in the Lousal village. The RELOUSAL Program required a solid institutional framework, which catalysed the joint efforts of the mine owner – the SAPEC Corporation – with the local authorities – the Municipality of Grândola – leading to the creation of the Frédéric Velge Foundation. Thus, less than ten years after the closure of the mine, it was decided to promote an integrated development program in Lousal, encompassing several complementary features. In 1995, Fundação Frédéric Velge appointed "Oficina de Arquitectura" a private company of architects to co-ordinate the program. The aim of the program is to rehabilitate the village, both in environmental, economic and social terms. Emphasis has been given to the cultural and scientific aspects, but the touristic potential of the whole project was strongly valued as well.

The number of technical professionals and scientists involved in the RELOUSAL program is really exceptional. More than fifty researchers coming from different institutions – Universities, Research Institutes, Museums and the Portuguese Association for Industrial Archaeology – and covering many different fields in Science and Technology (e.g., Geology, Biology, Chemistry, Physics, Mathematics, Engineering, Computer Graphics) have already been involved somehow, at least in one of the components of the Program. In particular, the strong commitment of the University of Lisbon, through its Faculty of Science, and the National Museum of Natural History and Science has raised very high the scientific standards of the whole initiative.

Several facilities have been created in the framework of RELOUSAL, aimed at adding value to the Lousal mining heritage, via reuse of the industrial complex, equipment and objects of the old mine (Fig. 4). The positive impacts of the program in terms of socioeconomic regeneration of the local community have been notable. Since 1996, the RELOUSAL program has supported a number of different activities and projects of different nature, including partial re-accommodation of the resident population, professional training for the ex-miners and their families, promotion of handicraft activities and family-scale manufactories, public-ware equipment, a handicraft centre (1999; Fig. 5A), a restaurant in the main storehouse of the mine ("Armazém Central", 2000), patrimonial valorisation, soil decontamination, reforestation and a visitor welcoming centre (2001). In 2003, a local technical office of the Grândola Municipality was installed in Lousal, and, in 2005, a charming hotel located in the ancient house of the mine administration was inaugurated (Sta. Bárbara Lodge; Fig. 5B). The Urban Plan for the village was formally ratified in 2007, fuelling the requalification of the urban space, the marketing of touristic projects and the internationalization of the whole initiative.

It should be said that, despite all these advances, probably the major achievement of the RELOUSAL Program is that, in the course of these years, the local new generation, sponsors, administrators, professionals, scientists and mine owners collectively became "contaminated" by this place and by its community, which remains determined to keep alive their mining traditions, patrimonial legacy, culture and way of living.

## 5. ENVIRONMENTAL RESTORATION

Besides some copper-rich gossans exploited on surface during the early years of the mine, the Lousal mining operation was mostly underground and oriented for the deeper pyritic lenses (Matos & Oliveira, 2003). Notwithstanding this, one main open-pit, now partially flooded, was developed in association with the underground works in order to assure the supply of barren rocks needed to refill the exploited underground galleries (Fig. 6). In addition, large volumes of waste were generated by the mining activities, ranging from barren overburden and barren rock, to various types of tailings (the amount of waste stored on-site is estimated to be greater than 1 Mt; Silva et al., 2005). Rainwater

*Figure 3. Underground work at the Lousal mine during the 60´s*

*Figure 4. Partial view of the Lousal open pit. The old building ahead was the crushing plant of the mine.*

*Figure 5A. Handcraft workshops at Lousal.*

circulates and percolates easily over and through these weakly cemented materials causing significant erosion and the transport of tailings debris to areas nearby and downstream (Silva et al., 2005). The soil at the mine area is now a mixture of soil, rock fragments and tailing material. The water flowing downslope from the waste piles represents a source of acid mine drainage (AMD) into the Corona stream. Mine wastes still containing high metal concentrations thus represent a long-lasting source of metal pollution, representing a long-term public concern. Another major concern is the water table rebound at the Lousal area, which is responsible for the formation of two interconnected ponds of acidic waters in the open-pit, with a groundwater spring draining directly to one of them. The underground connection between the abandoned adits and wells, the ponds and the groundwater spring, make this a complex system of 'diffuse' sources of AMD (Silva et al., 2006, 2009, Abreu et al. 2010).

About a decade ago, the Portuguese Government promoted an inventory and assessment of abandoned mine sites in the Portuguese territory, in order to identify the environmental impacts, the risks inherent to former mining operations and the most suitable remediation measures. This study was focused in aspects such as ore geology and mineralogy, ore extraction and processing, mineralogical and chemical compositions and physical characteristics of the tailings, safety, industrial relevance, etc. This approach led to the sorting of more than 100 mine sites according to hazardousness (Oliveira et al., 2002). Expectedly, after this study, the Lousal mine area was among the sites targeted as requiring an intervention with high priority. Later on, several other studies were made in the Lousal mine in order to characterize in detail the environmental situation and to propose a remediation strategy for this particular area (e.g., Silva et al., 2006, 2009; Matos & Martins 2006).

A rehabilitation plan directed to reclaim the Lousal contaminated area was defined by EDM (Empresa de Desenvolvimento Mineiro), the public company responsible for the implementation of remediation projects in old prospects and abandoned mines in Portugal. Presently, in the Iberian Pyrite Belt, EDM develops projects in the Aljustrel, Lousal, Chança, São Domingos and Caveira mines, all of them affected by AMD (Matos & Martins 2006, Silva et al. 2009, Abreu et al. 2010). Due to the RELOUSAL program, which was already running, the strategy adopted by EDM to the Lousal area aimed to preserve as much as possible the memory of the mining activities, with significant protection of the mining landscape, essential to the development of mining heritage projects (Matos et al. 2008). Their intervention was delineated to confine within the impacted perimeter the environmental aggressions identified, and sort them out without obliterating from the landscape the visual impressions left by almost a century of mining. The contamination sources at this area were assessed and a variety of combined interventions were implemented.

(i) In order to avoid that the deep slopes of the tailing deposits would promote the down slope movement of eroded material that easily would reach the Corona stream, large volumes of contaminated soils, sediments and mine processing wastes have been stabilized and consolidated on-site. This provided more stable surfaces, preventing the erosion by reducing water runoff. In addition, some vegetation was also grown in order to reinforce the topsoil and reduce the soil erosion and water loss by evaporation.

(ii) In order to minimize contaminated runoff leaving the site, several measures were undertaken, including diversion trenches and culverts, and evaporation ponds. Some localized soil-covered impermeable capping was applied to avoid the direct exposure of metal-rich or acid-producing solid wastes to rainwater and superficial weathering.

(iii) A wetland system, composed by seventeen "pools", was built between the groundwater spring and the Corona stream in order to minimize the complex problem of AMD related with two main sources: the milled ore deposited in the railway area and the old mine open pit (Fig. 7). This phytoremediation system envisages the reduction of the input of contaminated loads on the Corona stream ecosystem, and consists of two different groups of pools, one group with an aerobic environment used for iron precipitation, and a second one designed to favour the precipitation of heavy metals in an anaerobic environment.

The main stages of implementation of the EDM´s remediation project for Lousal are almost completed; nevertheless, some improvements in the functioning of the constructed wetlands are still missing, being planned for the near future.

## 6. MINING MUSEUM

One of the first big projects that have been completed under the scope of the RELOUSAL program was the Mining Museum. The project was promoted by the Frédéric Velge Foundation, and developed between 1998 and 2001 with the technical support of APAI, the Portuguese Association for Industrial Archaeology. This industrial museum was installed in a large building formerly hosting the electrical plant of the mine ("Central Eléctrica"). The installation accommodates several rehabilitated equipment that possess valuable significance from an industrial archaeological standpoint. Among the pieces contained therein standout a number of huge electrical alternators and air-compressors that closely follow the major steps of the evolution of the mining exploitation methods through time (Tinoco et al., 2002; Fig. 8A). The museum has multiple focal points, including an exhibition, inaugurated in 2006, of over fifty scale-models made of wood and metal that perfectly represent machines and devices used for mining exploitation during the 19th century (Fig. 8B). The collection was originally produced in Germany and was used for several decades to teach mining engineering, firstly at the Frieberg University, in Germany, and afterwards at the Technical University of Lisbon, in Portugal. The models went to Lousal in a very bad shape and were fully reconstructed by a local craftsman (ex-miner). Upon request, groups of visitors to the Mining Museum can be guided by a local ex-miner, who was one of the electricity technicians of the mine and thus is able to share with the public his own memories of the electrical plant and of the mine while they were still operating.

*Figure 5B. View of the Sta. Bárbara Lodge at Lousal (4* Rural Hotel)*

*Figure 6. Aerial view of the mine open pit (flooded) and of the village of Lousal*

## 7. SCIENCE CENTRE

In Portugal, there is a national network of science centres called "Ciência Viva" that depend directly of the government, through the "Ciência Viva" Agency, and are run jointly with the Pavilion of Knowledge in Lisbon, in collaboration with local authorities and Portuguese scientific institutions and research community. There are nineteen "Ciência Viva" Centres distributed all over Portugal, which invite people of all ages to join in the activities and interactive exhibitions in order to spread scientific and technological culture among the wider Portuguese public. The "Ciência Viva" Centres are examples of modern scientific museology. The main goals of the network are promoting knowledge and education on science and technology, mostly through attractive, hands-on, thought-provoking experiments.

SOCIETY FOR APPLIED MICROBIOLOGY MEETINGS AND EVENTS

*Figure 7. Partial perspective of the wetland system installed at Lousal*

*Figure 8A. General view of the Mining Museum of Lousal (alternators' area)*

The "Ciência Viva" Centre of Lousal - Mine of Science was inaugurated in 2010 (Fig. 9A; http://www.lousal.cienciaviva.pt/home/). It was conceived for a large-spectrum audience in terms of age, education and social or geographic origin. The general idea consists of taking advantage of the old mine environment to use the concept of "georesource" as a window opened through a wide range of fields of knowledge that include the natural and exact sciences, applied technologies and several fields of engineering. In the Mine of Science, one exploits science and extracts knowledge, always with interactivity at the fingertips. There, the visitors may discover some of the most fascinating phenomena of the world of science and technology, through tens of interactive experiences and "hands-on" exhibits (Fig. 9B). One can also try a virtual descent into a mine, by means of immersive 3D visualization technology. The development of immersive environments based on virtual reality ("CAVE-Hollowspace") is a must of this centre, creating imaginary environments where the past realities, or future possibilities can be recreated. The potential uses of this powerful technological tool extend from scientific purposes to virtual prototypes or industrial applications.

The Centre was set up in a building that was associated with the past activity of the mine (geology office, lanterns room, miners' locker room and bathhouse). The building has been adapted in order to function as a space for the dissemination of scientific and technological culture and today it offers a variety of functions: exhibition areas, interactive exhibits, the virtual mine, a chemistry laboratory, a cybercafé and a modern auditorium with 60 seats, for presentation of documentaries and organization of meetings, conferences, seminars and lectures. The Centre is extremely dynamic and promotes also many educational activities that go far beyond the walls of the building: guided visits to the open-pit, geo- and bio-field trips, astronomy observations, scientific camping, among many others (Fig. 9C).

The "Ciência Viva" Centre is administrated by five associated institutions: the local Municipality (Grândola), the Frédéric Velge Foundation and the "Ciência Viva Agency", which are the three funding entities, and the Faculty of Science of the University of Lisbon and the ISCTE (another Portuguese University), which are responsible for the renewing and credibility of the scientific and technological contents and activities of the Centre. The Centre is operated by a team composed by thirteen skilled young professionals, most of them graduated with a MSc. degree (geology, biology, physics, chemistry, engineering, computer graphics, sociology; Fig. 9D).

In two years, about twenty two thousand people – mostly scholar groups, families and tourists – have visited this science centre, and many other persons visited or benefited from the remaining components of the RELOUSAL program. These circumstances completely changed the daily life scenario in Lousal. The dynamic activity of the "Ciência Viva" Centre and its team brought a new reality to the village, pushed forward new economic activities, justified new job opportunities for the local population, and for the youth in particular, and opened a new cycle in the revitalization program initiated almost two decades ago.

## 8. WHERE TO NEXT?

The rehabilitation of Lousal is an on-going process that has already reached a point that allows one to look at the future with justified expectations. The steps forward that have been pursued so far have put together, in a consolidated way, a number of relevant partners with different, but complementary and compatible motivations. The implemented components of the program brought with them the critical experience needed to envisage the future challenges with renewed confidence.

Despite all the difficulties, one crucial aspect that is thought to be part of the Lousal



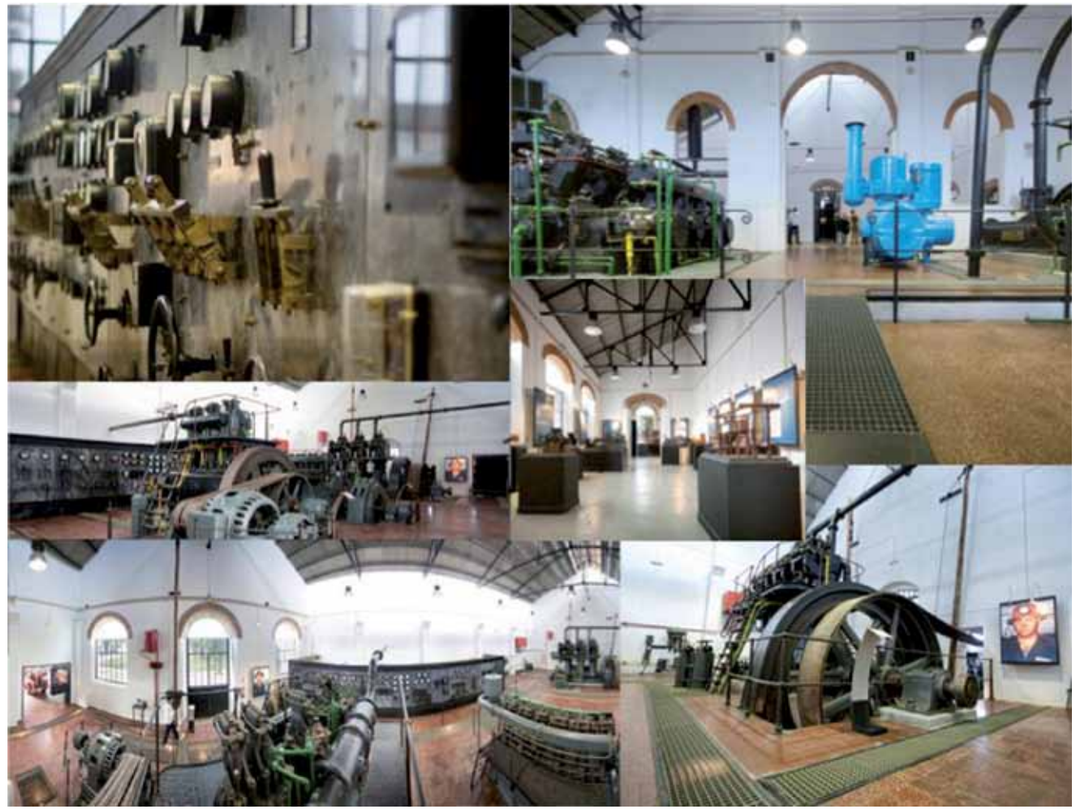


*Figure 8B. Photo-mosaic showing multiple aspects of the Mining Museum of Lousal*


*Figure 9A. Main entrance of the Lousal "Ciência Viva" Centre*

success lies on the permanent concern in keeping a strong dependence between the interests of the local community, high quality standards, and encouragement of local entrepreneurship and creativity. The forward-looking policy of the institutions involved – local and municipal authorities, "Ciência Viva" agency, universities and mine owners – provided the motivation and the capacity to polarize significant funding from national and European sources over time. The key words for the future are now consolidation, step-by-step development and economic sustainability. Sooner or later, Lousal should pass from a mining village under a rehabilitation program, to a territory able to attract investments and where good economic opportunities may emerge.

2012-13 will be a biennium marked by the implementation of two new projects. The "Ciência Viva" agency funds the first one, which is called "Home Sapiens – Science at Home". The project is already running and will enlarge significantly the exhibition area and the scientific contents of the science centre, as a contiguous building is being recovered to host an interactive exhibition on the scientific and technological concepts hidden behind the objects, materials and natural processes that accompany our day-by-day life at home (Fig. 10). The second project, mostly funded by UE, is already approved but not initiated yet. It is called AMPERE and will be devoted to renew and improve the Mining Museum, both in terms of contents and beneficiation of the building. A large room will suffer the necessary adaptations to become a hall

SOCIETY FOR APPLIED MINERALOGY

*Figure 9B. Photo-mosaic showing a variety of "hands on" exhibits at the "Ciência Viva" Centre*

for temporary exhibitions. In addition, the project will include the creation of a documentation archive, properly organized and opened to the public. This important component of the project will provide an opportunity to recover and properly classify and manage the abundant documentation left by decades of mining activity at the Lousal mine (maps, mine plants, reports on the ore geology and engineering, files, etc.). There is continuing demand for this type of visits, given their ample educational return, at all levels from high school to post-graduate and professional.

Lousal receive frequent visits from under- and post-graduate students, professors and researchers, both from Portuguese and foreign universities, mostly interested in ore geology, mining engineering, environmental sciences and sociology. However, the potential to enlarge this kind of collaboration is far from being exhausted. Lousal belongs already to a number of international networks related with mining industry and mining heritage sites. The European authorities encouraged the intensification of those contacts in order to provide more and better visiting and learning opportunities to European students and citizens in general. This aim intersects with a medium-term project directed to build a research centre in Lousal, devoted to metallogeny and environmental geochemistry, which would attract researchers and PhD students, a favourable condition to assure the scientific sustainability of the whole project in a long run.

There is also a strong bet in adding value to this territory by promoting the geo- and biotourism in the area (Martins and Matos, 2010). Tourism is a fundamental piece for regional development in this part of the country, and the authorities are committed in supporting initiatives that may potentiate a link between the tourism of nature, patrimony and mining legacy, with the classic coastal destinations. Obviously, this opens a window of opportunity for Lousal in terms of sustainable development and, simultaneously, an opportunity for Science in terms of public outreach. Accordingly, the long-term project is one that will include an underground visit to the Lousal mine (Relvas et al., 2004). This is a realistic objective once there is an underground gallery that is still well preserved and can be recovered and kept at a reasonable cost (located above the water table, in the flank of a hill; Figure 11).

ACKNOWLEDGEMENTS

This article is dedicated to the people of Lousal and to the extraordinary Lousal "Ciência Viva" team. Acknowledgements are due to those who have dedicated part of their lives to this project.

REFERENCES

Abreu, M., Batista, M.J., Magalhães, M.C.F., Matos, J.X. (2010) Acid Mine Drainage in the Portuguese Iberian Pyrite Belt. Cap. II In Mine Drainage and Related Problems Book, Editor Brock C. Robinson, Nova Science Publishers, ISBN: 978-1-60741-285-4, New York, USA, 51p

Carvalho, D., Barriga, F.J.A.S., and Munhá, J. (1999) Bimodal-siliciclastic systems – the case of the Iberian Pyrite Belt, in Barrie, C.T. and Hannington, M.D., eds., Volcanic-associated massive Sulfide deposits: processes and examples in modern and ancient settings: Reviews in Economic Geology, v. 8, Society of Economic Geologists, Inc., 375-408

de Oliveira, D., Matos, J.X., Rosa, C.J.P., Rosa, D.R.N., Figueiredo, M.O., Silva, T.P., Guimarães, F., Carvalho, J.R.S., Pinto, A.M.M., Relvas, J.M.R.S., Reiser, F.K.M. (2011) The Lagoa Salgada Orebody, Iberian Pyrite Belt, Portugal. Economic Geology, v. 106, 1111–1128

Fernandes A.S. (2011) Caracterização petrográfica, mineralógica e geoquímica do padrão de alteração hidrotermal a muro das massas de sulfuretos maciços do Lousal, Faixa Piritosa Ibérica. Tese de Mestrado, Universidade de Lisboa, Não Publicado, 218p

Leistel, J.M., Marcoux, E., Thiéblemond, D., Quesada, C., Sánchez, A., Almodóvar, G.R., Pascual, E., and Sáez, R. (1998) The volcanic-hosted massive sulphide deposits of the Iberian Pyrite Belt: Mineralium Deposita, v. 33, 2-30

*Figure 9C. Guided geologic trip to the Lousal open pit*

*Figure 9D. The "Ciência Viva" team at the Lousal Centre*

Martins, L., Matos, J.X. (2010) Mining heritage in Portugal – the Iberian Pyrite Belt as tourist attraction. Bergau Folge Landschaft Konferenzdoku-mentation, Int. Bauausstellung Fürst-Pückler-Land 2000-2010, ISBN 978-3-86859-043-2, 55-61

Matos, J.X. (2005) Carta Geológica e Mineira do Lousal, esc. 1/5000. INETI, Portugal

Matos, J.X., Martins, L. (2006) Reabilitação ambiental de áreas mineiras do sector português da Faixa Piritosa Ibérica: estado da arte e perspectivas futuras. IGME, Bol. Geológico y Minero España, ISSN 0366-0176, v. 117, nº2, 289-304

Matos, J.X., Martins, L.P., Oliveira, J.T., Pereira, Z., Batista, M.J., Quental, L. (2008) Rota da pirite no sector português da Faixa Piritosa Ibérica, desafios para um desenvolvimento sustentado do turismo geológico e mineiro. Projecto RUMYS, programa CYTED, Livro Rutas Minerales en Iberoamérica, Ed. Paul Carrion, Esc. Sup. Politécnica del Litoral, Guayaquil, Equador, 136-155

Matos, J.X.; Oliveira, V. (2003) Mina do Lousal (Faixa Piritosa Ibérica) - Percurso geológico e mineiro pelas cortas e galerias da antiga mina. IGME, Pub. Museo Geominero, nº2, 117-128

Matos, J.X., Rosa, C.J.P., Pereira, Z., de Oliveira, D., Rosa, D., Fernandes A.S., Relvas, J.M.R.S., Oliveira, J.T. (2012) Geology and Genesis of the Lousal Volcanic-Sediment-Hosted Massive Sulfide Deposit, Iberian Pyrite Belt, Portugal (in preparation)

Oliveira, J.T., Relvas, J., Pereira, Z., Matos, J., Rosa, C., Rosa; D., Munhá, J.M, Jorge, R., Pinto, A. (2006) O Complexo Vulcano- Sedimentar da Faixa Piritosa: estratigrafia, vulcanismo, mineralizações associadas e evolução tectono-estratigráfica no contexto da Zona Sul Portuguesa. In: Geologia de Portugal no contexto da Ibéria. Dias, R., Araújo, A., Terrinha, P., Kullberg, J.C. (eds.). Univ. Évora, Évora, 207-243

Oliveira, J.M.S., Farinha, J., Matos, J.X., Ávila, P., Rosa, C., Machado, M.J.C., Daniel, F.S., Martins, L., Leite, M.R.M. (2002) Diagnóstico Ambiental das Principais Áreas Mineiras Degradadas do País. Boletim de Minas, Instiuto Geológico e Mineiro, 39 (2): 67-85

Pereira, Z., Matos, J.X., Fernandes, P., Oliveira J.T. (2008) Palynostratigraphy and Systematic Palynology of the Devonian and Carboniferous Successions of the South Portuguese Zone, Portugal. Memórias do LNEG, N.º 34, 1-176.

SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS

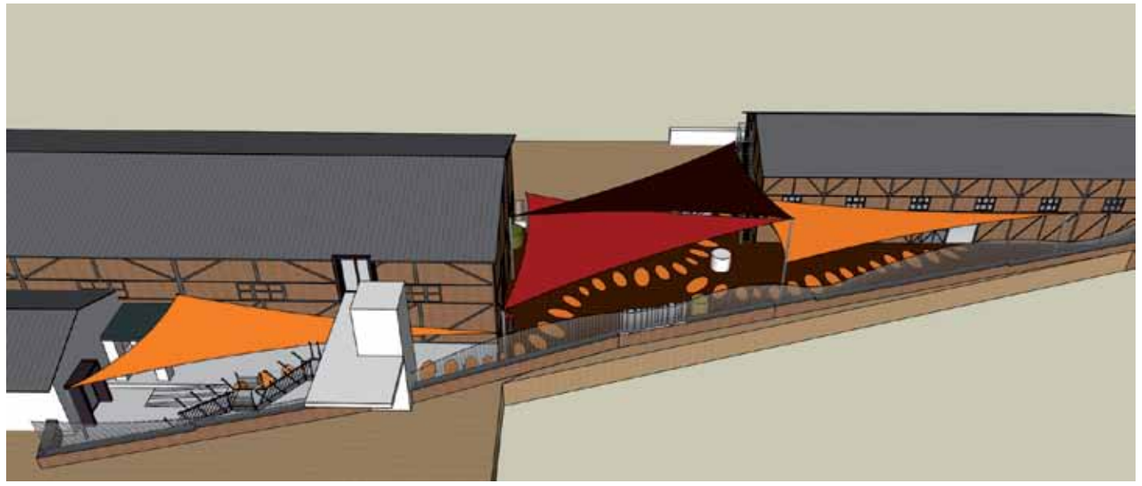


*Figure 10. Preview of the Lousal "Ciência Viva " Centre as it will look like after the implementation of the "Home Sapiens" project*

Reiser, F.K.M., Rosa, D.R.N., Pinto, A.M.M., Carvalho, J.R.S., Matos, J.X., Guimarães, F.M.G., Alves, L.C. and Oliveira, D.P.S. (2010) - Mineralogy and geochemistry of tin- and germanium-bearing copper ore, Barrigão re-mobilized vein deposit, Iberian Pyrite Belt, Portugal. International Geology Review, 1-27

Relvas, J., Póvoas, L., Costa, T., Matos, J., Varela, T., Barriga, F.J.A.S. (2004) Project "Underground Visit to the Lousal Mine": Public Outreach to the Geology and Mineralogy of the Iberian Pyrite Belt, 5th Int. Conf. "Mineralogy & Museums"- Bull. Soc. Française Minéralogie et Cristallographie, Paris, v. 16, 2., 70

Rosa C., McPhie J., Relvas J. (2010) Type of volcanoes hosting the massive sulfide deposits of the Iberian Pyrite Belt. Journal of Volcanology and Geothermal Research 194, 107-126

Schermerhorn L.; Zbyzewski, G.; Ferreira, V. (1987) Carta Geol. Portugal 42D Aljustrel, SGP, 55p

Silva, E.A.F., Bobos, I., Matos, J.X., Patinha, C., Reis, A.P., Fonseca, E.C. (2009) Mineralogy and geochemistry of trace metals and REE in volcanic massive sulfide host rocks, stream sediments, stream waters and acid mine drainage from the Lousal mine area (Iberian Pyrite Belt, Portugal). Applied Geochemistry 24, Elsevier Ed., 383–401

Silva, E.F., Patinha, C., Reis, P., Fonseca, E.C, Matos, J.X., Barrosinho, J., Oliveira, J.M.S. (2006) Interaction of acid mine drainage with waters and sediments at the Corona stream, Lousal mine (Iberian Pyrite Belt, Southern Portugal). Environ Geology Vol. 50, 7, DOI 10.1007, Springer Verlag, 0943-0105 (Print) 1432-0495 (Online)

Silva, F. (1968) As Minas do Lousal. Bol. Minas, Dir. Geral de Minas e SGP, 5 (3), 161-181

Silva, J.B., Oliveira, J.T., and Ribeiro, A. (1990) Structural outline of the South Portuguese Zone, in Dallmeyer, R.D., and Martinez Garcia, eds., Pre-Mesozoic geology of Iberia: Berlin, Springer-Verlag, p.348-362

Strauss, G. (1970) Sobre la geologia de la provincia piritífera del SW de la Península Ibérica y de sus yacimientos, en especial sobre la mina de pirita de Lousal (Portugal). Mem. ITGE T. 77, 266

Tinoco, A., Matos, A., Santos, L., Póvoas, L., Relvas, J.M.R.S., Lopes, C., Barriga, F.J.A.S., Damas, C. (2002) A valorização do património geológico e mineiro do Lousal. Actas Congresso Internacional do Património Geológico e Mineiro, IGM/SEDPGYM/IPB, Beja, Portugal.

Tornos F (2006) Environment of formation and styles of volcanogenic massive sulfides: the Iberian Pyrite Belt. Ore Geol Rev 28:259-307

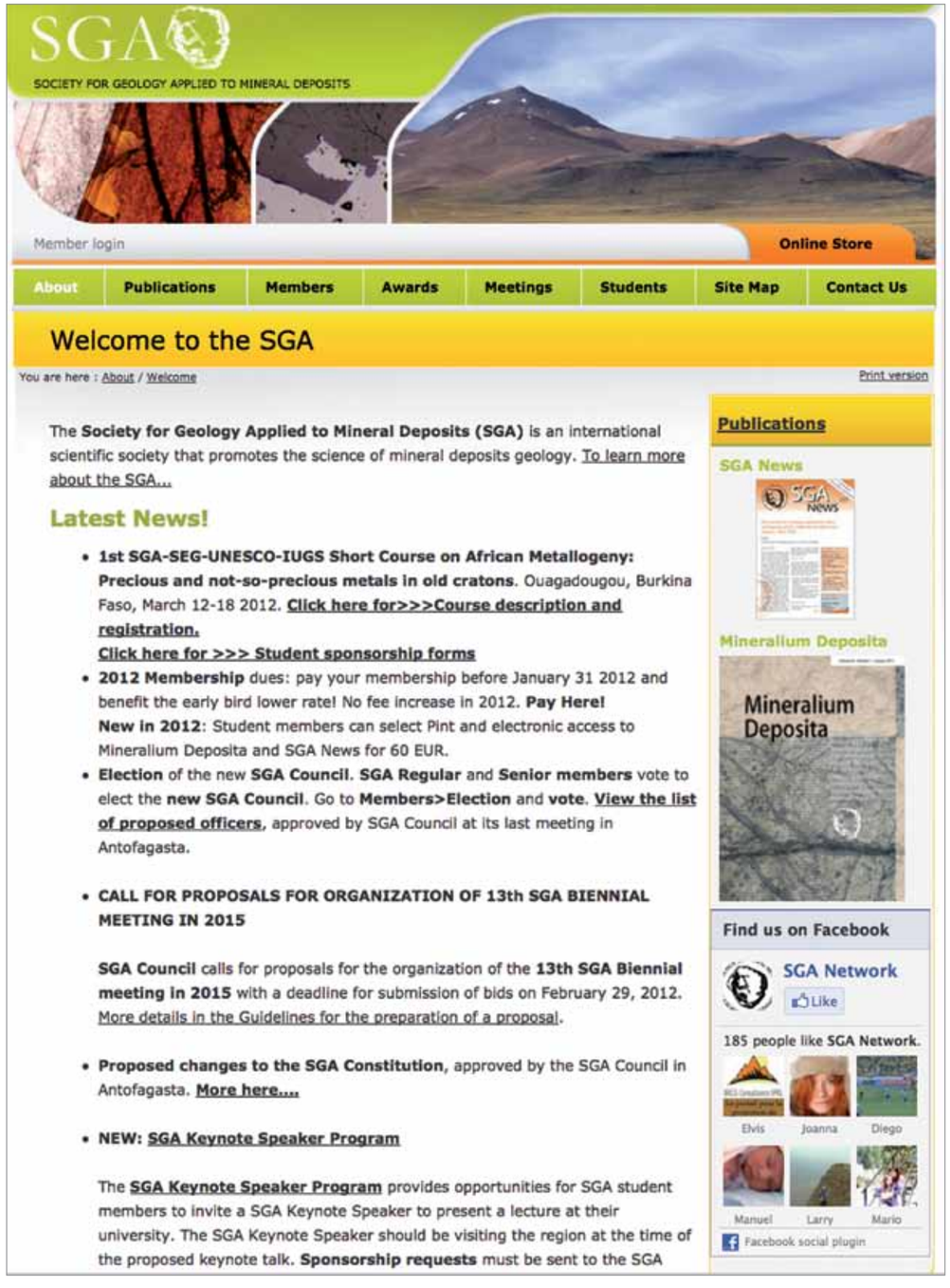
*Figure 11. Group of visitors in an underground gallery of the Lousal mine*



# The SGA website

**Daniel Layton-Matthews , Chief Editor SGA website**
*Queen's University, Kingston, ON K7L 3N6, Canada, dlayton@geol.queensu.ca*

## http://www.e-sga.org



# Report on the 1st SGA-SEG-UNESCO-IUGS Short Course on African Metallogeny in Ouagadougou, Burkina Faso, 12–18 March 2012

**Hartwig E. Frimmel, course coordinator**
*Institute of Geography and Geology, University of Wuerzburg, Am Hubland, D-97274 Wuerzburg, Germany,*
*e-mail: hartwig.frimmel@uni-wuerzburg.de*

After many months of planning and rising excitement, the 1st Short Course on African Metallogeny was held from 12th to 18th March 2012 in Ouagadougou, Burkina Faso. Having been the first event of this kind and of what is planned to become an annual series of courses, it was naturally an experiment with initially uncertain outcome. With hindsight it can safely be said that it was a huge success and a major milestone in the extra-university training of mine and exploration geologists in Africa.

The principle idea behind the Short Course followed the model of the highly successful UNESCO-SEG-SGA Latin American Metallogeny Courses that have been run annually in different locations in South America for the past three decades. The African continent is well endowed with mineral resources and yet much of Africa's mineral riches remain to be discovered. Mining has played a pivotal role in the economy of many African countries with contributions to foreign exchange earnings exceeding 50 % in many instances. There is no doubt that the exploitation of mineral deposits could form a substantial, if not the strongest, platform on which to base the future uplifting of the African economy. At the same time Africa is moving more and more into the focus of the global mining industry, especially gold miners. This became particularly evident at the recent PDAC Meeting in Toronto where discussions revolved around the growing number of junior companies producing gold in Africa and growing space of acquisitions in countries like Burkina Faso or Ivory Coast.

The discovery of new deposits as well as the economic and sustainable exploitation of known deposits requires skills that are not as readily available in many areas of Africa as they might be in other parts of the world. Thus, not surprisingly, the wish to organize some kind of training courses for young African geoscientists in the specific field of metallogeny, i.e. practical aspects of the genesis of ore deposits that can be applied in the formulation of future exploration strategies, has been voiced repeatedly by numerous companies and organizations, foremost the Geological Society of Africa (GSAf), SGA and SEG. As an aftermath of the IGCP's 40th anniversary celebrations, an Earth Science Education Initiative in Africa was launched and, as the concept of running professional short courses for African geoscientists fits perfectly into this initiative, it was no surprise that UNESCO and the IUGS swiftly welcomed the plan of Short Courses on African Metallogeny. Under the leadership of SGA, the course was organized with help from the Institut de recherche pour le développement (IRD) in Toulouse, financial contributions from SEG and IUGS and sponsorship (in kind) from UNESCO and the GSAf.

The decision to run this first short course on African metallogeny in Burkina Faso, a country that is known to many foreigners as "Burkina what?", was guided by a currently extraordinary interest by many exploration companies in the West African Craton as exemplified by WAXI, the West African Exploration Initiative, and a keen interest by local geologist to host the course there. Burkina Faso is one of the poorest countries in the world where the hopes for a better future are fuelled by the expectation to discover new ore deposits. Just in the past five years five gold mines opened in the country and the national gold production rose from close to zero in 2006 (based merely on artisanal mining) to 33 t in 2011 when gold overtook cotton as the country's most important export product. Several projects stand a good chance of becoming mines in the foreseeable future. Apart from gold there are also promising prospects in manganese and several other commodities. The largely covered bedrock geology is dominated by Palaeoproterozoic granite-greenstone belts (Birimian) adjacent to an Archaen craton further west. Taking into consideration the regional geological setting and current exploration interests,

"Precious and Not-so-precious Metals in Old Cratons"

was chosen as theme for the course.

The course was hosted by Teng Tuuma Geoservices (TTG), a young company in Ouagadougou that provides exploration services as well as a brand new training centre. In fact, this course was the very first event staged by TTG in their new building, which became finished literally on the day before the opening of the course. The managing director of TTG, Dr Morou Francois Ouedraogo, deserves much of the credit for the success of the course. Together with his staff he organized all the logistics on site, supported the delegates from their first steps into the country at the airport all the way through to taking care of food and drinks during the course and providing a well equipped, comfortable lecture theatre. Without his engagement and the tremendous work done by his wife and all the TTG staff this short course would not have been possible.

The course attracted considerable interest from the Burkina Faso government. Thus the opening ceremony on Monday, 12th March, was attended by Mr Nombre, representatitve of the Minister of Mines of Burkina Faso, who expressed his gratitude to the organizers for the initiative to train young geoscientists in Burkina Faso, and by Mr Koala, Executive Secretary of the Chamber of Mines of Burkina Faso. On the next day, Mr Salif Kaboré, Burkina Faso's Minister of Mines, Carriers and Energy himself, honoured our meeting with his presence and expressed his thanks for this initiative but also his hope for a continuation of the training of West African geoscientists in the years to come.

The theoretical part of the course covered a wide range of lectures. Following an introduction to the principal requirements for the formation of an ore deposit and an introduction to the regional geology, specific topics that were addressed in greater detail included hydrothermal ore-forming processes, structural control on mineralization, orogenic gold deposits in general and geochemical exploration tools for such deposits in particular, IOCG deposits in Archaean rocks, Palaeoproterozoic granite-hosted gold deposits (with examples from Brazil), Archaean palaeoplacer deposits, rare metal deposits in pegmatites, genesis of iron formation and their significance in the reconstruction of palaeoenvironmental conditions, and iron ore as well as manganese ore deposits. These contributions were presented by Pasi Eilu from the Geological Survey of Finland, Roberto (alias "Aleluia") Xavier from the University of Campinas, Brazil, Lenka Baratoux and Marieke van Lichtervelde, both from the Institut de recherche pour le développement (IRD) in Toulouse, France, Nic Beukes from the University of Johannesburg, South Africa, and Hartwig Frimmel from respectively the University of Wuerzburg (Germany) and the University of Cape Town (South Africa). Towards the end of the week, Peter Williams from Curtin University and partner in TTG provided insights into geophysical exploration methods, with many real-life examples, and Morou Francois Ouedraogo explained numerous examples of exploration successes in Burkina Faso. Finally, the course was concluded by an outlook on future availability of georesources by Hartwig Frimmel.

The five-day short course was followed by a two-day field trip to several exploration projects in the area near Gaoua in the southwestern part of Burkina Faso near the border to the Ivory Coast. This field visit was led by Morou Francois Ouedraogo and Athanase Nara, chief geologist of Volta Resources. The participants were able to examine the style of mineralization (mainly Cu and Au) in field outcrops, trenches and drill core, and gained a good insight into the principle controls of Cu and Au mineralization in that greenstone-dominated area, reaching the conclusion that an early porphyry Cu-type of mineralization was followed and overprinted by syn-Birimian orogenic gold mineralization along a major north-south trending shear zone. The field trip was generously supported by Volta Resources who sponsored a final dinner that was also attended by Mr Jean Baptiste Kambou, the mayor of Gaoua, and Mr Bernard Y. Sawadogo, the chief commissioner of the Southwest Region. Special thanks go to our host there, the country manager of Volta Resources, Mr Raphael Goama Zoungrana, for his great hospitality.

For logistic reasons the number of participants was initially set to not more than 50 for the theoretical part of the short course and not more than 20 for the post-workshop field trip. The demand for this course was, however, so overwhelming that, although several (late) applicants had to be turned down, a total of 61 delegates ended up for the short course, most of whom came along for the field trip as well. Altogether 14 different exploration companies were present. The country origin of the participants reflected perfectly the overall African (with focus on West African) flavour of the course, with delegates not only from Burkina Faso but also from as far afield as Australia, Botswana, Cameroon, Congo, France, Ghana, Guinea, India, Ivory Coast, Liberia, Niger, Nigeria, South Africa, and Sweden.

The entire short course was presented in English. A dominance of delegates from francophone countries led to initial concerns that language could be a stumbling block. Our French-speaking colleagues very quickly proofed, however, that their language skills had been underestimated and that they could follow the English-speaking presenters perfectly well, in spite of having to deal with a variety of dialects and styles of pronunciation.

A principal goal of this and hopefully all following Short Courses on African Metallogeny has been and will remain the provision of a platform for further training of young geologists who have difficulties in obtaining such training in the fields of ore deposit research and exploration due to financial constraints or the lack of capacity at their home institutions. This will be possible only for as long as sufficient funding for sponsoring students and professionals from economically disadvantaged backgrounds can be generated. Although professional societies, such as SGA and SEG, and organizations, such as UNESCO or the IUGS, can help to some extent, the onus of providing the required funds will continue to rest with the mining and exploration industry. To achieve a win-win situation for all parties, delegates from industry are expected to cross-subsidize with their course fees those delegates who do not have access to sufficient funds. Although this 1st Short Course on African Metallogeny saw a healthy mix of delegates from industry, academia and government institutions, the proportion of delegates from the exploration industry was higher than expected. This made it possible to accumulate some money that will form the beginning of an educational fund to be used to support a greater number of students (and some academics from economically disadvantaged institutions) in future courses. Thus the 1st Short Course on African Metallogeny was not only a great success for those who participated but also for those who plan to conduct, or participate in, similar courses on the African continent in the years to come.

Finally, it cannot be emphasized enough that the success of such a Short Course lies not only in the hands of an organizing society, such as SGA, but hinges completely on the cooperation, efficiency and willingness of a local partner. The whole team of TTG has set a high standard, for which we all owe them greatly. Now other groups in Africa are invited to take up the challenge to host one of the next Short Courses on African Metallogeny. Applications to stage such an event are called for and anyone interested is invited to submit a proposal to the SGA Executive Secretary Dr Jan Pašava (jan.pasava@geology.cz).

Thanks to our local sponsors in Burkina Faso, Teng Tuuma Geoservices and Volta Resources!

Teng Tuuma Geoservices Ouagadougou

VOLTA RESOURCES INC.

*Dr. Morou Francois Ouedraogo (left) is opening the short course in the presence of the Mr Koala, Executive Secretary of the Chamber of Mines (background left) and Mr Nombre, representative of the Minister of Mines (middle) and Prof. Frimmel, course coordinator (right).*


*An enthusiastic Roberto Xavier explains the principles of hydrothermal ore formation.*

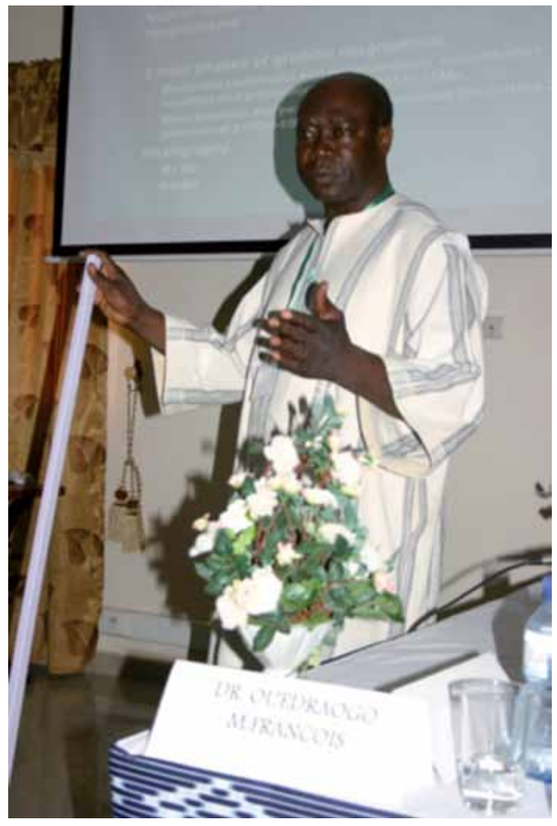
*Some of the delegates gathering for a "family" photo around Mr Koala, Executive Secretary of the Chamber of Mines and Mr Nombre, representative of the Minister of Mines (middle left).*


*Peter Williams sharing his vast experience in geophysical exploration in West Africa.*

*Mr. Salif Kaboré, the Minister of Mines, Carriers and Energy of Burkina Faso in the middle with Dr. Morou Francois Ouedraogo (to his left), surrounded by the lecturers and TTG staff in front of the TTG training centre.*


*Lenka Baratoux explains the intricacies of geological structures and their role in mineralization.*

*Location of the short course: the Teng Tuuma Geoservices Training Centre in Ouaga 2000.*




*Morou Francois Ouedraogo provides insights into the regional geology of Burkina Faso.*


*Delegates trying to solve an orogenic gold exploration exercise.*

*A happy round of lecturers during coffee break (from left: Nic Beukes, Roberto Xavier, Lenka Baratoux, Marieke van Lichtervelde, Hartwig Frimmel, Pasi Eilu)*

*Delegates following the old-timers' tracks in the search for copper near Gaoua.*

# News from the Baltic Student SGA Chapter

**Karolina Kielczyk, Andrzej Lis, Marta Sośnicka, Friederike Minz, Lisa Andersson**

*AGH University of Science and Technology, Cracow, Poland*
*Luleå University of Technology, Sweden*

The Faculty of Geology, Geophysics and Environmental Protection of the AGH University of Science and Technology in Cracow, Poland, hosted the SGA Student Conference "Ore deposits" in December 6-9, 2011. The Meeting was organized by the Polish members of the Baltic Students Chapter SGA.

In the meeting participated 17 members: 6 students from Lulea University of Technology in Sweden (Anders Zettergren, Lisa Andersson, Evelina Eriksson, Sanna Naalisvaara, Andreas Karlsson, Friederike Minz), one student from University of Turku in Finland (Mira Valkama) and 9 students of the AGH University of Science and Technology in Poland (Marta Sośnicka, Władysław Zygo, Ireneusz Królewicz, Karolina Kielczyk, Andrzej Lis, Gabriela Kozub, Tomasz Ćwiertnia, Arkadiusz Piotrowski, Maatla Letsholo, Agnieszka Bagnicka).

*Figure 1: Participants of the SGA Scientific Session at the AGH University of Science and Technology*

*Figure 2: The Meeting participants at the Cu exploitation front in the Polkowice-Sieroszowice Cu-Ag mine, Poland*

The Baltic Student Chapter Meeting included field trips to underground mines (pre-session field trip to Polish Kupferschiefer Cu-Ag mine and post-session field trip to MVT Zn-Pb mine), presentations of the SGA Scientific Session, celebration of the Miner's Day at the AGH University of Science and Technology and Cracow city sightseeing.

On the first day, all participants visited the underground copper mine in Polkowice-Sieroszowice, exploiting copper ores from Polish Cu-Ag (copper shale) deposit. It is one of the largest deposits of copper in Europe. The ore deposit is located in south-western Poland, and covers an area of around 467.6 km2. Mining operations are currently carried out at a depth between 0.6 and 1.38 km. The ore body is related to a formation of Permian rocks inclined towards the north-east. The ore contains around 2% of Cu and significant amounts of silver. In addition, salt rocks are extracted from the Zechtein beds located above the Kupferschiefer horizon. The room-and-pillar mining system is the applied mining method. During a four-hour tour, students saw the copper exploitation front and also the chamber in overlaying huge salt beds.

The Student Scientific Session took place at the AGH University of Science and Technology in Cracow on the 8th of December 2011. The official language of the SGA Session was English. Different aspects of ore deposits from Finland, Ukraine, Mongolia, Laos, Kosovo, Botswana and Poland were covered in the presentations given by the students. All presentations were evaluated by scientific committee of: Prof. Adam Piestrzyński, Dr Eng. Jadwiga Pieczonka and Dr Hab. Jaroslav Pršek. The committee awarded the best presentations: among PhD students: Tomasz Ćwiertnia and Mira Valkama and among Master students: Maatla Letsholo, Anders Zettergren and Arkadiusz Piotrowski. After SGA Scientific Session the Meeting participants listened to the planar lecture given by Prof. Adam Piestrzyński about the genesis of Polish Kupferschiefer Cu-Ag deposit. After the presentation, the SGA BSC's future was discussed and the new council was elected. The 2012 Council of the Baltic Student Chapter SGA consists of: the President of the Chapter: Marta Sośnicka (Poland), the Secretary: Evelina Eriksson (Sweden), the Treasurer: Mira Valkama (Finland) and the Webmaster: Tomasz Ćwiertnia (Poland). In the evening Polish and international participants enjoyed student night-life in Cracow during the ice-breaker party.

On the 9th of December participants visited the MVT Zn-Pb deposit in Olkusz-Pomorzany underground mine. The tour was guided in English by the main geologist Włodzimierz Cieślik. The initial mining reserves were estimated at about 70 Mt grading 4.6% Zn and 1.9% Pb. Current annual production of the Pomorzany mine reaches 2.17 Mt of ore grading 4.09% Zn and 1.77% Pb. The milling and concentrating facilities at the Olkusz-Pomorzany mine have a capacity of about 10,400 t/day. Economic Zn-Pb ores in Upper Silesia district are hosted by dolomites of the Muschelkalk (middle Triassic). It is estimated that 95% of the ore produced in the Silesia district is hosted by the 35-70 m thick ore-bearing dolomite. The lens-shaped ore bodies reach locally up to 25 m of thickness. The ore is composed mainly of fine grained, banded or colloform sphalerite, galena, marcasite and pyrite. Zn-Pb ores are also rich in the following elements: Ag, Cd, Ge, Ga and Tl.

*Figure 3: In the chamber of salt in the Polkowice-Sieroszowice Cu-Ag mine, Poland*

Back to Cracow, the participants attended the Miner's Day, called "Barbórka". The event has been celebrated by Polish miners since the end of the 19th century. The program of the celebrations at the AGH University of Science and Technology usually includes a holy mass, an official meeting, the "jumping over an apron" – a tradition that symbolizes that mining "apprentices" or "foxes" are admitted to the Miners' community. The celebrations were accompanied by the miners orchestra.

Interesting and informative days in Poland where achieved during this meeting, and a special thanks are directed to all the people who helped arranging this successful event.

*Figure 4: In the chamber of salt in the Polkowice-Sieroszowice Cu-Ag mine, Poland*

*Figure 5: In the MVT Zn-Pb Olkusz-Pomorzany mine, Poland*

*Figure 6: The participants in front of the MVT Zn-Pb Olkusz-Pomorzany mine, Poland*

SOCIETY APPLIED GEOLOGISTS

# >>> FORTHCOMING EVENTS <<<

*** marks a new entry**

## 2012

**July 15–20**
GORDON RESEARCH CONFERENCE ON GEOCHEMISTRY OF MINERAL DEPOSITS, Proctor Academy, Andover, New Hampshire, USA. For the last 50 years, Gordon conferences have presented cutting-edge research and provoked spirited discussion on the origins of and exploration for mineral deposits. Held every three to four years, it has served as one of the premier think-tank meetings in economic geology. More so than other meetings, Gordon conferences provide a unique opportunity for scientists from academia, industry, and government, as well as students, from all over the world to meet and interact with recognized experts in an informal environment to examine new data and ideas and discuss future directions of research concerning ore deposits. Attendance is generally limited to 125-150 participants, providing an intimate setting. The 2012 Gordon Research Conference on the Geochemistry of Mineral Deposits continues this tradition. Sessions, which will be held in the morning and evening, include:
1. Frontiers in Economic Geology Research
2. Metallogenic Provinces and Epochs: The Role of Upper Mantle/Lower Crust Inheritance
3. Sediment Hosted Copper Systems: Focus on the African Copper Belt
4. Magmas, Fluids and Metals
5. Iron Oxide-Copper-Gold-Systems
6. Active Submarine and Subaerial Hydrothermal Systems
7. Distal Expressions of Large Gold and Copper Systems
8. Dynamics of Ore Systems
9. Rare Earth Element Systems

In addition to attracting leaders and rising stars to present talks and lead discussions in the sessions listed above, we will be encouraging all attendees, especially students and junior scientists, to participate by presenting their work in poster format. Also, as a vehicle to encourage student engagement, the session leaders will convene informal afternoon meetings of mainly students, who will be tasked to summarize the sessions and identify new avenues of research. They will then informally report to entire group prior to the talks of that evening's session. Much of the expected funding being raised will be earmarked specifically to assist students and junior scientists with their travel and registration expenses. The planned program, including discussion leaders, speakers, and titles of talks is being continually updated online at http://www.grc.org/programs.aspx?year=2012&program=geochem. The 2012 Gordon Conference organizers are John Muntean (munteanj@unr.edu), the chair, Jon Hronsky (jon.hronsky@wesminllc.com), industry co-chair, and Robert Moritz (Robert.Moritz@unige.ch), the vice-chair. For those who wish to attend, please fill out the application form on the aforementioned website. Please do not hesitate to contact us with any questions.

***July 15–22**
9th ISEG — International Symposium on Environmental Geochemistry, Aveiro, Portugal – Contact: Amélia Paula Marinho Dias dos Reis Departamento de Geociências Universidade de Aveiro (UA) Campus de Santiago 3810-193 Aveiro Portugal; Phone: [+351 234 370759]; Email: pmarinho@ua.pt; weblink: http://9iseg.web.ua.pt

**August 5–10**
34th International Geological Congress, Brisbane, Queensland, Australia. Contact: phone: (+61 62499556); weblink: http://www.ga.gov.au/igc2012

***August 6–8**
Ocean Crust Processes and Consequences for Life, Bremen, Germany -Contact: http://www.darkenergybiosphere.org/RCN/meetings/2012.html

**August 11–12**
ACROFI IV — Asian Current Research On Fluid Inclusions, Brisbane, Australia. The conference provides an international forum for exchange of the latest research results and ideas between geoscientists from academia, government and industry from Asian countries and other nations. It focuses on studies of fluid- and silicate-melt inclusions and their significance in understanding mineralising processes – Contact: http://acrofiiv.heroku.com/

***August 12–17**
75th Annual Meeting of the Meteoritical Society, Cairns, Queensland, Australia – Contact: http://shrimp.anu.edu.au:16080/metsoc2012/Welcome.html

***August 19–24**
Rock Deformation — Feedback Processes in Rock Deformation, Andover, NH, United States. Gordon Research Conferences – Contact: http://www.grc.org/programs.aspx?year=2012&program=rockdef

***August 20–24**
Hawaiian Volcanoes: From Source to Surface, Waikoloa, Hawaii, United States – Contact: http://www.agu.org/meetings/chapman/2012/dcall/

***August 21–22**
World Congress on Earth Science & Climate Change, Chicago, United States – Contact: http://www.omicsonline.org/earthscience2012/

**September 2–6**
1st European Mineralogical Conference, Frankfurt/Main, Germany – Contact: weblink: http://emc2012.uni-frankfurt.de/

***September 11–12**
Integrated Approaches for Volcanic Risk Management, Stuttgart, Baden-Württemberg, Germany – Contact: Prof. Dr. Karl Stahr Emil-Wolff-Str. 27 Stuttgart Baden-Württemberg Germany; Phone: (+49 (0) 711 459-23981); weblink: http://https://miavita2012.uni-hohenheim.de

***September 14–18**
International conference 'Ore potential of alkaline, kimberlite and carbonatite magmatism'. School 'Alkaline magmatism of the Earth', Sudak, Ukraine – Contact: http://alkaline.web.ru/2012/

**November 4–7**
2012 Geological Society of America (GSA) Annual Meeting, Charlotte, North Carolina, United States – Contact: http://www.geosociety.org/meetings/2012/

**November 12–13**
Precious Metals '12, Cape Town, South Afriuca - Contact: http://www.min-eng.com/preciousmetals12/index.html

***December 3-4**
GEOS 2012 — Annual International Conference on Geological & Earth Sciences, Singapore, Singapore – Contact: http://www.geoearth.org/

**December 10–14**
AGU 2012 Fall Meeting, San Francisco, California, United States. The Fall Meeting provides an opportunity for researchers, teachers, students, and consultants to present and review the latest issues affecting the Earth, the planets, and their environments in space – Contact: AGU Meetings Department 2000 Florida Avenue, NW Washington DC USA 20009; phone: (202-777-7333); email: meetinginfo@agu.org; weblink: http://www.agu.org/meetings/

## 2013

***June 5–9**
ECROFI — 22nd European Current Research on Fluid Inclusions, Antalya, Turkey – Contact: Dr.Gulcan BOZKAYA Cumhuriyet University Department of Geological Engineering TR-58140 Sivas/ TURKEY Dr.Nurullah Hanilci Istanbul University Department of Geological Engineering 34100 Avcilar -Istanbul TURKEY; Email: info@ecrofi2013.org; weblink: http://www.ecrofi2013.org

**July 20–24**
IAVCEI 2013 General Assembly: Forecasting Volcanic Activity, Kagoshima, Japan – Contact: http://www.iavcei2013.com/

***August 12–15**
12th SGA Biennial Meeting "Mineral Deposit Research for a high-tech World", Uppsala, Sweden – Contact: www.akademikonferens.uu.se/sga2013; e-mail: sga2013@sgu.se

***September 1–6**
11th International Conference on Paleoceanography (ICP11), Barcelona, Spain – Contact: http://www.icp2013.cat/

**December 15–19**
AGU 2013 Fall Meeting, San Francisco, California, United States. – Contact: AGU Meetings Department 2000 Florida Avenue, NW Washington DC USA 20009; weblink: http://www.agu.org/meetings/; AGU Meetings Department 2000 Florida Avenue, NW Washington D.C. U.S.A. 20009; Phone: (+1-202-777-7333)

## 2014

***August 30–September 6**
IMA 2014 General Meeting — 21st General Meeting of the International Mineralogical Association, Johannesburg, South Africa – Contact: http://www.ima2014.co.za

## 2015

***August 24–27**
13th SGA Biennial Meeting "Mineral Resources in a Sustainable World", Nancy, France – Contact: sga-2015@univ-lorraine.fr



## 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:

**SGA Treasurer's Office** - c/o Sabine Lange
Rixenweg 2, D-24222 Schwentinental-OT Klausdorf
GERMANY
e-mail: sabine-klausdorf@t-online.de and treasurersga@aol.com

Name _____

Old address

_____

_____

_____

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

_____

_____

_____

_____

_____

_____

## PRICES FOR ADVERTISING IN SGA NEWS

| | |
|---|---|
| 1 page | 400 EUR |
| 1/2 page | 200 EUR |
| 1/4 page | 125 EUR |
| 1/8 page | 70 EUR |

Before sending your advertisement contact SGA News (see address on page 2). Advertisement should be sent as attached files via e-mail to SGA News (see page 2). Credit card payments are welcome.

**>>>** SGA CORPORATE MEMBERS are offered the special opportunity to advertise for free on SGA News for a space of 1/4 of a page!!!

# Ophiolites and related ore and industrial minerals: field workshop, Turkey, 16–22 May 2012

**Ibrahim Uysal**
*Karadeniz Technical University, Trabzon*

The first "Ophiolites and Related Ore and Industrial Minerals" workshop was held in Trabzon, Turkey during May 16th to 22nd. It was honored by 6 invited speakers and about 70 scientists from fourteen different countries that presented new data and updated knowledge on ophiolites mainly from Turkey but also from other important ultramafic complexes in the world such as Iran, Canada, Scotland, Portugal, Russia, Italy, Austria, Japan and Dominican Republic.

After opening ceremony the meeting was started by introducing the Society for Geology Applied to Mineral Deposits (SGA) in a 30 min. presentation given by J. Pasava (SGA Executive Secretary). SGA was co-organizer of this important international geoevent.

The meeting was a fruitful environment for the discussion of ideas and future co-operation projects, and also enabled friends and colleagues that share a passion for ophiolitic rocks to enjoy generous hospitality of the Karadeniz Technical University and to meet its fantastic facilities. The workshop has been sponsored by 10 different companies: Koza Gold, TPAO, Pozitif Sondaj, Matel, Akmetal, Eti Bakır A.Ş., TürkMag, Vommak, Körfez Restaurant and Doğuş Çay. They all deserve great thanks of the local organizing committee.

The organization from the Karadeniz Technical University, the Society for Geology Applied to Mineral Deposits and International Mineralogical Association was highly appreciated by all participants. In addition to a social trip to Batumi (Georgia), two field trips were organized after the 2 days of scientific sessions which was also an opportunity to view the astonishing Turkish geology:

1- Chromite and magnesite deposits at Aşkale, Erzurum (NE Turkey): Different types of mostly Cr-rich chromitites, with more than 12 million tons of reserve, including massive, disseminated and banded textures are present in the Kop ophiolites which extend from Erzincan to Erzurum in NE Turkey and consist mainly of highly serpentinized harzburgite and limited dunite and lherzolite. The chromitites have low total platinum group element (PGE) concentrations (up to 600 ppb). In the same region, magnesite, with an estimated reserve of 8 million tons, is also widely exposed within the ultramafic rocks consisting predominantly of serpentinized harzburgite. Magnesites are exposed along NE-SW trending normal faults in the ultramafic rocks and occur either as sediment or infill of vein-type fractures.

2- Volcanogenic Massive Sulphide deposit at Küre, Kastamonu (N Turkey): Production of copper and pyrite concentrate at Eti Copper Kastamonu Küre facilities are realized with an annual capacity of 1.000.000 tons of ore, resulting in 90.000 tons copper concentrate and 400.000 tons pyrite concentrate from the 3 open and 1 underground mines.

*Kure VMS deposit, Kastamonu (north Turkey)*

*Ice-breaking party at the Karadeniz Technical University*

*Students from Karadeniz Technical University helping with organization (from left: B. Karakaya, M. Basalma, T. Aktemur, E. Aysert, A. Dogan)*

*Ice-breaking party from the left: S. Chistyakova, E.V. Kislov, I. Uysal, F. Zaccarini, G. Garuti, J. Pašava, R. Latypov, A. Vymazalová, J. Relvas*

*Participants of the workshop having tea, sponsored by Doguscay*




*Participants of the workshop in front of the Congress centre in the University campus*

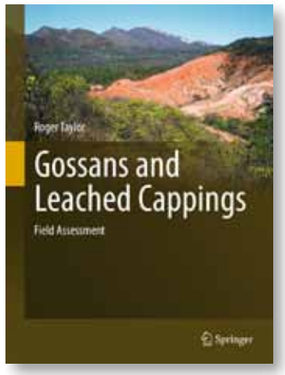

*Participants of the workshop in front of the Congress centre in the University campus*

*The audience during the workshop*

*Magnesite outcrops at Askale, Erzurum (north-east Turkey)*

Springer
the language of science

springer.com




1st Edition., 2012, XVIII, 146 p. 213 illus. in color.

Printed book

**Hardcover**
- **99,95 € | £90.00 | $129.00**
- *** 106,95 € (D) | 109,95 € (A) | SFr. 143.50**

eBook

**Available from libraries offering Springer's eBook Collection, or for individual purchase via online bookstores.**
**A free preview is available on SpringerLink.**
- **springer.com/ebooks**

MyCopy

**Printed eBook exclusively available to patrons whose library offers Springer's eBook Collection.*****
- **€ | $ 24.95**
- **springer.com/mycopy**

R. Taylor, James Cook University, Townsville, QLD, Australia

**Gossans and Leached Cappings**

**Field Assessment**

- **The only modern text on the subject**
- **A how to do with numerous field illustrations for exploration geologists - prospectors**
- **A senior undergraduate text**
- **Also a guide for lecture teaching**

This text concentrates upon field observations concerning leached cappings and gossans, occurring as oxidised surface expressions of underlying ore zones.Although the advent of modern multielement geochemical sampling and easier mechanical excavation assist considerably in subsurface interpretation, there are still many occasions where the first observation and recognition are made by the lone field geologist. New exposures continue to be found in remote and often difficult terrains, where "on the spot" skills are of prime importance.In general terms the text has been arranged from the broad scale to the specific, and it should be realised that all scales provide valuable input for final interpretation. The topics covered include:• Theoretical perspectives• Initial recognition• General field observations• Detailed field observations (secondary minerals, boxworks)• Porphyry copper leached cappings

**Order online at springer.com** ► or for the Americas call (toll free) 1-800-SPRINGER ► or email us at: orders-ny@springer.com. ► For outside the Americas call +49 (0) 6221-345-4301 ► or email us at: orders-hd-individuals@springer.com.

The first € price and the £ and $ price are net prices, subject to local VAT. Prices indicated with * inlude VAT for books; the €(D) includes 7% for Germany, the €(A) includes 10% for Austria. Prices indicated with ** include VAT for electronic products; 19% for Germany, 20% for Austria. All prices exclusive of carriage charges. Prices and other details are subject to change without notice. All errors and omissions excepted.

*** Regional restrictions apply.

**Business Card**
Staple HERE

# SGA

Society for Geology Applied to Mineral Deposits (www.e-sga.org)

## MEMBERSHIP APPLICATION FORM

I would like to become a member of the **Society for Geology Applied to Mineral Deposits** and to receive my personal copy of **Mineralium Deposita**. Membership fees will be due after acceptance of the membership application by the SGA Council. **- Type or Print -**

| | |
|---|---|
| **Name** | |
| **First name** | |
| **Title** | |
| **Mailing address** | |
| | |
| | |
| **Phone** | |
| **Fax** | |
| **e-mail** | |
| **Academic degrees** | |

**Select your Membership Dues**

☐ 75.00 EUR Regular Member (Print+Internet **Mineralium Deposita** and **SGA News**)
☐ 60.00 EUR Regular Member (Internet only **Mineralium Deposita** and **SGA News**)
☐ 10.00 EUR Student Member (Internet only **Mineralium Deposita** and **SGA News**, certificate required)
☐ 60.00 EUR Student Member (Print+Internet **Mineralium Deposita** and **SGA News**, certificate required)
☐ 60.00 EUR Senior Member (Print+Internet **Mineralium Deposita** and **SGA News**, after retirement - certificate required)
☐ 300.00 EUR Corporate Member (includes 3 copies of **Mineralium Deposita**) (for industry only, no academic)

**Check only one of the two boxes below**

☐ I want to receive Mineralium Deposita and membership privileges for the current calendar year including back issues
☐ I want to receive Mineralium Deposita and membership privileges for the next calendar year

If my 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 credit card:

☐ VISA ☐ MASTERCARD/EUROCARD ☐ AMERICAN EXPRESS

**Card No:** _____ **Expiry date (MM/YY):** _____

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

**Sponsor (SGA member):**
Name Place Date Signature

1. _____

**Send the Membership Application Form to:**

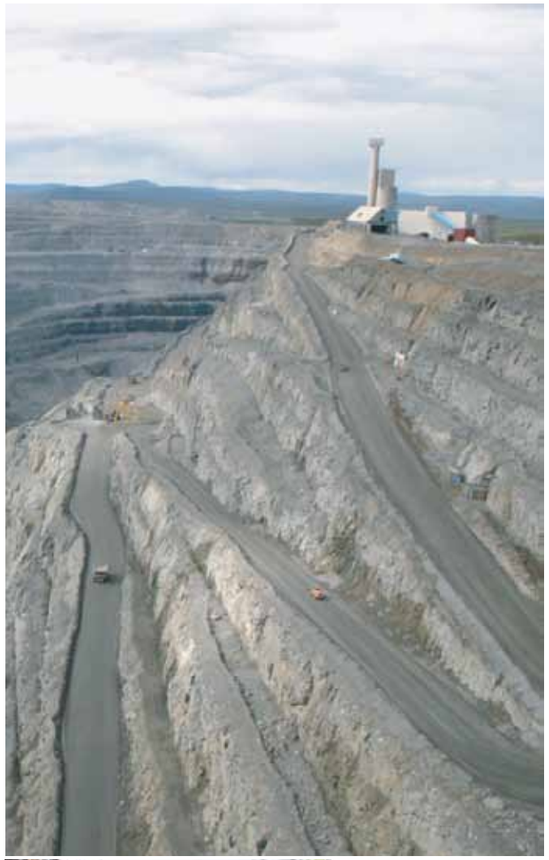
Dr. Jan Pasava
SGA Executive Secretary
Czech Geological Survey
Klárov 131/3
CZ-118 21 Praha 1
CZECH REPUBLIC

Phone: ++(420)-2-51085506
Fax: ++(420)-2-51818748
E-mail: secretary@e-sga.org

SGA, the Geological Survey of Sweden and the Nordic mining industry invite you to the

## 12th SGA Biennial Meeting
## Uppsala, Sweden
## 12–15 August 2013

# Mineral deposit research for a high-tech world



### Provisional session themes

1st circular

- Methods and advances in mineral deposit studies.
- Ore forming processes and major deposit types.
- Iron oxide deposits.
- Fennoscandian mineral deposits.
- High-tech elements – deposits and processes.
- Industrial minerals.
- Society, mining and sustainability.
- Open session.

### Field trips – preliminary list

- VMS deposits in the Skellefte district.
- IOCG and spatially related deposits in Fennoscandia.
- Orogenic gold deposits in Fennoscandia.
- Base metal deposits and iron ores of the Bergslagen province.
- Ni-PGE deposits in Finland and Russia.
- Classic rare-metal pegmatite deposits.
- Titanium-mineral deposits in southwest Fennoscandia.
- Metallogeny of the Oslo Rift and neighbouring shield areas.
- Metallogeny of the Repparfjord Window.
- Greenland.
- Alkaline deposits of the Kola peninsula.

### Preliminary workshops and short courses

- 3D/4D modelling.
- Geochemical modelling of ore deposits.
- Orogenic gold – with emphasis on exploration.

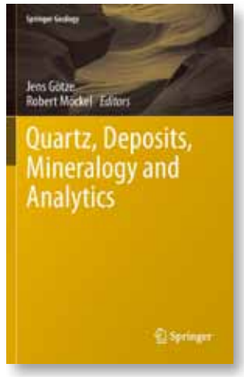
**Interested in offering short courses or workshops?**

Contact the organizing committee:
www.akademikonferens.uu.se/sga2013
e-mail: sga2013@sgu.se

**Important dates!**

| | |
|---|---|
| Second circular and call for papers | October 19th, 2012 |
| Registration opens | October 19th, 2012 |
| Early registration closes | April 12th, 2013 |
| Open submission of papers | December 14th, 2012 |
| Paper submission deadline | February 4th, 2013 |

Springer springer.com




2012, 2012, XV, 360 p. 130 illus., 56 in color.

**J. Götze**, Institute of Mineralogy, Freiberg, Germany; **R. Möckel**, Institute of Mineralogy, Freiberg, Germany (Eds.)

**Quartz: Deposits, Mineralogy and Analytics**

- First state of the art compilation about quartz and quartz raw materials
- Covers the whole field from quartz deposits via mineralogical properties to industrial application of SiO2
- Presentation of sophisticated analytical methods of quartz and SiO2 analysis

The book will include contributions of the state of the art of quartz raw materials (deposits and properties) and their analytics.
The chapters are presented by leading scientists in the quartz field. The presentations cover the main interrelations between genesis of quartz - formation of specific properties - analytics - industrial applications of SiO2 raw materials.

Printed book

Hardcover
- 129,95 € | £117.00 | $179.00
- *139,05 € (D) | 142,94 € (A) | CHF 173.00

eBook

Available from libraries offering Springer's eBook Collection, or for individual purchase via online bookstores.
A free preview is available on SpringerLink.
- springer.com/ebooks

MyCopy

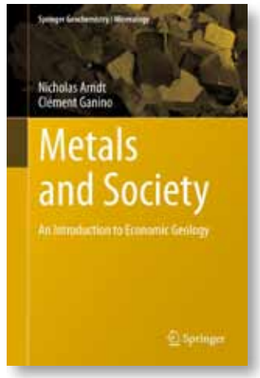
Printed eBook exclusively available to patrons whose library offers Springer's eBook Collection.***
- € | $ 24.95
- springer.com/mycopy

Order online at springer.com ► or for the Americas call (toll free) 1-800-SPRINGER ► or email us at: orders-ny@springer.com. ► For outside the Americas call +49 (0) 6221-345-4301 ► or email us at: orders-hd-individuals@springer.com.

The first € price and the £ and $ price are net prices, subject to local VAT. Prices indicated with * include VAT for books; the €(D) includes 7% for Germany, the €(A) includes 10% for Austria. Prices indicated with ** include VAT for electronic products; 19% for Germany, 20% for Austria. All prices exclusive of carriage charges. Prices and other details are subject to change without notice. All errors and omissions excepted.

*** Regional restrictions apply.

Springer springer.com




2012, 2012, XIII, 160 p. 61 illus., 40 in color.

**N. Arndt**, University of Grenoble, France; **C. Ganino**, University of Nice, France

**Metals and Society**

**An Introduction to Economic Geology**

- Contains numerous case studies and worked examples
- First introductory book which deals extensively with the economic and social issues of mineral exploitation
- Numerous colour figures

Printed book

Hardcover
- 59,95 € | £53.99 | $89.95
- *64,15 € (D) | 65,95 € (A) | CHF 80.00

eBook

Available from libraries offering Springer's eBook Collection, or for individual purchase via online bookstores.
A free preview is available on SpringerLink.
- springer.com/ebooks

MyCopy

Printed eBook exclusively available to patrons whose library offers Springer's eBook Collection.***
- € | $ 24.95
- springer.com/mycopy

Order online at springer.com ► or for the Americas call (toll free) 1-800-SPRINGER ► or email us at: orders-ny@springer.com. ► For outside the Americas call +49 (0) 6221-345-4301 ► or email us at: orders-hd-individuals@springer.com.

The first € price and the £ and $ price are net prices, subject to local VAT. Prices indicated with * include VAT for books; the €(D) includes 7% for Germany, the €(A) includes 10% for Austria. Prices indicated with ** include VAT for electronic products; 19% for Germany, 20% for Austria. All prices exclusive of carriage charges. Prices and other details are subject to change without notice. All errors and omissions excepted.

*** Regional restrictions apply.

# 50th SGA Anniversary meeting

**Welcome back to the roots of SGA**

## 13th SGA Biennial Meeting

Nancy, France, August 24-27, 2015

## Mineral Resources in a Sustainable World

*Photo : V. Huault*

**sga-2015@univ-lorraine.fr**