Metallic mineral deposits in Fennoscandia, Greenland and NW Russia

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The Nordic countries, including Greenland, and NW Russia have a long tradition in mining. Documented mining dates back to the 8th century AD. Today this region is the most important metallic mining district of the European Union. Metals are produced from active mines in all countries except Iceland and related industries are thriving in all countries.

Important ore deposit types include: volcanicogenic massive sulphide deposits (Cu, Zn, Pb, Au, Ag), orogenic gold (Au), layered intrusions (Ni, PGE, Ti, V, Cr), intrusive-hosted Cu-Au, apatite-Fe deposits, carbonatite and peralkaline intrusions (Nb, REE, Ta, Ti, Zr), and anorthosite-hosted Ti deposits. Besides these well-documented deposits, new kinds of deposits are being explored, e.g., iron oxide-copper-gold (IOCG), porphyry (Cu-Au, Mo, and shale-hosted Ni-Zn-Cu).

The Fennoscandian Shield, which forms a large part of the Nordic countries and the NW Russia and possibly extends into the Archaean and Paleoproterozoic areas of Greenland, has historically been one of the most active mining areas in Europe. Since the industrial revolution in the 19th century, numerous iron mines were exploited in Bergslagen and, during the 20th century, mining of both base metals and iron ore started in several new mining districts such as the Skellefte and Northern Norrbotten districts in Sweden, the Vihanti-Pyhäsalmi and Outokumpu districts in Finland, the Pechenga district in Russia, Tellnes and Sør-Varanger in Norway, and the Kobbeminebugt (Josva and Lilian Mines) and Black Angel mine in Greenland. However, Fennoscandian (the Precambrian Shield together with the Caledonides) can still be regarded as under-explored and having a good potential for major new discoveries, as shown by the discovery of metal, industrial mineral and natural stone deposits made every year in the region. The present economic mineral deposits (Figure 1) are largely concentrated in the Paleoproterozoic parts of the Fennoscandian Shield. Nickel-PGE, black shale Ni, orogenic gold, and VMS, Pb-Zn, BIF and Fe-oxide deposits are the main types of economic interest in the Shield (Table 1). Also, apparent porphyry-style Cu-Au and Mo deposits (e.g., Åtlik), anorthosite-hosted Fe-Ti-V, chromite in layered intrusions, and REE and other rare metals in peralkaline intrusions are major deposit types.
News of the Society

SGA Ordinary Council Meeting, April 11, 2013, Lisbon, Portugal

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

P. Weihed welcomed Council Members (G. Beaudoin, N. Bortnikov, S. Bouhlel, P. Eilu, H. Frimmel, A. Cheilletz, J. Pašava, A. Piestryński, J. Relvas, A. Vymazalová, and J. Wilkinson) and guests (E. Jonsson and P. Klingbjer, LOC SGA 2013, Swedish Geological Survey for Item 7 and S. Lange, SGA Treasurer’s Office) and thanked J. Relvas and his team for organization of the meeting and the Geology Department for hosting it.

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

Reports of Officers on Council and Matters Arising from These Reports

Reports were submitted by the SGA Executive Secretary, Treasurer’s Office, Regional VP for Oceania, RVP for North Africa and Middle East, RVP South America and Chief Editor, SGA News. SGA Annual Report for 2012 was highly appreciated by IUGS. In 2012 SGA membership slightly decreased from 1215 to 1144 (mainly due to non-renewal by some student members).

After discussion, Council approved the reports with great thanks and the following motions:

A. Vymazalová to inform SGA Student Chapters about possibility of presentation of major results of Chapter at the SGA General Assembly in Uppsala (August 13, 2013 from 11.00 to 12.00).

G. Beaudoin to contact Barrick Gold to find out if Barrick is interested to continue with SGA-Barrick Young Scientist award through a new written contract.

All Council members coordinated by RVP’s to contact SGA 2012 members who haven’t renewed their membership yet.

J. Pašava to ask Council members who intend to take part in FUTORES Conference (Australia, June 2013) to get in touch with D. Huston to assist him manning the SGA booth.

E. Ferrari to supervise creation of SGA Chapter in Peru and collaboration with Geological Society of Peru.

M. Chiaradia to make sure that printing of SGA News in Heidelberg (after a careful correction by several Council members) will be without serious printing mistakes (e.g., altered titles in no. 32).

All Council members are asked to help M. Chiaradia in identifying potential contributors for the main articles in SGA Newsletter.

D. Layton-Matthews to suggest improvement of SGA website for the next SGA Council Meeting (Uppsala, August 11, 2013).

Editorial matters (B. Lehmann, P. Williams)
The report was given by G. Beaudoin, who became Chief Editor after P. Williams in June 2012. The journal continues to attract a high level of submissions, maintaining an objective of 1000 pages per volume. Two thematic issues are in preparation. He also presented a proposal for the best MD paper award (nominated 5 papers). Council approved the reports with great thanks and the following motions:

J. Pašava to organize electronic vote for the best MD paper award by April 30, 2013 and inform Chief Editors about a result of the simple majority Council vote.

B. Lehmann to inform award recipient about presentation of award during the SGA 2013 Opening Ceremony (Uppsala, Monday, August 12, 2013).

Report of the chair of the Nomination Committee (P. Weihed)

P. Weihed presented the report – a list of nominations with two positions still pending (a subject of adding). Council approved the list and the following motions:

P. Weihed to provide J. Pašava with remaining two names by April 30, 2013.

J. Pašava to organize electronic Council vote.
Progress report on the creation of SGA Educational Foundation (G. Beaudoin)
The report was presented by G. Beaudoin. Instead of creation of the SGA Educational Foundation, the SGA is under present status (not-for-profit legal entity under Swiss law) able to receive donations from industry and individuals through a new account in the name of the SGA Educational Fund. Council recommended to adopt Terms of References and approved the report with the following motions:

H. Frimmel to open a new account and provide its coordinates to P. Weihed.
P. Weihed to contact industrial donors that already showed interest in this project, to prepare a master-copy of a letter addressing new prosperous donors and coordinate this effort.
P. Eilu to prepare a draft of a new SGA membership application form to enable collecting individual donations.

Status of planning for SGA 2013 in Uppsala (P. Klingbjer and E. Jonsson)
The report was presented by Per Klingbjer and Erik Jonnson from the SGA 2013 LOC. To date 120 participants registered and paid registration fee. Totally, 604 abstracts were registered with 580 abstracts in process (this no. includes several duplicates thus a real no. will be much lower). Several field trips (3 to Norway and 1 to Finland) had to be cancelled due to a low no. of participants. Council appreciated efforts of the LOC and approved the report and the following motions:

P. Eilu to contact Ch. Bendall (Springer) to encourage Springer Publishing House to set up a booth in the SGA 2013 meeting.
A. Cheilletz to contact BRGM officials to encourage them to set up a booth at the SGA 2013 meeting.
P. Weihed to advertise possibility of having booth at the upcoming meeting of the Mining Association of Nordic Countries.
LOC to provide H. Frimmel and P. Eilu a list of subjects asked for sponsorship (to avoid duplication of requests).
LOC (E. Jonsson) to send instruction to session chairs how to proceed with revised abstracts by mid-April 2013.
J. Pašava to send LOC more detailed info on the presentation of SGA awards at the SGA 2013 Opening Ceremony.
J. Wilkinson to contact M. Harris from RTZ to present a plenary lecture on morality of mining at SGA 2013.
H. Frimmel to check the conference budget.

Status of preparation of the SGA 2015 Biennial Meeting (A. Cheilletz)
The report was presented by A. Cheilletz. Council recommended various revisions regarding suggested symposia and field trips and approved the report with great thanks and the following motions:

A. Cheilletz to inform the LOC 2015 about suggested changes and to submit revised document to J. Pašava who will circulate it to Council members for the final approval. A. Cheilletz and LOC SGA 2015 to prepare a leaflet on SGA 2015 to be distributed in Uppsala and other geo-events.

Awards Sub-Committee – status on received nominations for the SGA-Barrick Young Scientist Award and SGA-Newmont Gold Medal (D. Houston et al.)
The report, prepared on behalf of the Awards Sub-Committee by D. Huston was presented by J. Pašava. At the close of nominations (31 March 2013), no additional nominations were received for either SGA-Barrick Young Scientist not the SGA-Newmont Gold Medal to be awarded at the 12th SGA Biennial Meeting in Uppsala. The Sub-Committee suggested and Council approved to work with existing still eligible nominations. Council approved creation of a new SGA award (SGA Krol Silver Medal named after G.I. Krol, the President of the provisional executive committee of SGA) – recognizing service to the Society Council which would consist of an engraved silver plaque and support (economy air fare, accommodation and registration) to attend the Biennial Meeting for presentation. Society members or former members who have made significant contributions to the Society through Council or other activities will be eligible for this award. It will be given initially on ad hoc basis with the first one at the 13th SGA Biennial Meeting (2015, Nancy, France). Council approved the report with great thanks and the following motions:

D. Huston and the Committee to actively solicit future nominations for SGA awards.
J. Pašava to organize electronic vote on both SGA awards by April 30, 2013 and to inform P. Weihed who will then contact winning candidates.
A. Piestrzynski to negotiate with KGHM to provide a proposal for a new SGA award – the SGA Krol Silver Medal and report to the next Council meeting.
J. Pašava to try to find a contact to G.I.Krol family to seek permission for naming the medal after Prof. G.I.Krol.

Status of SGA Guidebook series and update on revival of SGA Special Publications (J. Slack)
The report, prepared by J. Slack was presented by J. Pašava. J. Slack proposed for the SGA-Springer book series the books to be focused on mineral deposits of large regions for which modern summaries and detailed data are not available in English. The first book planned in this series is on North Africa (Algeria, Egypt, Libya, Mali, Mauritania, Morocco, Niger, Sudan, and Tunisia). Mohammed Bouabdellah from Morocco, and Salah Bouhlel from Tunisia, have agreed to serve as the editors of this book. Council also revisited the issue of field trip guidebook-series originally considered for the SGA-Springer series and decided that these will be published independently by LOCs. After discussion Council approved the report with great thanks and the following motions:

J. Slack to ask M. Bouabdellah (with a cc to A. Cheilletz and S. Bouhlel) to submit a more detailed proposal for individual chapters in the planned book for Moroccan side to be presented at the next SGA Council Meeting (August 2013, Uppsala).

Progress report on membership drive from the last SGA Council Meeting (P. Eilu, S. Lange, J. Pašava, A. Vymazalová)
The report was presented by P. Eilu. By the end of 2012, SGA had 1144 members which is a slight reduction from the year of 2011, mainly in the category of student member. This can be related opportunistic student membership taken out only for the year of the Biennial Meeting. Unfortunately, the loss of members remains a serious problem. Sabine Lange recently distributed to all RVP’s excel file listing 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 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 reports were presented by A. Vymazalová. After discussion Council approved two new Chapters – Nancy Chapter and Tehran Chapter. Council approved all reports with great thanks and the following budgets for 2012 activities (Baltic Chapter – EUR 3000, Barcelona Chapter – EUR 3000, Nancy Chapter - EUR 1000, Novosibirsk Chapter – EUR 1500, Prague Chapter – EUR 3000). No budget was requested by the Tehran Chapter.

A. Vymazalová to contact Chapter Presidents to inform them about approval of two new Chapters and budgets and invite them for brief (up to 5 min.) presentations about their Chapters to the SGA GA (August 13, 2013 at 11.00)

Past activities
- Ophiolites and related ores and industrial minerals (16-22 May 2012 Trabzon, Turkey) – SGA sponsored workshop – organized by I. Uysal et al. – info in SGA News
- 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 Councilors.
- 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 were 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. Finally, sessions were merged and student support was distributed to SGA student members
- 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.
- 11th Freiberg Short Course in Economic Geology - Automated Mineralogy & Petrography for Geometallurgy (December 5-7, 2012 Freiberg, Germany) – J. Gutzmer et al. - SGA sponsorship (student’s participation) – EUR 1000 support to SGA student members (A. Vymazalová reporting)
- XX Congreso Geologico Boliviano (1-4 October 2012 La Paz, Bolivia) – request for SGA keynote speakers – O. Arce (President, BGA) – E. Ferrari acted as SGA keynote – report provided by organizers.
- XXXI Curso Latinoamericano de Metalogenia UNESCO-SEG-SGA (19-22 September, 27 September - 1 October, 2012) – F. Tornos (supported by 3000 USD – returned 800 USD) – most likely no course in 2013
- SGA involvement in SEG 2012 Conference (September 23-26, 2012 Lima, Peru) - F. Tornos – keynote speaker
- Short course on pegmatite deposits (Barcelona Student Chapter, Barcelona, January 9, 2013) – T. Aiglsperger - supported through SGA Keynote Speaker Program.
- SGA at PDAC 2013 (March 3-6 Toronto, Canada) – P. Weihe.

Future activities
- “Ore deposits models and exploration” workshop traditionally held in China (January 13-19, 2013 Guangzhou, China) – SGA keynote D. Leach – support 1500 USD
- 4th International Students Conference (April 19-21, 2013 Brno, Czech Republic) – support to SGA student members.
- FUTORES (June 2-5, 2013 Townsville, Australia) - Noel White Symposium on ore deposits to summarize the current understanding and to discuss the future directions in research and exploration (co-sponsored SGA) – D. Huston et al.
- 2nd Short Course on African Metallogeny (June 17-21 Kitwe, Zambia) – S. Roberts et al.
- SGA Short Course „Gold deposits” (September 13-20, 2013 Morosko Au deposit, Czech Republic) – flagship course offered to
industry sponsors of the SGA EF – D. I. Groves, Z. Pertold et al.

Requests for sponsorship
• Session on Gold Deposits at the IMA Meeting (September 1-3, 2014 Johannesburg, South Africa – L. Greyling (asking 1,500 EUR for a keynote speaker). Action: J. Pašava to inform Lynette about approval of her request.

Any other business
Requests for financial support to editors of SGA Special Publications (J. Slack)
Action: Covered in item 10.

SGA insurance (update)
Action: SGA Treasurer’s Office to ask Zurich Insurance Company to send invoices for renewal of insurance to SGA Treasurer’s Office.

SGA award for recognition of special services to the society - update (H. Frimmel)
Action: Covered in item 9.

ICSU grant proposals and IUGS initiative on Resourcing Future Generations
SGA Council discussed the IUGS document and suggested to build on our successful collaboration in the field of geo-educational activities (short courses on metallogeny) in Africa that could be, if desired adapted and offered in other parts of the world according to prioritized needs. Action: D. Huston to inform I. Lambert about SGA attitude towards RFG initiative.

Proceedings of the SGA Biennial Meetings – how they should look like in the future?
Council did not find any reason to change the present format (up to 4 pages abstracts).

Date and Place of the Next Council Meeting
The next SGA Council meeting will be held on Sunday, August 11, 2013 (from 10.00 to 18.00) in the building of the Geological Survey of Sweden in Uppsala (Headoffice, Villavagen 18, Uppsala Rubinsalen).

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

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**FORTHCOMING EVENTS**

* marks a new entry

### 2013

**June 17-21**

**July 3-5**
CORALS-2013 — Conference on Cathodoluminescence and Raman Spectroscopy in Geosciences, Vienna, Austria. Contact: http://www.univie.ac.at/Mineralogie/Coralis2013/index.html

**July 7-12**
17th International Zeolite Conference, Moscow, Russia - Contact: http://www.izc17.com

**July 8-12**
MPE2013 — Mathematics of Planet Earth 2013: The Conference, Melbourne, Australia. Contact: Email: mpe@amsi.org.au; http://www.mope.org.au/events/2013/

**July 10-13**
11th International Congress of Applied Mineralogy, Mianyang, China - Contact: http://www.icam2013.org

**July 20-24**
IACVEI 2013 General Assembly: Forecasting Volcanic Activity, Kagoshima, Japan - Contact: http://www.iacvei2013.com/

**August 12-14**

**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

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**August 25-30**
Goldsmiths 2013, Florence, Italy - Contact: http://goldsmiths.info/2013/program/program-ViewThemes

**September 1-5**

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

**September 2-5**

**September 4-6**
ISPA — Recent advances in signal processing and pattern recognition in geosciences, Trieste, Italy. Contact: Said GACI, Sonatrach, Division Exploration, Boumerdes, Algeria.; Phone: [+213 (0) 696 470 613]; Email: Said_gaci@yahoo.com; http://www.isispa.org

**September 7-13**
30th International Conference on Ore potential of Alkaline, Kimberlite and Carbonatite Magmatism, Hurghada, Egypt. Contact: Prof. Hussein A. Hegazy, Geology Department, Assiut University, Egypt.; Phone: [+2 01227831604]; Email: AlkMag2013@gmail.com; http://www.aun.edu.eg/conferences/alkaline2013/

**September 9-13**

**September 13-20**
Gold Deposits: From Theory to Exploration Practice. Prague and Živohošť, Mokrsko Deposit, Czech Republic. Contact: http://www.gemotion.cz/sgagoldcourse

**September 20-25**
SEG & SEG Canada Foundation Conference, Whistler, Canada. Contact: http://www.seg2013.org/

**September 22-27**
AIG-10 — 10th Applied Isotope Geochemistry Conference, Budapest, Hungary. Contact: Email: congress@aikfrt.hu; http://www.aig10.com

**September 24-27**
GM 2013 — The 3rd International Conference on Crustalogenesis and mineralogy, Novosibirsk, Russia. Contact: http://km.igm.nsc.ru

**October 21-22**
Exploration, Resource & Mining Geology Conference 2013, Cardiff, Wales, United Kingdom. Contact: Sienna Deano, Conference Coordinator; Phone: [+44 3 9658 6120]; Email: conference@ausimm.com.au; http://www.ermg2013.com

**October 21-23**
SFO — Solar System Formation and Observation Conference, Bern, Switzerland. Contact: Email: sfo@space.unibe.ch; http://www.sfo-anibe.ch

**October 24-25**
17th Workshop of Active Tectonic Research Group, Antalya, Turkey. Contact: Email: atag17@akdeniz.edu.tr; http://www.atag17.com

**October 27-30**
Geological Society of America 2013 Annual Meeting, Colorado Convention Center, Denver, Colorado, United States. Contact: http://www.geosociety.org/meetings/2013/

**November 27-29**
International Heavy Minerals Conference 2013, Visakhapatnam, India. Contact: http://www.
Greenland

The Palaeoproterozoic rifting stages of Nuna

Meeting of the International Mineralogical As-

Association, Johannesburg, South Africa - Contact:

http://www.ima2014.co.za

*September 1-6

31st International Conference on Ore potential

of Alkaline, Kimberlite and Carbonatite Mag-

nmatism, Antalya, Turkey. Contact: Email: al-

kaline2014@akdeniz.edu.tr; http://alkaline2014. com/

*September 10-12

Planet Formation and Evolution 2014, Kiel,

Germany. Contact: http://www1.astrophysik.uni-kiel.de/~kiel2014/main/

*September 27-30

Society of Economic Geologists (SEG) 2014

Conference, Building Exploration Capability for

the 21st Century, Keystone, Colorado, USA. Contact: www.seg2014.org

2014

*August 11-14

XII International Platinum Symposium, Ekater-

inburg, Russia. Contact: http://12rpsuran.ru

August 30-September 6

IMA 2014 General Meeting — 21st General

Number 33 June 2013

KEEP YOUR MINERALOGICAL PRACTICE AT THE NOW in a Sustainable World”, Nancy, France - Con-

tact: sga-2015@univ-lorraine.fr

December 15-19

AGU Fall Meeting, San Francisco, CA, USA - Contact: http://www.agu.org/meetings.shtml,

AGU Meetings Department 2000 Florida Ave-

 nue, NW Washington D.C. U.S.A. 20009; Phone: (+1-202-777-7333)

2015

August 24-27

13th SGA Biennial Meeting “Mineral Resources

in a Sustainable World”, Nancy, France - Con-

tact: sga-2015@univ-lorraine.fr

Greenland

In the Archaean of Greenland, the Isua
deposit represents the probably oldest BIF on Earth (ca. 3.8 Ga) that is explored and is likely to be mined in the near future. BIF deposits are also the target in the Melville Bight, where they extend from deposits in the Baffin Bay iron mine district of Canada. A number of small orogenic gold occurrences have also been found (Kolb et al., 2013), and to the north of the capital Nuuk, several ultramafic intrusions are tested as Ni-PGE targets.

The Palaeoproterozoic rifting stage is not well preserved, except for some dyke complexes and the formation of the Black Angel SEDEX deposit, which was subsequently metamorphosed and deformed during basin inversion and continent collision (Thomassen, 1991). Internal and external Palaeoproterozoic ores are generally underexplored, but are tested for ultramafic intrusion hosted Ni-Cu-PGE, VMS and IOCG (Stensgaard et al., 2011), and host the only active mine in Greenland, the Nanuq gold mine, which is an orogenic gold deposit (Bell & Kolb, 2013).

The Palaeoproterozoic assembly of Nuna is followed by a relative tectonic quiescence with rifting and basin development until the Caledonian and Ellesmerian orogens formed in North and East Greenland. Sedimentary basins in these regions host some stratiform Cu and SEDEX occurrences that are currently explored (Harpøth et al., 1986). Rifting predating the Grenvillian orogen has formed some of the rarest rocks on Earth in peralkaline intrusions of the 1350-1140 Ma Gardar Province in South Greenland (Upton et al., 2003). These intrusions host some large REE-Zr-Nb-Ta-U-Th-Zn and cryolite occurrences in the Kvanefjeld, Kringlerne, Kryolit and Motzfeld deposits. Mafic dykes of the Gardar Province host the large Isortoq Fe-Ti-V deposit. The Palaeozoic Franklinian Basin in North Greenland hosts the Citronen SEDEX deposit in the same units as the Polaris mine in Canada (Van der Stijl and Mosher, 1998). Inversion of the basin during the Palaeozoic orogenies led to the formation of MVT-like occurrences in carbonates of the hinterland in northern Greenland. The Caledonian in East Greenland is represented by the foreland fold-and-thrust belt, where exploration is directed towards intrusion-related vein-type, skarn and porphyry deposits (Harpøth et al., 1986). In the following, small continental basins formed mainly in northern and eastern Greenland, which are only weakly endowed.

In particular at the northern margin of the North Atlantic Craton to the north of Nuuk, carbonatites and kimberlites intruded in the following of the Iapetus opening and again after opening of the Atlantic. The Sarfartoq rare metal-U deposit is hosted in one of the older carbonatite intrusions (Secher et al., 2009). The opening of the Atlantic also resulted in extensive flood basalt eruptions and mafic as well as felsic intrusions in central eastern Greenland. Flood basalts are explored for Ni in the Disko Island area north of Nuuk, whereas the mafic layered intrusions comprise the world-famous Skærgeraad intrusion hosting a PGE-Au deposit (Nielsen and Bernstein 2004). Tertiary felsic intrusions host porphyry Mo deposits in Flammeefjeld and Malmbjerg (Harpøth et al., 1986).

Fennoscandian Shield

Mined Archaean BIFs (e.g. Kostomuksha, Bjørnevatn) occur, and a number of small orogenic gold occurrences have been identified. Unlike some other Archaean areas, komatiite-hosted nickel-copper sulphide deposits are rare, and significant volcanogenic massive sulphide deposits are not known from the Archaean supracrustal belts of Fennoscandia.

The Palaeoproterozoic rifting stages of the Archaean continent(s) in northern and eastern Fennoscandia have included the intrusion and extrusion of large volumes of mafic-ultramafic magmas, now seen in abundance associated with occurrences of layered intrusion-, intrusion- and some komatiite-hosted ore deposits. These deposits vary from sulphide-poor Cr, V-Ti-Fe and PGE producing systems to more sulphiderich Ni-Cu-PGE systems. Major metal mineralisation peaks are at 2.44 Ga, 2.05 Ga and 1.98 Ga, where the first event includes the Kemi Cr mine and the last event the famous Pechenga Ni ores. Nickeliferous black schists (Talvivaara), were also formed
Figure 1. Location of major metallic mineral deposits in Fennoscandia, based on Eilu et al. (2013). Geology map from Lahtinen et al. (2005).
Table 1. Metallic mineral deposits in Fennoscandia, data from Eilu et al. (2013).

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Notes: Aktivv = Actively mined; References = References for the data.
Figure 2. Major metallic mines and prospects in Greenland. Geology map from Henriksen et al (2009).
during this epoch, probably between 2.1 and 1.95 Ga. The significant new greenfield discovery of the Sakatti Cu-Ni-PGE deposit in Finnish Lapland shows that northern Fennoscandia is still fertile territory for new discoveries of rift-related deposits. The 2.44 Ga layered intrusions are probably related to a failed rift and thus can be classified as intra-cratonic. Many of the 2.1–1.98 Ga deposits also are intra-cratonic in nature, although they show affinity to asthenosphere-derived mantle melts. The systems related to bimodal alkaline magmatism during craton break-up at ca. 2.05 Ga produced REE-Nb mineralisation. While the age of the very large black shale-hosted Talvivaara Ni-Zn-Co-Cu deposit is not known, it forms a unique deposit class of its own. Sedimentary exhalative or red bed-type Cu, V and VMS-type deposits have been found related to sag and rift phases, respectively. The Outokumpu-type deposits have a VMS-type (Co-Cu-Zn) protore, formed at 1.95 Ga, but were strongly modified during deformation at ca. 1.90 Ga. Some intracratonic U occurrences have been found, but none yet in mineable sizes.

The VMS deposits in Fennoscandia are among the most important Palaeoproterozoic VMS districts in the world. They were formed in intra-arc extensional settings prior to basin inversion and accretion. The arc settings vary from primitive, bimodal arc complexes at 1.92 Ga (Pyhäsalmi) to the 30 million years younger Skellefte district deposits mainly formed in mature arc crust. The VMS deposits in the Bergslagen area, south-central Sweden, are similar in age to the Skellefte deposits but formed in a continental margin back arc setting. In the Bergslagen area, a number of economically important iron ores, mostly carbonate replacement (skarn iron ores), were also formed at this time. The economically important group of Fe-apatite ores (Kiriuna, Grängesberg) formed at this time, too, in two restricted areas in northern and south-central Sweden, respectively. The northern Palaeoproterozoic part of Fennoscandia is also host to porphyry copper (Aitik) and IOCG deposits.

Palaeoproterozoic orogenic gold deposits formed at syn- to post-peak metamorphism. Svecofennian orogenic Ni-Cu deposits are related to mafic-ultramafic rocks intruded during transpressional collisional phases along linear belts at the margins of microcontinents. Late- to post-collisional stages include intrusion of Ti-P rich mafic magmas, pegmatites and carbonatites with minor rare-metal mineralisation. The Palaeo- to Mesoproterozoic transition in Fennoscandia included the intrusion of 1.65–1.47 Ga rapakivi granites, and the Gothian (1.64–1.52) and Teymarikian accretionary events (1.52–1.48 Ga) without the formation of any significant metallic ore deposits. Several minor Cu (Au, Ag) and Co occurrences are known in the pre-Sveconorwegian supracrustals (1.34–1.14 Ga). Similarly, the rocks formed during the Sveconorwegian orogeny (1.14–0.97 Ga) have almost no known mineralisation, except the large volumes of post-collisional anorogenic magmas hosting major Ti deposits (Tellnes) and minor synorogenic Mo deposits. Stratabound Mesoproterozoic U mineralisation occurs in unmetamorphosed Mesoproterozoic sandstone in the Ladoga region, Russia.

In Neoproterozoic to Palaeozoic times, the opening of the Iapetus Ocean (ca. 600 Ma) included the development of an Atlantic-type passive margin. This stage produced stratabound-stratiform VMS Zn-Pb-Cu and sedimentary Fe ores (Rana) followed by deposition of bituminous alum shales, which now host large but low-grade V-U-Mo deposits (Myrviken). Arcs and marginal basins formed either outward of the present Fennoscandia (Baltica plate) or on the Laurentian side of the Iapetus Ocean. Abundant Zn-Cu, Cu-Zn and Fe-Cu VMS deposits, and Cu-Ni-(PGE) deposits related to boninitic intrusions have been found in these arc and marginal basin settings. During initial collision, intrusion-related Ni-Cu deposits and Cu-Zn VMS deposits formed in a transtensional environment. At some time between the early Cambrian (age of host rocks) and mid-Silurian to early Devonian (faulting of mineralised rocks), the formation of a sandstone-hosted Pb deposit (Laisvall) took place.

The final Palaeozoic continent-continent collision occurred during the Scandian orogeny (ca. 430–390 Ma) and produced metamorphic rutile deposits in eclogites (Engbøfjellet). Palaeozoic post-collisional peralkaline to carbonatic rocks are widespread in the NE part of Fennoscandia (especially in Kola), and have a significant potential for Ti and rare metals (Hibiny, Lovozero, Sokli). The last major metallogenic event is the Permian Oslo Rift (300–240 Ma), when porphyry Mo deposits (Nordli) were formed in alkaline to peralkaline granitic rocks. The Ag-rich calcite veins at Kongsberg are also related to this magmatic-hydrothermal event.

### Caledonides

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Concluding remarks

The Fennoscandian Shield is one of the most intensely mineralized Palaeoproterozoic areas in the world. Important ore deposit types include volcanicogenic massive sulphide, orogenic gold, black-shale Ni, layered intrusions, intrusive hosted Cu-Au,apatite-Fe, IOCG, and anorthosite Ti deposits. Currently all these types of deposits are exploited and exploration expenditure has been at an all time high since 2007. Investment in exploration in the Fennoscandian Shield in 2012 will probably be close to 200 million euro. Greenland is still a frontier area concerning mineral exploration and mining, however, present high activity of exploration is promising for the country. One mine is in operation (Nalunaq), two deposits have and exploitation license (Black Angel, Malmbjerg) and feasibility studies are in progress for four deposits.

References


Baltic Student Chapter SGA Annual Meeting 2012

Paulina Kolarz (text) & Tomasz Ćwiertnia (photos)

AGH – University of Science and Technology, Kraków, Poland

In 2012, the annual meeting of the SGA Baltic Student Chapter took place in Luleå, Sweden. The picturesque region in northern Sweden attracted students from Kraków, Poland (Tomasz Kmiecik, Paweł Łydek, Urszula Janicka, Andrzej Lis, Władysław Zygo, Tomasz Ćwiertnia, Paulina Kolarz, Joanna Kołodziejczyk, Marta Sośnicka, Marta Kiedrowska, Adrian Krzemieński), Turku, Finland (Jani Jääsberg, Jenni Nevalainen, Evgeniia Serediiuk) and Sweden & Czech Republic (Lisa Andersson, Sanna Naalisvaara, Astrid Lindgren, Friederike Minz, Nikola Denisova, Kateřina Schloglova). The organizers, Lisa Andersson, Nikola Denisová, Astrid Lindgren and Sanna Naalisvaara, hosted participants at Luleå University of Technology (LTU) and created an unforgettable event.

During the three-day meeting, which was held on 20-22 November 2012, student members of SGA were given the opportunity to learn about the ore deposits of Northern Scandinavia.

The first day was the conference day. Lectures and presentations given by experts and senior lecturers covered a wide range of ore types both in Sweden and worldwide. Professor Pär Weihed (LTU) introduced students to the metallogeny of the Skellefte district and Professor Wolfgang Maier (University of Oulu, Finland) approached the topic of gold, platinum and diamonds in South Africa and Finland. Further lectures were given by Dr. Olof Martinsson (LTU) on the characteristics and origin of iron ores of Kiruna types, and by Dr. Christina Wanhainen (LTU) on the Aitik Cu-Au-Ag deposit. These lectures were an introduction to field trips which were held on the following two days of the meeting.

The field trips took place in Northern Norrbotten County in Sweden. After a long journey, participants crossed the Polar Circle (Fig. 1) and reached the town of Gällivare. The Aitik Cu-Au-Ag mine is located 17 km east of the town and belongs to New Boliden. Ore deposit is thought to be a hybrid between porphyry-copper and IOCG (Iron Oxide Copper Gold ore deposits). The proved mineral reserves are 476 Mt ore with 0.24 % Cu, 0.14 ppm Au, 1.5 ppm Ag and 26 ppm Mo (New Boliden 2013). After processing of the ore material (comminution & flotation), the final concentrate contains an average grade of 27-29 % Cu, 8 ppm Au and 250 ppm Ag (Nordin et al. 2007).

Fig. 1. Participants at the Polar Circle.

Fig. 2. Looking for ore minerals in Aitik open pit mine.
During the visit, participants had the opportunity to see an impressive Aitik open pit, which is 3-km-long, 1.1-km-wide and 450-m-deep and take rock samples with ore minerals there (Fig. 2). What is more, students were introduced to the ore excavating and ore processing, and finally they visited a truck workshop (Fig. 3). The tour was guided by Boliden specialist.

The second excursion day was carried out in the Kiirunavaara mine. It is located in the town of Kiruna in the north of Sweden. The mine is the largest of the AIO (Apatite Iron Ore) type in Sweden and belongs to LKAB. At the early stages, the mine was operated as an open pit, but now it is only an underground excavation on a huge scale. The 6-km-long, up to 200-m-thick ore body is on the contact line between a pile of trachyandesitic lava and pyroclastic rhyodacite, and it extends at least 1500 m below the surface. The iron ore is estimated at 2000 Mt with 60 to 68% Fe (Martinsson & Bergman 2007). The final concentrate as pellets has an average 67% Fe content (LKAB 2013).

During guided tour through the mine, the whole process involved in mine operation were explained and demonstrated: from exploration, extraction and transport, through processing, and the export of the final product to the world. Students were taken to the ore body where they could take rock samples (Fig. 4, Fig. 5). Finally, they visited drill core logging center and received core souvenirs (Fig. 6).

Besides the lectures and field trainings, participants enjoyed a dinner with lecturers and professionals from mining companies. Students from four European countries could exchange their knowledge and experience and have a good time together. Moreover, travelling through Scandinavian countries, they could enjoy the marvelous landscapes and learn about the local culture and traditions. Participants will surely remember the Baltic Student Chapter SGA meeting in Luleå for a long time. They have gained the skills and knowledge which will be their key to success in a geological career.

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Nordin R., Wanhainen Ch., Aaltonen R., 2007, Regional geology of Norrbotten, Sweden, skarn iron ores and the Kiirunavaara apatite Fe-deposit, in: Metallogeny and tectonic evolution of the Northern Fennoscandian Shield: Field trip guidebook, p. 79

Fig. 3. Visiting the truck workshop in Aitik.

Fig. 4. Magnetite ore body in Kiirunavaara mine.
Fig. 5. Participants visiting Kiirunavaara mine.

Fig. 6. Drill core logging center in Kiirunavaara mine.

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News from the Prague Student Chapter - Origin of ore deposits in the Erzgebirge (Krusne hory) Mts., Central Europe

Vit Peresty and David Dolejs

Faculty of Science, Charles University, 128 43 Praha 2, Czech Republic - E-mail: sga.prague@gmail.com

The SGA Student Chapter Prague organized its final excursion for 2012 on November 4-5, with the main focus on the origin of ore deposits in both the Czech and German parts of the Krusne hory/Erzgebirge Mts. The main attraction of the field trip was an underground visit in the historical mines of Ehrenfriedersdorf and Pöhla and at the Zlatý Kopec near Boží Dar (Gotesgab).

The common feature of all localities is a widespread cassiterite mineralization related to the hydrothermal fluid flow from late Variscan biotite to topaz granites (327–312 Ma). The tin deposits are located in the paleooroof of the Krusne hory/Erzgebirge batholith formed by Neoproterozoic and Early Paleozoic supracrustal sequences: phyllites, micaschists, paragneisses, amphibolites, and marbles that were altered and host stratiform or disseminated mineralization. Altered rocks are also intersected by numerous ore-bearing veins. The highest abundances of economic minerals are concentrated in skarns that formed by replacement of dolomites or surrounding metasediments and metavolcanics. Therefore skarns were target of historical mining as well as post-war exploration and became the principal target of our field trip.

We first visited the tin deposit of Ehrenfriedersdorf, where we spent several hours on the second underground level of the mine. The mining activities started about 750 years ago and continued until 1990. The cassiterite mineralization mostly occurs as zonal vein swarms trending E-W and ENE-WSW, with thickness ranging from several mm to a few cm and of metre length. Cassiterite, arsenopyrite, loellingite, wolframite, scheelite and molybdenite are abundant in the quartz veins together with topaz, micas, fluorite, chloride and beryl. Younger greisen-type mineralization is developed along the upper contact of the lithium granite intrusion and attains thickness on the order of 0.1 to 1 m. Fluorite, triplite, cassiterite, arsenopyrite and molybdenite are present in minor amounts. The thickness of skarn bodies with cassiterite and sulphide mineralization ranges from 0.2 to 2 m. As part of our visit at Ehrenfriedersdorf, we were able to examine collection of minerals and mining techniques in the local museum.
On the second day, the excursion continued along the Czech-German border where our next excursion locality, the abandoned mine at Zlatý kopec, was located. This small mining district belonged to one of the richest skarn deposits on the Czech side of the Krusne hory/Erzgebirge Mts. The first mention of mining activities comes from the 16th century, the largest ore production dates back to the 17th century and the mining of Sn, Ag, Cu and, to a lesser extent, of Fe and Zn ores continued with variable success till the 19th century. The diverse mineralization at the Zlatý Kopec site is a result of combination of several ore-forming processes. The most prominent is anomalous elevation of the hidden granite surface, which promoted fracturing in its host rocks. In addition, proximity of the regionally important fault enhanced porosity and allowed increased fluid flow. Finally, dolomites and mafic metavolcanics acted as a chemical barrier, which promoted strong wall-rock alteration and significant ore precipitation. Two main mineralization styles occur at Zlatý Kopec: Sn-W mineralization and Ni-Co-Bi-Ag-U mineralization that are temporarily separated. The most important Sn-W ores were found in skarns (up to 5 % Sn), but also in the tourmalinized phyllites (0.6 % Sn in lenses 30–40 m long and 1.5–9.5 m thick) that are cut by numerous quartz–tourmaline–cassiterite veins with abundant sulphides: arsenopyrite, pyrite, sphalerite, pyrrhotite, chalcopyrite, and locally fluorite.

Despite that the Zlatý Kopec mine is abandoned, it still contains substantial reserves of Sn-ore with estimated grade up to 1 % SnO2. Other metals of recent interest are In or Cd, which mostly occur in sphalerite at levels of 0.1 % and 1 %, respectively. However, all metal-bearing minerals have microscopic scale, and presently the exploitation is not economically and technically feasible.

Our final stop was the Pöhla ore deposit. From the geological viewpoint, the underground mine is particularly interesting because it exposes superposition of several contrasting mineralization styles. The oldest ores are represented by magnetite skarns, which form stratiform or stratabound bodies in the Cambrian and Ordovician volcanosedimentary sequences. During Variscan magmatic events, that is, emplacement of peraluminous highly evolved granites, the Sn-W mineralization formed. It includes magnetite skarn formation in carbonate precursors and precipitation of cassiterite and scheelite. The next mineralization style are uranium-bearing hydrothermal veins of Mesozoic age that are contemporaneous with the famous Czech uranium deposit at Jáchymov (Joachimsthal), from which the name of dollar originates. The youngest hydrothermal process was fracturing and precipitation of low-temperature fluorite-barite veins during Tertiary period.

The mining activities at Pöhla continued for several centuries, however, most metals were extracted after the World War II, when uranium mineralization was discovered. During its exploitation, major magnetite skarn bodies with cassiterite and scheelite mineralization was found. The Pöhla mining district was important for its production of tin, zinc, iron, uranium but also rare metals such as indium or cadmium. The Ag-rich veins were mined as well, however due to their high amounts of As, the mining was inefficient and stopped. The mining activities ceased in 1990 but today, more than 3 kilometers of underground adits are accessible for sightseeing or geological courses. We shall also mention a local curiosity - a large ceremonial hall in one of the large cassiterite-magnetite skarn caverns where weddings, concerts and other cultural events are held.

This excursion provided an interesting and educational opportunity to better understand ore-forming processes in the Krusne hory/Erzgebirge Mountains that are applicable elsewhere as well. It was indeed a very pleasant closing of the chapter activities in 2012 and we would like to thank all our guides for their time and effort to make the mine visits successful.

Late fluorite-barite vein in the Pöhla mine. Photo by Jan Bubal.
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Organisers

Venue

The conference will be held at the Uppsala University main building, located in the centre of the town. Built in the 1880s and hosting a magnificent and spacious foyer and a Grand Auditorium, it is often used for academic ceremonies such as inauguration of full professors and the doctor's degrees ceremonies. The University main building also has many smaller lecture halls of various sizes and it is therefore often used for conventions and conferences. The venue is centrally located in a beautiful area within walking distance to most downtown hotels. The building has free unlimited wireless internet access.

The workshops and short courses will primarily be held at Geocentrum – the Department of Earth Sciences at Uppsala University and at the Geological Survey of Sweden.

The official language of the meeting, workshops and excursions will be English.
Committees

Local organizing committee

Kaj Lax, Geological Survey of Sweden (chairman)
Alireza Malehmir, Uppsala University
Erik Jonsson, Geological Survey of Sweden
Iain Pitcairn, Stockholm University
Karin Högdahl, Uppsala University
Katarina Nilsson, Geological Survey of Sweden
Kjell Billström, Swedish Museum of Natural History
Magnus Ripa, Geological Survey of Sweden
Per Weihed, Uppsala University (student representative)
Pär Weihed, Luleå University of Technology (SGA liaison)
Raimo Lahtinen, Geological Survey of Finland
Rodney Allen, Boliden Mineral AB
Ragnvald Boyd, Geological Survey of Norway

Scientific committee

Erik Jonsson, Geological Survey of Sweden (chairman)
Axel Müller, Geological Survey of Norway
Christopher Juhlin, Uppsala University
Gilles Bellefleur, Geological Survey of Canada
Henrik Stendal, Bureau of Minerals and Petroleum Greenland
Holly Stein, Colorado State University
Iain Pitcairn, Stockholm University
Jan Pašava, Czech Geological Survey (SGA liaison)
Jochen Kolb, Geological Survey of Denmark and Greenland
Kirsti Loukola-Ruskeeniemi, Geological Survey of Finland
Pasi Eilu, Geological Survey of Finland
Raimo Lahtinen, Geological Survey of Finland
Rodney Allen, Boliden Mineral AB
Thomas Wagner, University of Helsinki
Wolfgang Maier, Oulu University
Scientific Program

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Pre-conference excursions</td>
<td>Plenary session</td>
<td>Plenary session</td>
<td>Scientific sessions</td>
<td>Scientific sessions</td>
<td>Post-conference excursions</td>
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<tr>
<td>Lunch</td>
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<td>Afternoon</td>
<td>Scientific sessions</td>
<td>Scientific sessions</td>
<td>Scientific sessions</td>
<td>Scientific sessions</td>
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<tr>
<td>Evening</td>
<td>Aug 11 Ice breaker</td>
<td></td>
<td></td>
<td>Conference Dinner</td>
<td></td>
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</tr>
</tbody>
</table>

Scientific Sessions

S1 Present and future of metals and minerals
S1.1 New metal needs and new deposit types
S1.2 Sustainability in mining and exploration: the role of geosciences.

S2 Methods and advances in mineral deposit studies
S2.1 3D modelling of ore deposits,
S2.2 New advances in geophysical mineral exploration.
S2.3 New analytical methods and applications in mineral deposit studies.
S2.4 Advances in mineral chemistry of Fe oxides: ore-forming processes and implications for exploration.
S2.5 Ore mineralogy and geometallurgy.
S2.6 New advances in geochemical exploration.
S2.7 Predictive modelling.

S3 Ore forming processes and deposit types
S3.1 Volcanic-hosted base and precious metal deposits.
S3.2 Sediment-hosted deposits.
S3.4 Magmatic and hydrothermal hypogene and supernogene iron ores.
S3.5 Porphyry systems and epithermal deposits.
S3.6 Ore deposits associated with mafic and ultramafic rocks.
S3.7 Orogenic gold deposits.
S3.8 Hydrothermal ore-forming processes.
S3.9 New developments in the understanding of IOCG deposits.
S3.10 Metallogenesis of collisional orogens in the tethyside domain.
S3.11 Metallogeny in the Urals.
S3.12 Skarn deposits – 138 years after Törnebohm.
S3.13 Uranium and thorium deposits.

S4 Fennoscandian mineral deposits
S4.1 Metallogeny of Fennoscandia: The Shield, the Caledonides and the Oslo rift.

S5 High-tech elements – deposits and processes
S5.1 High-tech elements – deposits and processes

S6 Industrial minerals
S6.1 Industrial minerals.
S6.2 Construction materials.

S7 Open session
Excursions

**Finland and Russia**
FINRUS Ni-Cr_PGE deposits of Finnish Lapland and the Kola peninsula, pre-conference, Aug 5-11

FIN1 Orogenic gold excursion, Finland, post-conference, Aug 16-19
Deadline for registration and cancellation: May 31, 2013.

FIN2 Proterozoic base metal deposits along the Archean-Proterozoic boundary in central Finland, pre-conference, Aug 6-9
Deadline for registration and cancellation: March 15, 2013.
Registration closed. Excursion cancelled due to too few participants.

RUS Gold deposits of the Russian North East, pre-conference
Information and registration through Nikolay Goryachev, e-mail: goryachev@neisri.ru

**Greenland**
GRE South Greenland excursion, post-conference, Aug 16-24

**Norway**
NOR1 Metallogeny in the Oslo Rift and adjoining shield areas, pre-conference, Aug 8-11
Deadline for registration and cancellation: April 1, 2013
Registration closed. Excursion cancelled due to too few participants.

NOR2 Fe-Ti and Fe-Ti-V-P deposits in the Rogaland Anorthosite Province, S. Norway, post-conference, Aug 16-19
Deadline for registration and cancellation: April 1, 2013
Registration closed. Excursion cancelled due to too few participants.

NOR3 Copper and gold-copper mineralizations in N. Norway, pre-conference, Aug 8-11
Deadline for registration and cancellation: April 1, 2013
Registration closed. Excursion cancelled due to too few participants.

**Sweden**

SWE2 The gold line and deposits in the Skellefte district, pre-conference, Aug 7-9
Deadline for registration and cancellation: June 7, 2013

SWE3 Norra Kärre REE-Zr project and the birthplace of the light REEs, pre-conference, Aug 10-11
Deadline for registration and cancellation: June 7, 2013

SWE4 Bergslagen, post-conference, Aug 16-21
Deadline for registration and cancellation: May 24, 2013. Registration closed.

SWE5 IOCG and related deposits in northern Fennoscandia, post-conference, Aug 16-20

SWE6 One day excursion to the historic Sala Ag deposit, post-conference, Aug 16
Deadline for registration and cancellation: June 7, 2013

SWE7 One day excursion to the island of Utö, post-conference, Aug 16
Deadline for registration and cancellation: June 7, 2013

SWE8 City walks to see ornamental and building stones in Uppsala Cathedral, (Once a day, Aug 12-15)
Registration will take place on-site, August 12-15, 2013
Workshops and Short Courses

A number of workshops and short courses will be arranged in association with the SGA 2013 meeting in Uppsala. More detailed information will be provided on the conference webpage. Those interested in offering short courses or workshops, please contact the local organizing committee at: sga2013@sgu.se.

New proposals will be considered until December 7th, 2012.

Workshops

W1: 3D/4D Modelling of Mineral Deposits. Dr. Nigel Phillips & Dr. Gervais Perron, Mira Geoscience.
W2: Applied Structural Geology in Exploration and Mining. Dr. Chris Bonson, Dr. Ivo Vos and Paul Stenhouse, SRK Consulting.
W3: BIF-hosted iron ore systems: Genesis and exploration models. Prof. Steffen Hagemann, Thomas Angerer, Paul Duuring, Centre for Exploration Targeting-University of Western Australia. Prof. Lobado, Prof. Figueiredo e Silva, Prof. Rosiere Universidade Federal Minas Gerais at Belo Horizonte, Brazil.
W4: Archaean-Proterozoic basic and ultrabasic magmatism of the Karelian and Kola cratons. To be held pre-exursion in Oulu, Finland. Prof. Eero Hanski, Prof. Wolfgang Maier, Oulu University, Finland.

Short Courses

S2: Fluids, minerals and melts: Investigating hydrothermal processes using laser ablation-ICP-MS techniques. Dr. Brian Rusk, Western Washington University, USA.

Cancellations and Refunds

Cancelling Registration

Notification of cancellation must be made in writing and sent to Akademikonferens, the conference secretariat. Cancellation of registration will be accepted until May 31, 2013, up to which date the total amount will be refunded minus SEK 750 for cancellation fee. We regret that no refunds or reductions of fees will be accepted for cancellations made after the registration deadline date, nor for no-shows for any reasons.

Cancelled event by the organizers

If your chosen workshop or short course should be cancelled by the organizers, due to too few participants or by other reason, your full fee will be returned. The cancellation will be announced as soon as possible after the registration deadline (May 31, 2013).

Accommodation

Please make your hotel reservation by filling in your request on the registration form. Hotel rates and room availability can only be guaranteed if your booking is made by June 27, 2013. The hotel rooms will be confirmed on a first come – first served basis.

Credit Card Guarantee

In order to guarantee accommodation you need to state your credit card details on the registration form. The information will only be used in case of no-show or late cancellation. Please read “Cancellation and Refunds” on the Registration page.

Payment Options

Accommodation must be paid directly to the hotel during your stay. You will be able to pay by credit card or by cash.

Changes to your Reservation

If you need to change your reservation, please contact the conference secretariat at e-mail: sga2013@akademikonferens.uu.se

• See map of Uppsala

Note: In Sweden, all public facilities are by default non-smoking, including hotels. There is usually only smoking allowed outside the entrance. Our selected hotels below, are all non-smoking.
## Accommodations in Uppsala

<table>
<thead>
<tr>
<th>Hotel Name</th>
<th>Website</th>
<th>Location</th>
<th>Non-smoking</th>
<th>Free Internet</th>
<th>Single Room</th>
<th>Double Room</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Best Western Hotel Svava</strong></td>
<td><a href="#">website</a></td>
<td>In the city centre, across the street from the Uppsala Travel centre. Non-smoking. Free internet.</td>
<td><strong>Single</strong> room SEK 1220</td>
<td>Double room SEK 1500</td>
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<tr>
<td><strong>Clarion Hotel Gillet</strong></td>
<td><a href="#">website</a></td>
<td>Located 5 minutes walk from the Uppsala Travel centre. Non-smoking. Internet available.</td>
<td>Single room SEK 1195</td>
<td>Double room 1445</td>
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<tr>
<td><strong>Profilhotell Hotel Uppsala</strong></td>
<td><a href="#">website</a></td>
<td>Located in the city centre, 5 minutes walk from the Uppsala Travel centre. Non-smoking. Free internet.</td>
<td>Single room SEK 1350</td>
<td>Double room SEK 1550 (Fri-Sat SEK 669 resp 869)</td>
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<tr>
<td><strong>Scandic Hotel Uplandia</strong></td>
<td><a href="#">website</a></td>
<td>Located in the city centre, 5 minutes walk from the Uppsala Travel centre. Non-smoking. Free internet.</td>
<td>Single standard SEK 1450</td>
<td>Single superior SEK 1550</td>
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<tr>
<td><strong>Akademihotellet</strong></td>
<td><a href="#">website</a></td>
<td>Located by the Uppsala University Main Building, 15 minutes walk from the Uppsala Travel centre. Non-smoking. Free internet. The front desk has restricted opening hours.</td>
<td>Single room SEK 1020</td>
<td>Double room SEK 1280</td>
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<tr>
<td><strong>Hotell Charlotte</strong></td>
<td><a href="#">website</a></td>
<td>Located 20 minutes walk from the Uppsala Travel centre. Non-smoking. The front desk has restricted opening hours. Free internet in most rooms.</td>
<td>Single room SEK 1110</td>
<td>Double room SEK 1370</td>
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<tr>
<td><strong>Hotel and Hostel Centralstation</strong></td>
<td><a href="#">website</a></td>
<td>Located across the street from Uppsala Travel centre. Non-smoking. Free wireless Internet. Front desk is open around the clock. Hostel rooms only have window towards corridor and shared bathroom. Some hotel rooms might have windows to corridor, not towards the street. These prices all include breakfast, bed linen and cleaning.</td>
<td>Single hotel room SEK 749</td>
<td>Single hostel room SEK 500</td>
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If you wish to find less expensive accommodation, we recommend you to contact:

- Fyrishov Cabins & Camping, phone: +46 18 727 46 60, stugby@fyrishov.se
- Bed & Breakfast Agency Uppsala, phone: +46 18 42 10 30, bb.018421030@telia.com
- Citystay, phone +46 18 121 000, booking@citystayuppsala.se
Students

The future and development of economic geology depends on the involvement of graduate and postgraduate students. Therefore, students within a broad field of ore deposits research are invited and encouraged to submit abstracts and present their results at the 12th SGA biennial meeting in Uppsala. The meeting offers a great opportunity for students to interact with leading scientists, other young researchers and the industry in an inspired and informal environment. Attractive benefits are being offered to students to encourage their participation in SGA2013 including:

Reduced registration fees
The registration fee for all students is at a reduced level, with SGA student members paying the lowest registration fee.

Student grants
To support participation of students at the conference, a limited number of grants are open for students who are senior authors of accepted abstracts. For these grants, SGA student members are prioritised. The student grants will be awarded upon the acceptance of an abstract for oral or poster presentation at the conference, and will be based on the financial need and scientific relevance of the submitted contribution. An application form for student financial support will be available on http://www-conference.slu.se/sga2013/students.

Free excursions
Several pre- and post-meeting excursions to Nordic countries and Russia are being organized. For students, a limited number of free registrations will be offered (only one per trip). An application form will be available on the conference website. The Greenland and North-east Russia excursions are excluded.

Student awards
The best student oral and poster presentation will be awarded a certificate and a prize of 300 USD.

Social evening ‘Student & Industry’
All registered students are also invited to a social event organized by the industry to discuss future projects, employment opportunities or just to mingle with a range of different types and sizes of mining and mineral exploration companies, active in the Nordic countries and elsewhere. For further information about this event, please contact Rodney Allen: rodney.allen@boliden.com.

Do not hesitate to contact the Student Committee members if you have any questions, comments or suggestions.

The SGA Student Committee
Anna Vymazalová
anna.vymazalova@geology.cz
Jorge Relvas
jrelvas@fc.ul.pt

Student SGA2013 Local Organizing Committee
Peter Hedin peter.hedin@geo.uu.se
Karin Högdahl karin.hogdahl@geo.uu.se

The Hall of State at Uppsala Castle, prepared for a dinner hosted by SGU. Photo: Carl-Erik Alnavik
Social Program

Conference Banquet at Uppsala Castle

The Uppsala Castle dates back to the 16th century and is the site of numerous historical events. Today, the castle houses the art collection of Uppsala city and Uppsala University and a museum on peace. It is also the residence of the county governor. The conference banquet will include a three-course dinner in the magnificent Hall of State, where Queen Christina of Sweden abdicated her throne in June of 1654.

Location

The castle is located centrally: an easy 15–20 minute walk from several downtown hotels, and a 10–15 minute walk from the conference venue, also facing the beautiful botanical gardens.

Destination Uppsala

Uppsala’s profile as a city of learning, with close proximity to Stockholm and Stockholm-Arlanda Airport and a wide variety of modern and historical experiences that only the Uppland region can offer, lays the foundation for a winning concept for both national and international meetings.

A town with two universities

Uppsala is the fourth largest city in Sweden, with a steadily increasing population of around 200,000. The city retains the charm of a small town while offering major urban opportunities and attractions. Here are two universities, the Swedish University of Agricultural Science and Uppsala University, founded in 1477. Uppsala is considered to be the religious and historic centre of Sweden.

People

The city has a solid base of knowledge and tradition from which to progress. At the same time, the atmosphere is youthful, and more than 40,000 university students are a significant factor to this vivacity. Uppsala also hosts Sweden’s oldest botanical gardens, the Garden of Linnaeus, founded by the great natural scientist himself. Carl Linnaeus’ professorial residence is situated in the garden. Just outside of the city you can visit his summer residence, Linnaeus’ Hammarby.

Sightseeing

Uppsala boasts the largest cathedral in Scandinavia, one of Sweden’s most famous locations of prehistoric artifacts (Old Uppsala), a unique anatomical theatre built in the 1600’s by Olof Rudbeck the Elder, the great university library (Carolina Rediviva) with the Silver Bible, Uppsala Castle dating back from the mid-1500’s, and many more marvellous sites and attractions. The city’s geographical location, only 20 minutes from Stockholm- Arlanda airport and 45 minutes from Stockholm, the capital, has made Uppsala an attractive place for meetings and to establish new companies.

Getting to and around Uppsala

Transport

Uppsala has a well functioning public transportation system and taxis are also available at the Central Station. Sweden has a highly efficient rail network spanning the entire country. For those traveling by car, Sweden offers a well-maintained network of roads and motorways which makes Uppsala easy to access by car. Delegates will also have the possibility to travel to Stockholm by boat. Ferries regularly connect Stockholm to Finland, Estonia, Latvia and Poland. Trains from Stockholm Central Station to Uppsala Central Station depart at least twice an hour from 6 am to 11 pm and the journey takes 40 minutes. Stockholm-Arlanda International Airport is situated between Uppsala and Stockholm. The airport offers 170 destinations worldwide and 70 airlines. Easy access buses and trains run frequently directly from the airport to Uppsala city centre and the trip takes 20–45 minutes. You can go by taxi straight from the airport to your hotel in Uppsala for approximately 55 €, if the price is agreed on beforehand (if not, the price may turn out much more expensive).

Currency

The Swedish monetary unit is the Swedish krona (SEK), divided into 100 öre. Exchange rates in October 2012: Euro 1=SEK 9 USD 1=SEK 7 GBP 1=SEK 11. Major credit cards are accepted almost everywhere. There are several currency exchange
offices and cash dispensers at Stockholm Arlanda International Airport and in Uppsala. Exchange rates may vary. To see current exchange rates, please visit oanda.com or x-rates.com.

**Accommodation**
There are several hotels and hostels within walking-distance from the conference centre. For more information, please see pages XXX and visit the conference webpage.

**Lunches**
There will be an option to pre-purchase lunch at registration. However, there are several restaurants in downtown Uppsala. Prices vary between c. 10 and 15 €. Going downtown, eat lunch and walk back will take approximately 1 hour.

**Security**
Uppsala is a peaceful city and the only risk to consider is pickpockets – always keep an eye on your belongings. The same goes for Stockholm, where there are more tourists and therefore also more pickpockets.

**Weather**
At the time of the conference the weather in Uppsala is either sunny or rainy, due to thunderstorms. Temperatures vary from c. 15 to 25 °C and it might be windy.
Important information

Registration

<table>
<thead>
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<th>Registration fees</th>
<th>By May 31 at the latest</th>
<th>After May 31</th>
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<tbody>
<tr>
<td>SGA member</td>
<td>SEK 4300</td>
<td>SEK 5000</td>
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<td>Student, SGA member</td>
<td>SEK 2000</td>
<td>SEK 2500</td>
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<td>Non-member</td>
<td>SEK 5300</td>
<td>SEK 6300</td>
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<td>SEK 2500</td>
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<tr>
<td>Accompanying person</td>
<td>SEK 1000</td>
<td>SEK 1500</td>
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Registration fees include:
- Access to all technical and plenary sessions.
- Morning and afternoon refreshments.
- Ice breaker party.
- All meeting materials including the final programme and conference abstract volume in digital format.

Lunch is not included in the registration fee, but during registration lunch can be purchased for an additional fee of c. 580 SEK. A printed copy of the proceedings can be ordered in conjunction with registration for an additional fee.

Exhibits

Limited space is available for exhibits at the conference venue. Please contact the local organizing committee (sga2013@sgu.se) for more information regarding reservation and prices.

Sponsorship

Sponsorship is available in different categories – please contact the local organizing committee for a detailed offer (sga2013@sgu.se).

Please note

Only abstracts by authors who have paid their registration fee (limit two papers per first author) by May 31st will be included in the conference program and abstract volume.

Important dates

- June 3: Deadline for early bird registration
- May 24: Detailed schedule posted
- Feb 22: Abstract submission is closed
- Jan 11, 2013: Info about sessions updated
- Jan 7, 2013: Registration is open
- Nov 8, 2012: Please click here for 2nd circular

For more information and registration: www.akademikonferens.uu.se/sga2013
50\textsuperscript{th} SGA Anniversary meeting
Welcome back to the roots of SGA

13\textsuperscript{th} SGA Biennial Meeting

Nancy, France, August 24-27, 2015
Mineral Resources in a Sustainable World

sga-2015@univ-lorraine.fr