Society for Geology Applied to Mineral Deposits

8th Biennial SGA Meeting
August 18-21, 2005
Beijing, China

第八届国际矿床地质会议 北京

主题 矿床研究——应对全球挑战

Mineral Deposit Research: Meeting the Global Challenge

Second Circular

8th SGA BIENNIAL MEETING

Beijing, August 18-21, 2005

Mineral Deposit Research: Meeting the Global Challenge

August 12 – 17	**Pre-Meeting Field Trips**
August 16 – 17	**Short Courses and Workshops**
August 18 – 21	**Thematic and Poster Sessions**
August 22 – 31	**Post-Meeting Field Trips**

The Meeting is co-sponsored by following institutions:

China University of Geosciences (Beijing)
Institute of Mineral Resources, Chinese Academy of Geological Sciences
National Natural Science Foundation of China
China Society of Geology
Society of Resource Geology
Society of Economic Geologists
International Association on the Genesis of Ore Deposits
Institute of Geology and Geophysics, CAS
Institute of Geochemistry, CAS
State Key Lab for Mineral Deposit Research (Nanjing University)

For the most current updates, visit our web site: www.sga2005.com

Contents

SOCIAL PROGRAM

EXHIBITION

Registration Form

Appendixes

MESSAGES FROM THE ORGANIZING COMMITTEE

Message from the President and Secretary General

The Chinese economy is rapidly growing which is reflected in the expanding Chinese and global markets for minerals. The future mineral resource need of the global community depends on the discovery of new and unconventional resources that must be linked to ore deposit research. This meeting provides an exceptional opportunity to participate in technical presentations, workshops, and field trips organized by university, industry, and government geologists dedicated to the study of ore deposits.

Beijing provides an exciting venue for the conference. Modern tourist facilities, interesting cultural attractions, and unique historical sites provide a background for the conference. Considering the tremendous progress in research and exploration of Chinese mineral deposits along with the remarkable economic growth during the last twenty years, the 8th SGA Biennial Meeting in Beijing provides opportunities for exchanging new ideas on research, exploration and mine development. Numerous field trips will be offered to some of the world's largest ore deposits. We warmly invite you to make plans to participate in the 8th Biennial SGA Meeting in Beijing.

Yuchuan Chen
President

Jingwen Mao
Secretary General

Organizing Committee of the 8th Biennial SGA Meeting

Message from the SGA President

The 2005 Biennial SGA Meeting in Beijing marks a major milestone for SGA as it will be our first Biennial Meeting outside of Europe. The Beijing venue reflects SGA's commitment to our growing international membership and to the global community of ore deposit geologists. The conference brings together academic and government researchers with industry geologists from around the world to integrate results from mineral resource exploration and ore deposit research.

Beijing is an ideal venue to focus on the global challenges to find new mineral resources. China's impressive economic growth is accelerating the need for new mineral resources and highlights the need for new insights into why and where ore deposits form in the Earth's crust. Beijing provides an excellent departure point for stimulating field trips to important ore deposits in the region. The conference benefits from several IAGOD and SEG-organized technical sessions and field trips. An exciting social and guest program will provide additional highlights to the conference.

SGA and the Beijing Organizing Committee are working to make the conference accessible to students and economically disadvantaged professionals. We have a committee that is focused on student needs for the conference. We thank Doug Kirwin of Ivanhoe Mines for organizing corporate sponsorships for students and professionals in need of travel assistance. On behalf of SGA, I encourage you to join us in Beijing in 2005 for this exceptional conference.

David Leach
SGA President

Message from the CUGB President

I am very pleased that China University of Geosciences (Beijing) (CUGB) is honored to be the venue of the 8th Biennial SGA Meeting. On behalf of CUGB, I sincerely welcome all participants from all over the world to our university. CUGB is a comprehensive university offering educational opportunities in many areas with geology, resources, environment, and geological engineering technology as the main educational and research activities which are coordinated with various science disciplines, engineering, liberal arts, management, economics and law. During the past fifty years, more than 80,000 scientific graduates were educated by CUGB, including many academic masters and political figures. This meeting will also provide a great opportunity for the scientists of CUGB to exchange their latest research results on geosciences with the colleagues over the world.

Ganguo Wu
President of China University of Geosciences (Beijing)

I promise to provide everything possible for the meeting and trust that the 8th SGA Biennial meeting will be successful and fruitful.

GENERAL INFORMATION

PLACE, DATE AND THEME

The 8th Biennial SGA Meeting will be held in Beijing, August 18-21, 2005 in the Academic Exchange Center of the China University of Geosciences, 29 Xueyuan Road, 100083

The Meeting Theme is

Mineral Deposit Research: Meeting the Global Challenge

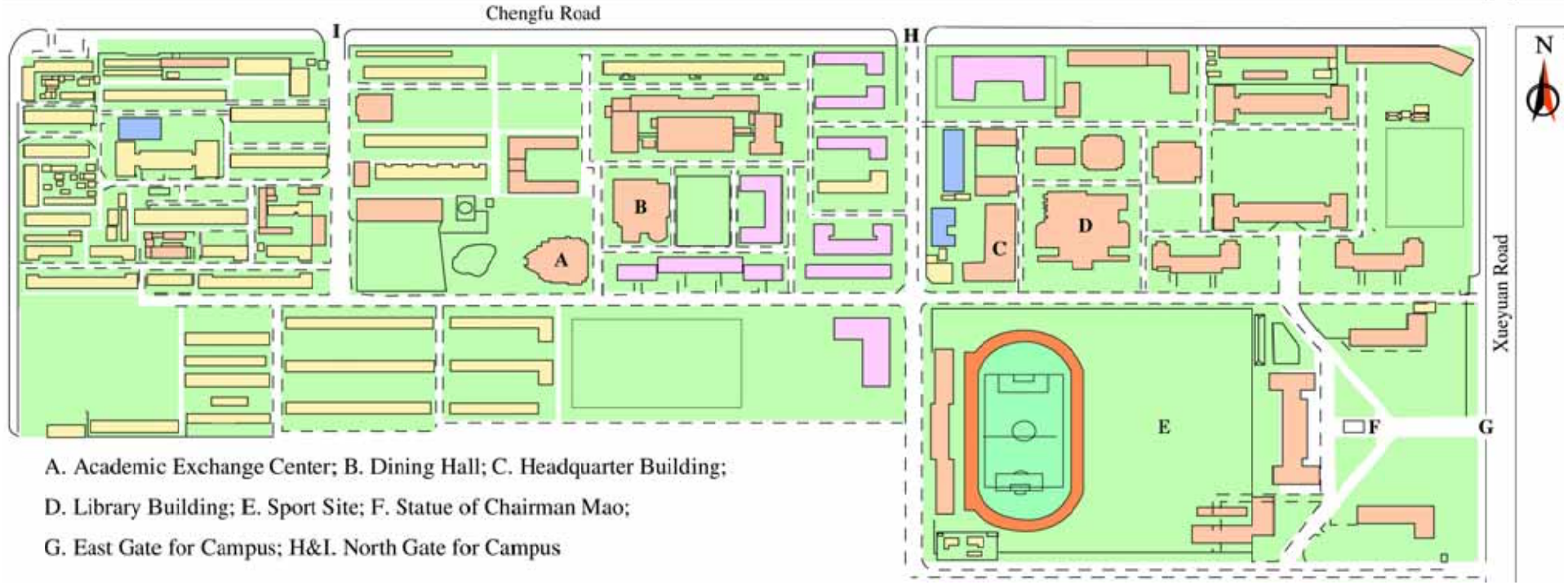
August 12 – 17	Pre-Meeting Field Trips
August 15– 17	Short Courses and Workshops
August 18 – 21	Thematic and Poster Sessions
August 22 – 31	Post-Meeting Field Trips

矿床研究 —— 应对全球挑战

Academic Exchange Center of the China University of Geosciences

How to get to the China University of Geosciences

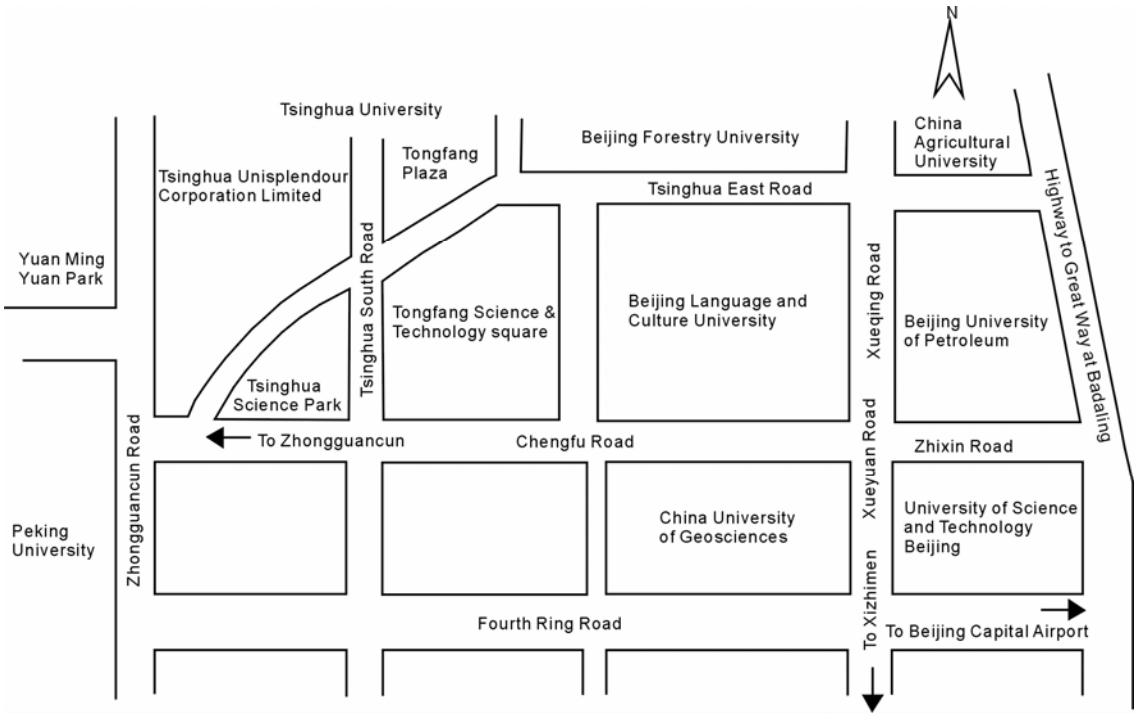
Plan of China University of Geosciences



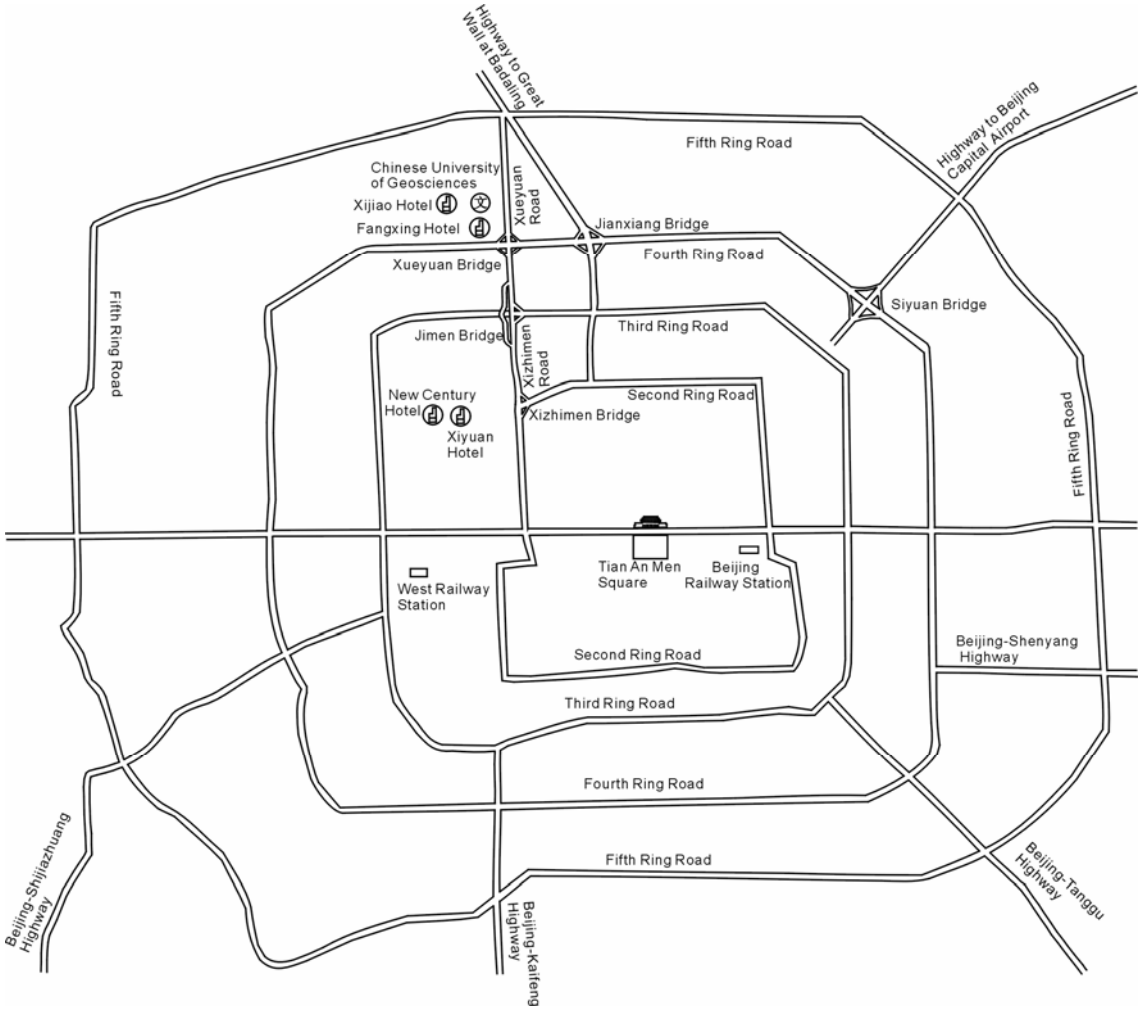
A. Academic Exchange Center; B. Dining Hall; C. Headquarter Building;

D. Library Building; E. Sport Site; F. Statue of Chairman Mao;

G. East Gate for Campus; H&I. North Gate for Campus



Map of the area near the China University of Geosciences



Map of Beijing

Organizing Committee

Honorary Chairmen

Jiahua Shou, Xianlai Meng, Guangchi Tu

Chairman

Yuchuan Chen

Vice Chairmen

Ganguo Wu, Hongtao Zhang, Yucheng Chai, Jingwen Mao

Members

Nigel Cook (Oslo), Richard Goldfarb (Denver), David Groves (Perth), Craig J.R. Hart (White Horse), Peter Herzig (Kiel), Brian Hoal (Littleton), Jun Deng (Beijing), Zengqian Hou (Beijing), Ruizhong Hu (Guiyang), Renmin Hua (Nanjing), David Leach (Denver), Zhijian Li (Beijing), Ziying Li (Beijing), Dunyi Liu (Beijing), Fengjun Nie (Beijing), Jan Pasava (Praha), Rongfu Pei (Beijing), Qiming Peng (Beijing), Reimar Seltmann (London), Masaaki Shimizu (Toyama), Jingbin Wang (Beijing), Mili Wang (Beijing), Yupeng Yao (Beijing), Mingguo Zai (Beijing), Yusheng Zai (Beijing), Mianping Zheng (Beijing), Meifu Zhou (Hongkong)

Secretary General

Jingwen Mao (jingwenmao@263.net)

Secretary Group

Kelin Zhao (mail@sga2005.com)

Caisheng Zhao(mail@sga2005.com)

Dahu Meng (mengdh@cugb.edu.cn)

Treasurer

Lijie Wang (wlj@cugb.edu.cn)

SGA Technical Liaison

Bernd Lehmann (lehmann@min.tu-clausthal.de)

Program Committee

David Groves (dgroves@geol.uwa.edu.au)

Craig J.R. Hart (craig.hart@gov.yk.ca)

Jingwen Mao (jingwenmao@263.net)

Meifu Zhou (mfzhou@hku.hk)

Field Trip Chairmen

Richard Goldfarb (goldfarb@usgs.gov)

Yitian Wang (wyt69@263.net)

Masaaki Shimizu (mshimizu@sci.toyama-u.ac.jp)

Short Courses

Fengjun Nie (nfjj@mx.cei.gov.cn)

Timothy Baker (tbaker@jcu.edu.au)

Exhibition Manager

Haiming Xu (mail@sga2005.com)

SGA Promotion Manager

Gregor Borg (gregor.borg@geo.uni-halle.de)

Student Representatives

Jorge Relvas (jorge.relvas@fc.ul.pt)

Hongcai Fei (feihongcai@sohu.com)
Ana Vymazalova (anvym@cgu.cz)

Corporate Representative

Doug Kirwin (doug@ivanhoemines.com)

Publications

Jingwen Mao (jingwenmao@263.net)
Frank Bierlein (frank.bierlein@sci.monash.edu.au)

Spouse and Guest Activities

Susan Leach (Susanleach@aol.com)
Hongyan Li (hyli@public3.bta.net.cn)
Yulan An (yulan2005@hotmail.com)

Meeting Language

English

Deadlines

January 31, 2005 - submission of extended abstracts, early registration for field trips and application for student grants
February 28, 2005 - notification of abstracts acceptance
March 15, 2005 - final submission of abstracts and notification of student grants
April 30, 2005 - payment of early registration, short courses and field trips fees

Insurance

The Organizing Committee will not be liable for any personal accidents or illness of the meeting participants. Attendees are responsible for personal insurance coverage.

Venue and Climate

The Meeting will be held in the China University of Geosciences (Beijing).
29, Xueyuan Road, Haidian District, Beijing 100083, China. The weather during the conference should be pleasant with temperature around 30℃.

Registration fee

	By 2005-4-30	After 2005-4-30
Members of SGA/SEG/IAGOD/GSG	300US$	400US$
Non-Members	350US$	450US$
Student Members	100US$	150US$
Student Non-Members	200US$	250US$
Accompanying guests	50US$	100US$

Icebreaker Party

All registered participants are invited to attend the Icebreaker Party, held in the Canteen

close to the Academic Exchange Center, beginning at 6 PM, Aug. 17.

Hotel Accommodation

1. Beijing New Century Hotel, 5 star

Deluxe Room	90US$
Business Room	100US$
Executive Room	130US$
Deluxe Suite	150US$

Room includes breakfast
2 bottles of mineral water are provided each day/room free of charge
Guests in Business and Executive Room enjoy free ADSL internet service
Fitness, swimming and Sauna services are free for guests

2. Xiyuan Hotel, 5 star

Standard Room(B)	60US$
Standard Room(A)	65US$
Deluxe Room	75US$

Breakfast to be paid separately,
Western breakfast: 8US$
Chinese breakfast: 5US$ per person

3. Xijiao Hotel, 3 star

Single Room	40US$
Apartment Room	45US$
Double Room	35US$
Standard Room	50US$
Deluxe Room	80US$

Room bills include Chinese breakfast
Guests enjoy free ADSL internet service

4. Fangxing Hotel

Standard Room (A)	30US$
Standard Room (B)	40US$

Room bills include breakfast
Guests enjoy free ADSL internet service

5. Student dormitory (for students only)

Single Room	10US$ (One bed)
Double Room	16US$ (Two beds)

Payments

All payments should be made in USD by bank transfer or internationally accepted credit cards at the Organizing Committee bank account. Chinese participants can pay in RMB by bank transfer at the Organizing Committee bank account given in website www.sga2005.com

1. **USD ACCOUNT**
   Bank transfer to: Xueyuan Road (or College Road) Branch, Agricultural Bank of China
   Address of the bank: China University of Geosciences, Xueyuanlu 29, Beijing 100083
   Account no. 11-2505140000173
   Swift: ABOCCNBJ010
   Chips UID: 372731
   Currency: US$

2. **Type of Credit card** ..... (VISA, MasterCard, American Express)
   Name on card .....
   Number .....
   Exp. Date .....
   Total USD .....
   Date: ..... **Signature:** .....

3. **人民币账号**

   收款人:中国地质科学院 矿产资源研究所

   账号：0200001409008818567

   开户行：北京工商银行百万庄支行

Contacts

Dr. Jingwen Mao
Institute of Mineral Resources
Chinese Academy of Geological Sciences
26 Baiwanzhuang Rd., Beijing 100037, China
Tel: +86 10 68327333 Fax: +86 10 68336358
E-mail: mail@sga2005.com

SCIENTIFIC PROGRAM

Thematic Sessions

1. Tectonics, lithospheric, and deep mantle controls on global metallogenic provinces and giant ore deposits
   Co-chairs:
   David Groves (dgroves@sunny.segs.edu.au)
   Rongfu Pei (peirf@sohu.com)
   Jon Hronsky (jon.hronsky@wmc.com.au)
   Meifu Zhou (mfzhou@hku.hk)
2. Basin evolution: base and precious metal mineralization in sediments
   Co-chairs:
   Jan Pasava (pasava@cgu.cz)
   Poul Emsbo (pemsbo@usgs.gov)
   Xiaoming Sun (eessm@zsu.edu.gov)
   Raymond Coveney (CoveneyR@umkc.edu)
3. Uranium deposits: metallogeny and exploration
   Co-chairs:
   Zhiying Li (zyli@public.bta.net.cn)
   Maurice Pagel (pagel@geol.u-psud.fr)
   Bohdan Kribek (kribek@cgu.cz)
   Ruizhong Hu (huruizhong@vip.163.com)
4. Magmas and base-metal ore deposits
   Co-chairs:
   David Cooke (d.cooke@utas.edu.au)
   Renmin Hua (huarenmin@nju.edu.cn)
5. Epigenetic gold systems
   Co-chairs:
   Frank Bierlein (frank.bierlein@sci.monash.edu.au)
   Fengjun Nie (nfjj@mx.cei.gov.cn)
   Yasushi Watanabe (y-watanabe@aist.go.jp)
   Yanshao Chen (ychen@barrick.com)
   Albert Hofstra (ahofstra@usgs.gov)
6. Submarine ore systems and ancient analogues: Global comparisons of VMS (IGCP 502)
   Co-chairs:
   Steven Scott (scottsd@circon.geology.utoronto.ca)
   Rodney Allen (rodallen@algonet.se)
   Lianxing Gu (lxgu@nju.edu.cn)
   Fernando Tornos (ftaitge@iponet.es)
7. Understanding ore systems though precise geochronology, isotope tracing and microgeochemistry
   Co-chairs:
   Holly Stein (hstein@cnr.colostate.edu)
   Shaoyong Jiang (shyjiang@public1.ptt.js.cn)

Rolf Romer (romer@gfz-potsdam.de)
Denghong Wang (wangdenghong@hotmail.com)

8. Geology and economics of non-metallic resources
   Co-chairs:
   Mianping Zheng (zmp@public.bta.net.cn)
   Zhenhao Duan (duanzhenhao@yahoo.com)
9. General economic geology
   Co-chairs:
   Franco Pirajno (franco.pirajno@doir.wa.gov.au)
   Hongrui Fan (fanhr@mail.igcas.ac.cn)
   Inna Mudrovska (mudrovska@hotmail.com)
10. Mesozoic to recent geodynamics and metallogeny of eastern Asia
    Co-chairs:
    Yusheng Zhai (yszhai@cugb.edu.cn)
    Craig Hart (craig.hart@gov.yk.ca)
    Shunso Ishihara (shunso@gsj.go.jp)
    Dongsheng Ma (dongsma@public1.ptt.js.cn)
11. Metallogeny of the Tethys-Himalayan Orogen
    Co-chairs:
    Xuanxue Mo (moxx@cugb.edu.cn)
    Georges Beaudoin (beaudoin@ggl.ulaval.ca)
    Zengqian Hou (hzq@cags.net.cn)
    Rod Kirkham (rkirkham@bc.sympatico.ca)
12. Geodynamics and metallogeny of the Altaid Orogen（IAGOD +IGCP-473）
    Co-chairs:
    Reimar Seltmann (rs@nhm.ac.uk)
    Jingbin Wang (wjb@bigm.com.net)
    Wenjiao Xiao (wj-xiao@mail.igcas.ac.cn)
    Kezhang Qin (qkz@mail.iggcas.ac.cn)
13. Metallogeny of the Au-Ag-Se-Te mineralized systems（IAGOD +IGCP-486 sponsored）
    Co-chairs:
    Nigel Cook (n.j.cook@nhm.uio.no)
    Zhenhua Zhao (zhzhao@gig.ac.cn)
    Hidehiko Shimazaki (caw40120@pop21.odb.net.jp)
    Cristiana Ciobanu (c.l.cook-ciobanu@nhm.uio.no)
14. Conceptual targeting of mineral deposits
    Co-chairs:
    Paul Roberts (ppaul.roberts@csiro.au)
    Guangsheng Yan (yguangsheng@mail.cgs.gov.cn)
15. Exploration, Discovery, and Mine Developments in China（SEG Sponsored Session）
    Co-chairs:
    Roric Smith (RSmith@AngloGoldAshanti.com.au)
    Greg Hall (greg_hall@placerdome.com)
    Rui Feng (rfvan@yahoo.com)

Zhanlin Gao (Zhanlin.Gao@wmc.com)

Short Courses and Workshops

Short courses and workshops will be offered before the meeting. All persons wishing to attend a short course or workshop must be pre-registered for the course even if the course is free of charge. Please complete the registration form. On-line registration may be possible for some short courses providing that space is available.

SHC-1
Geology, metallogeny, and numerical modelling of supergene oxidised zinc deposits

Speakers: Gregor Borg（gregor.borg@geo.uni-halle.de）,Jörg Reichert and Farahnaz Daliran
Date: August 16-17, 2005
Place: Academic Exchange Centre, China university of Geosciences
Lately, supergene non-sulphide zinc deposits have attracted much attention as alternative zinc exploration targets, due to their technical, economic, and ecological advantages.
The 1.5 day course will present a number of different examples from this class of deposits and will cover various continents, host rock lithotypes, and geological settings. This includes the presentation and discussion of past and current metallogenetic concepts and classifications as well as strategies in and obstacles to exploration of these deposits. A module on geochemical numerical modelling - using PHREEQC software - will present firm thermodynamic constraints on some of the most important mineral reactions and this will also include a hands-on exercise with this programme.（Maximum: 30 participants）
Enrolment: 170US$ for professionals and 20US$ for students

SHC-2
Geochemical Mapping — Regional, National and Global

Speakers: Xuejing Xie (xuejing@public.bta.net.cn) and Xueqiu Wang
Dates: August 16-17 (one and half days), 2005
Place: Academic Exchange Centre, China university of Geosciences
The 1.5 day course will include one day's lectures on historical development of geochemical mapping concepts and methodology, China's regional and national geochemical mapping projects. Now strategy for mineral exploration based on the development of geochemical mapping. The application geochemical mapping to solving agricultural and environmental problems. Recent proposal of global geochemical mapping along world major rivers. Geochemical mapping will provide important basic information for mineral resources exploration and environmental assessment, metallogenic and ore genesis study.
In the other half day a visit will be organized to IGGE's analytical laboratory and world famous standard reference sample bank in Langfang (70 km from Beijing). (Maximum: 50 participants)
Enrolment: 50US$ for per person (cover the travel to Langfang and the second day lunch).

SHC-3

Metallogeny: current theory and exploration models

Speakers: Steven Scott (scottsd@geology.utoronto.ca), Xuanxue Mo (moxx@cugb.edu.cn), Kaihui Yang, David Leach and Noel White. Other international experts to be announced

Dates: August 15-17, 2005

Place: Academic Exchange Centre, China university of Geosciences

An in-depth examination with lectures and laboratory sessions of a spectrum of ore deposits, both modern and ancient, presented by experts from several countries. The focus is on up-to-date research and industrial applications. Laboratory sessions will involve examination of hand specimens and maps of important ore deposits from around the world. Students are particularly welcome. (Maximum: 50 participants).

Enrolment: 170US$ for professionals and 20US$ for students.

Workshop-1

Gold deposits: New Development and Exploration (SEG workshop)

Speakers: Richard Goldfarb, Noel White, John Muntean and Craig Hart (craig.hart@gov.yk.ca)

Dates: Date: August 16-17, 2005

Place: Academic Exchange Centre, China university of Geosciences

The Society of Economic Geologists is offering its very successful Gold Deposit Workshop, as previously held in Beijing and Moscow. Speakers will include Richard Goldfarb (USGS) - Orogenic gold Deposits, Noel White (consultant, Brisbane) - Epithermal Gold Deposits, John Muntean (Placer Dome) - Carlin-type Gold Deposits, and Craig Hart (Yukon Geological Survey) - Intrusion-related Gold Deposits. Materials presented will be rich in geological descriptions of some of the world's best examples of these deposit-types, as well as sections on exploration methods. This workshop would be of interest to all geologists, particularly those involved in gold exploration.

Enrolment: 100US$ for Professionals and 20US$ for Students

Workshop-2

Metallogeny of Intrusion-related gold deposits in China and adjacent countries

Speakers: Shunso Ishihara, Timothy Baker and Fengjun Nie (nfjj@mx.cei.gov.cn)

Date: August 17, 2005

Place: Academic Exchange Centre, China university of Geosciences

The intrusion-related gold deposits and their associated plutonic provinces are globally widespread. Investigation and exploration of this type gold deposit have attracted much attention as an important exploration target. Geological, geophysical and geochemical data are emerging and expanding at an extremely rapid pace. We will examine the status of our knowledge on intrusion-related gold deposits. The one-day work shop invites experienced geologists from industry and academic circles to give lectures on the intrusion-related gold deposits. These may include discussions of defining criteria,

essential features, tectono-magmatic setting, igneous environment, structural controls and hydrothermal fluid evolution of this class of deposits. Both genetic and exploration models of this type gold deposits will be discussed. Meanwhile, the relationship of intrusion-related gold deposits to other types of magmatic hydrothermal system will be examined. Moreover, geological maps and rock/ore samples selected from two or three typical intrusion-related gold deposits occurring within the North China craton will present for audiences hand-on examination. (Maximum: 50 participants)
No charge for the workshop.

ABSTRACTS AND PROCEEDINGS

The Organizing Committee invites the participants to prepare oral presentations and/or posters. Extended abstracts will be reviewed by the Scientific Committee and those accepted for publication will be printed in the Proceedings Volume (including a CD-Rom), distributed at the Meeting. The price of the Proceedings Volume is included in the registration fee. The abstract language is English. Abstracts submitted by non-English speaking authors should be edited by native English speakers. The official Publisher of the Proceedings Volume will be the Springer Verlag.

The maximum length of abstract manuscripts is four pages including figures, gray-tone photographs and references. Colored photographs and drawings will not be accepted. For details see the Springer instructions below. Deadline for abstracts submission is January 31, 2005. Abstracts will be accepted before February 28, 2005 and should be returned to the Organizing Committee in the camera-ready form before March 15, 2005 at the address:

Dr. Jingwen Mao
Institute of Mineral Resources
Chinese Academy of Geological Sciences
26 Baiwanzhuang Rd., Beijing 100037, China
Tel: +86 10 68327333 Fax: +86 10 68336358
E-mail: mail@sga2005.com

Abstracts will be printed only if the registration fee is paid together with the submission of camera-ready manuscript and/or before April 30, 2005. For late payments (after April 30, 2005), publication of abstracts cannot be guaranteed.

The details about the ***Typing Instructions*** and ***Paper Sample*** are in Appendixes.

Citations and References

Literature citations in the text may be given in either of 2 different styles:

• Author name/s and year of publication in parentheses:
one author: (Miller 1998)
two authors: (Miller and Smith 1998)
three or more authors: (Miller et al. 1998)

• Reference numbers in square brackets: [3, 7, 12]. The number system is especially suitable for large numbers of citations (as long as alterations do not lead to renumbering).

If citation is by number, the list of references may be either alphabetical or in order of citation. If it is by name, the list should be ordered alphabetically. In an alphabetical list, the following order is used for multiple works by an author:

• First, all works by the author alone, ordered by year of publication;
• Next, all works by the author with a coauthor, alphabetically by coauthor;
• Finally, all works by the author with several coauthors, ordered by year of publication.

References may be styled as follows:

• Monographs:
Snider T, Grand L (1998) Air pollution by nitrogen oxides. Elsevier, Amsterdam
• Anthologies and proceedings:
Noller C, Smith VR (1998) Ultraviolet selection pressure on earliest organisms. In: Kingston H, Fulling CP (eds) Natural environment background analysis. Oxford University Press, Oxford, pp 211-219
or
Noller C et al (1999) ...
• Journals:
Peters S, Jaffe HG (1998) Lactose synthesis and the pentose cycle. J Biol Chem 98:15-33

Use the following abbreviations:
ed (editor)
eds (editors)
edn (edition)
p (page)
pp (pages)
vol (volume)
Do not set commas between names and initials, or periods after initials or abbreviations.

Acknowledgements

If you copy text passages, illustrations, or tables from other works, you must in each case obtain permission from the copyright holder. The source of a copied text passage, figure, or table must be acknowledged at the end of the passage, in the legend, or in the heading, at least by means of a reference to the original publication.

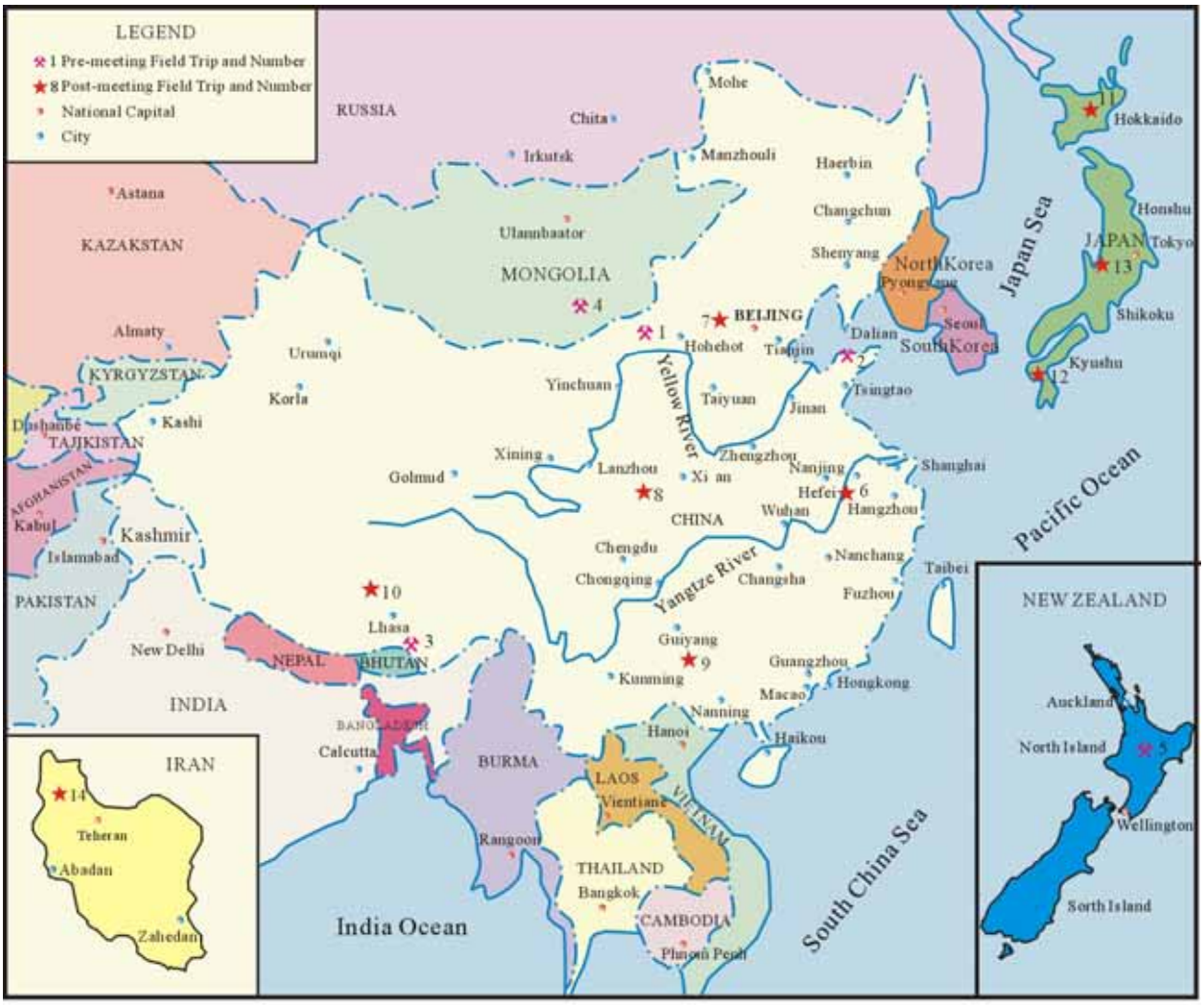
*Note: If there are any contradictions of instruction of citations and references here to other parts (**Type instructions** and **Paper Sample** given in Appendixes), follow this instruction, please.*

POSTERS

Poster session will be held from August 18 to 21, simultaneously with the thematic sessions. The available space for a poster is: vertical length 195 cm and horizontal length 95 cm. Poster authors will be required to be present with the poster at a specified time to be determined.

East Gate for Campus of the China University of Geosciences

FIELD TRIPS



Location Map of Field Trips

Pre-meeting Field Trips:

1. Mineral deposits of western Inner Mongolia--Bayan Obo supergiant Nb-REE-Fe deposit and Wulashan lode gold deposit, Inner Mongolian Autonomous Region, China

Located 130 km north of Baotou City, the second largest city in Inner Mongolian, Bayan Obo is the largest Nb-REE-Fe deposit in the world, and contains 75% of the total REE reserve of the world. The deposit occurs within Middle Proterozoic volcano-sedimentary sequences and shows an intimate spatial relationship with Paleozoic alkaline igneous rocks. The unique geological and geochemical features of the deposit have attracted great attention from the international economic geological community, and debate concerning ore genesis of the unique deposit is ongoing. In addition, Paleozoic alkalic-magmatic gold occurrences are well developed in the Baotou-Bayan Obo region. Among these gold

deposits, the 50 t Au Wulashan deposit is the largest. The deposit, located 25 km NW of Baotou City, consists of a series of gold-bearing quartz-K feldspar veins cutting Archean metamorphic rocks near Paleozoic igneous rocks. Participants on the field trip will tour the Bayan Obo and Wulashan deposits and examine the local geology, sample host rocks and ores, and discuss ideas of ore genesis.

Leaders: Fengjun Nie (Institute of Mineral Resources, CAGS) and Hong Zhang (Inner Mongolian Geological Survey)

Dates: 11-16 Aug.

Max. / Min. number of participants: 36/20

Cost (US$): 500

2. Giant orogenic gold deposits and related granitoids in the eastern Shandong Province, China

Shandong Province is China's most significant gold province with at least 30 Moz of past production and defined reserves, and great remaining resource potential. It is the world's most important granitoid-hosted lode gold province. The Yanshanian (ca. 125-120 Ma) veins and disseminated ores are predominantly hosted by the margins of massive Mesozoic granitoids, which intrude Late Archean country rocks. Our visit will be to four of the most important deposits in the province--Linglong, Jiaojia, Sanshandao and Cangshang, each with at least 2-3 Moz Au and with Cangshang being the largest open pit gold mine in China. The metamorphic country rocks, ore-hosting granitoids, and major tectonic features of the region will also be visited.

Leader: Yitian Wang (Institute of Mineral Resources, CAGS)

Time: 11-15 Aug.

Max. / Min. number of participants: 25/15

Full cost (US$): 575

3. Cenozoic metallogeny of Tibet, China: the Gangdese Cu-Mo and Au metallogenic belt

The Gangdese copper belt occurs in the Gangdese magmatic arc along the northern side of the Yaluzangbo suture. Five large copper deposits (Cu reserves ≥0.5 million tons) and several medium to smaller copper deposits have been discovered in this newly defined belt during the last few years. The ore-bearing porphyries have an adakite affinity and intrusion ages range from 18 Ma to 14 Ma. The copper-dominant polymetallic mineralization occurred during the final stages of this magmatic episode. The trip will visit three important deposits: Jiama Cu porphyry-polymetallic skarn deposit, Tinggong porphyry Cu-Mo deposit, and Xiongcun Cu-Au deposit.

Leader: Xiaoming Qu (Institute of Mineral Resources, CAGS)

Time: 12-16 Aug.

Max. / Min. number of participants: 15/10

Full cost (US$): 1300

4. Copper and Gold Deposits of Mongolia (SEG-IAGOD field trip)

The giant mid Palaeozoic Oyu Tolgoi (Turquoise Hill) porphyry gold and copper system is

located in the south Gobi region of Mongolia. Mineralisation outcrops at Central and South Oyu whereas the gold-rich copper zone at Southwest Oyu and the high grade copper-gold being explored at the Hugo zone in the north are blind discoveries. The newly discovered deeply buried porphyry system at Hugo North is one of four cogenetic copper and gold porphyries delineated along a six kilometer northeast trending structural corridor. The Erdenetiin Ovoo (Erdenet mine) is the largest porphyry copper-molybdenum deposit in Mongolia (1.78 Gt @ 0.62% Cu, 0.025% Mo). Multiple intrusions of diorite to granite porphyries control multi-stage mineralization. The oxide zone overlies a 30 to 300 m thick supergene enrichment blanket where secondary chalcocite replaces hypogene chalcopyrite and bornite-covellite assemblages in stockworks and sheeted veins. The Boroo gold deposit, 10.3 Mt of ore averaging 3.52 g/t gold, is largely granite hosted with lesser portions hosted by sheeted quartz veins in a deformed meta-turbidite sequence, and is classified as a low silica Au+As sulfide system, probably intrusion-related. Trip will start and end in Ulaanbaatar

Aug 14th: 8am charter flight to **Oyu Tolgoi** and technical presentation, lunch;
visit to key outcrops and drill core; 5pm return to Ulaanbaatar and dinner

Aug 15th: 7am departure by bus to **Erdenet** with packed lunch. 2pm technical presentation and visit to open pit. Overnight at hotel at Erdenet.

Aug 16th: 8am drive to **Boroo** and technical presentation followed by lunch. Afternoon visit to open pit and return to Ulaanbaatar.

Leaders: Doug Kirwin (Ivanhoe Mines), Reimar Seltmann (NHM CERCAMS) and Ochir Gerel (Mongolian University of Science and Technology, Ulaanbaatar)

Time: 13/14-16 Aug. (to arrive Ulaanbaatar by 13th Aug.; departure 17th Aug.)

Max. /Min. number of participants: **18/10**

Full cost (US$): 900

(including reference guidebook publication and air & vehicle charters from/to Ulaanbaatar. Note this does not include hotel in Ulaanbaatar or airfares from and to Beijing. Assistance with visas and hotel bookings will be provided).

5. Active and extinct hydrothermal systems of the North Island, New Zealand (4 days)

Visits will be made to geothermal systems in the Taupo Volcanic Zone and several low sulphidation epithermal gold-silver deposits in the Coromandel region to illustrate the hydrology, fluid chemistry, alteration and mineralisation of subaerial epithermal systems. Highlights include Champagne Pool at Waiotapu where gold-silver precipitates are actively forming, the Waihi gold mine, and spectacular scenery of lakes and recently active volcanoes. Trip will start and end in Auckland.

Leader: Tony Christie (Institute of Geological and Nuclear Sciences, NZ)

Time: 11-16 Aug.

Max/Min number of participants: 24/14

Full cost (US$): 1000

Post-meeting Field Trips:

6. Porphyry-skarn-stratabound Cu-Au-Mo deposits of the Middle and Lower Yangtze River region, China: Xinqiao, Dongguashan, Shizishan, Anqing, Chenmenshan, and Wushan deposits

The Middle-Lower Yangtze River metallogenic belt runs though the provinces of Hubei, Jiangxi, Anhui and Jiangsu in eastern China, and consists of more than 200 economic metal deposits. These include the copper deposits of Tieshan, Chengchao, Tonglushan, and Tongshankou in the Daye area; Chengmenshan, Wushan, and Yangjishan in the Jiurui area; Tongguanshan, Shizishan (Dongguashan), Fenghuangqiao, and Xinqiao in the Tongling area; and the iron deposits in the Ningwu-Luzong area. The mineralization is intimately related to the Yanshanian magmatism, with many large and Cu-Au porphyry and skarn deposits, as well as less significant stratabound ores. This metallogenic belt is the most important porphyry-skarn province in China, and has been the focus of numerous studies by economic geologists from both China and overseas. A tour of the beautiful Lushan Mountain scenery will also be included during the trip.

Leader: Taofa Zhou (Hefei University of Technology)
Time: 23-28 Aug.
Max. /Min. number of participants: 60/15
Full cost (US$): 650

7. Intrusion-related gold deposits of the northern margin of the North China craton, Hebei Province, China

The Dongping, Hougou and Huangtuliang gold deposits, located about 250 km NW of Beijing, are important lode gold deposits that have a strong spatial relationship to Paleozoic alkaline intrusive bodies intruded along the northern craton margin. In addition to these deposits, the nearby Xiaoyingpan lode gold deposit will also be visited, which in contrast is hosted by medium to high grade Precambrian metamorphic rocks of the North China craton. These deposits are dominated by continuous and thick quartz veins, and also contain high-grade ores disseminated in strongly K-altered wall rocks. Spectacular views of Yanshan Mountain, the Great Wall of Badaling, and the Xuanhua Ancient Clock Tower, as well as a stop at the hot springs in Chicheng County, will make the trip both informative and enjoyable.

Leader: Sihong Jiang (Institute of Mineral Resources, CAGS)
Time: 22-25 Aug.
Max. /Min. number of participants: 30/10
Full cost (US$): 375 (or 425US$ for single room)

8. Giant mineral deposits of central China—the Daijiazhuang Pb-Zn sedex deposit, Jinchuan mafic-ultramafic rock-related Cu-Ni sulfide deposits (Gansu Province), and the Baguamiao and Jianchaling lode gold deposits (Shanxi Province)

We will fly to Xi'an and visit four of China's giant mineral deposits. These will include: 1) the Changba Pb-Zn deposit occurs in folded marine clastic and carbonate rocks of the western Qinling; 2) the superlarge Jinchuang Cu-Ni magmatic sulfide deposit, mainly

hosted by medium- to coarse-grained Neoproterozoic lherzolite, occuring within the rifted southwestern margin of the North China craton; 3) the Mesozoic Baguamiao orogenic gold deposit that is hosted by late Paleozoic marine clastic rocks of the western part of the Qinling tectonic belt; and 4) the Mesozoic Jianchaling gold deposit, of controversial origin (Carlin-like vs orogenic), which occurs along a dolomite-ultramafic contact within the southern edge of the western Qinling belt. Local travel in a modern, air-conditioned bus will allow time for viewing the magnificent mountain scenery, as well as the Terracotta Warriors museum in Xi'an.

Leaders: Wenyuan Li (Xi'an Institute of Geology and Mineral Resources, China Geological Survey) and Ruiting Wang (Northwest Bureau of Nonferrous Metal Geology)
Time: 23-29 Aug.
Max. /Min. number of participants: 30/15
Full cost (US$): 1300

9. Cambrian black-shale hosted Ni-Mo-PGE, barite and phosphorous deposits, Guizhou Province, China

The southern margin of the Yangtze massif in Guizhou Province is an important region for mineral resources in China, where three deposits will be visited during this trip. These include: 1) the large Lower Cambrian Huangjiawan Ni-Mo-PGE deposit in Zunyi area, 2) the super-large Neoproterozoic Wengfu phosphorous deposit in Weng'an area, and 3) the world-class Lower Cambrian Dahebian barite deposit in Tianzhu area. Stops will also be made to examine the country rocks, fault-controlled basins, and related sedimentary environments in Neoproterozoic strata.

Leaders: Ruizhong Hu and Changyan Wang (Institute of Geochemistry, CAS)
Time: 22-26 Aug.
Max. /Min. number of participants: 30/20
Full cost (US$): 650

10. Investigation of the genesis of salt lake deposits in Tibet, China

Many lakes appear as gems that dot the large mysterious Tibetan Plateau. The lakes in the eastern part of Tibet have evolved from the "Qiangtang East lakes". They are characterized by turquoise blue water, are in an area with magnificent views of the nearby mountains, and there are numerous levels of lakes and high-stand lake sediments. Large magnesite and boron deposits, and smaller potash and mirabilite deposits occur in these lakes. In addition, attendees may wish to visit Potala Palace, Jokhang Temple, etc., in Lhasa, and other famous historic sites. Much will be learned about the history and status quo of Tibetan Buddhism, one will feel the Tibetan ethnic life and culture, and enjoy the beautiful prairie and unique natural scenes.

Leaders: Yuanyi Zhao and Fanjing Kong (Institute of Mineral Resources, CAGS)
Time: 22-28 Aug.
Max./Min. number of participants: 20/10
Full cost (US$): 1650

11. World-class Toyoha polymetallic deposits, Hokkaido, Japan (5 days)

This trip will visit the polymetallic veins at Toyoha, which is the biggest indium resource in the world, as well as the nearby Koryu epithermal Au-Ag deposit, Minami-Shiraoi (Barite) and Kunitomi Kuroko deposits, the Noboribetsu spa and hydrothermal system, the Kokko Tertiary manganese nodule deposit, and the Otaru-Akaiwa acid sulfate auriferous alteration zone. The trip will also include visits to the active volcanoes of Usu and Showa-Shinzan that have recently erupted. Trip will start and end at Tokyo Narita airport.
Leaders: Hiroharu Matsueda and Shuji Ono (Hokkaido U.)
Time: 22-26 Aug.
Max. / Min. number of participants: 15/5
Full cost (US$): 1200

12. Epithermal gold deposits in southern Kyushu, Japan (4 days)
Visits to the world-class, high-grade Hishikari quartz-adularia type, low-sulfidation epithermal Au-Ag vein deposit, Nansatsu-type high sulfidation Au deposit, surface thermal manifestation of the Yamagawa geothermal field, and the active Sakurajima volcano. Enjoy hot springs and spa during the trip as well. (Trip will start and end in Fukuoka—there are direct daily flights from Beijing)
Leaders: Koichiro Watanabe, Akira Imai (Kyushu U.) and Sachihiro Taguchi (Fukuoka U.)
Time: 22-26 Aug.
Max. / Min. number of participants: 15/5
Full cost (US$): 600

13. Miocene Kuroko- and vein-type deposits, and active geothermal area, northern Honshu, Japan (4 days)
Visits will be made to Kosaka-Motoyama Kuroko VMS deposits and the Osarizawa Cu-vein deposit to examine the Kuroko geology, bimodal volcanism, alteration, and mineralization. The Kosaka-Motoyama system is the first discovered Kuroko deposit. The debates on seafloor hydrothermal mineralization started from this open-pit. This trip will also visit the active Osorezan Au-Ag epithermal systems and the Hachimantai geothermal plant, with some scenic stops at caldera lakes and active volcanoes in northern Honshu. Trip will start and end at Tokyo Narita airport.
Leaders: Toshio Mizuta, Daizo Ishiyama and Yohei Ishikawa (Akita U.)
Time: 22-26 Aug.
Max. / Min. number of participants: 15/5
Full cost (US$): 1100

14. The Angouran nonsulfide zinc deposit, northwestern Iran, with an overview of the regional geothermal system (5 days)
Leader: Farahnaz Daliran
Time: 23-27 Aug.
Max. / Min. number of participants: 12/7
Full cost (US$): 1250

YOUTH PROGRAM AND SGA AWARDS

Awards for the Best Student Oral and Poster Presentations

Experience shows that the technical content of the program and the quality of the presentations in any conference improve with the increase of student participation. The SGA Council is committed to having a large number of students fully integrated into the meeting and well represented in the oral and the poster sessions. One of the most important missions of the Student Advisory Committee is to ensure that an adequate number of students will be giving papers. Students are strongly encouraged to submit extended abstracts. The chair and co-chairpersons of each session will be particularly sensitive to student participation in the meeting. Awards will be given to the best oral and poster presentations senior-authored by students.

The quality of the student abstracts is an important factor in the selection process for best presentations. The chair of each session will suggest the best abstracts and the Conference Committee (consists of Student Advisory Committee, Student Representative on SGA, MD editors and Representative of the Scientific Program Committee) will select the best oral and poster presentations given during the meeting. The criteria of selection will be based on: scientific merit, innovation and international significance, quality and presentation format. The best presentation will be announced and awarded at conference dinner. The award will consist of a certificate and a check for 200 US$.

Several field trips to some of the world's largest ore deposits will be offered. Students are invited to attend the field trips and a limited number of free student registrations in selected field trips will be offered.

Student Grants

SGA recognizes that the costs to attend conferences are particularly acute for students who generally have less access to funding than senior researchers. During the Beijing meeting, students will have available low-cost accommodations in one of several student residences at the China University of Geosciences. Limited financial support will be available for students. Applications for financial assistance can be directed to the Student Advisory Committee either in written form or electronically at a conference website. The application should include personal and professional details.

Only applicants whose abstracts were accepted for the meeting will be considered for financial assistance. Financial assistance will be paid directly at the registration desk during the conference. No advance payments are possible. The decision regarding financial assistance will be announced by Organizing Committee by March 15, 2005.

Student participation in field trips and short courses: Several pre-meeting Short Courses, and numerous pre- and post-meeting Field Trips to some of the world's largest ore deposits will be offered, please see the list of field trips. Students are invited to get involved in these activities.

One free participation for a student on each field trip will be offered by the conference. Interested students should apply to Student Advisory Committee by January 31, 2005. The following information should be addressed in a letter of application: Name, advisor, university, degree and year expected, thesis title, and one paragraph (5 sentences) explaining why they want to attend the trip.

The decision regarding the free field trip attendance will be announced by Organizing Committee by March 15, 2005.

SGA Young Scientists Award

The SGA Young Scientist Award is offered biennially to a young scientist who has contributed significantly to the understanding of mineral deposits. The award consists of a citation, prize money (currently EUR 1500), and travel to the Biennial meeting for the presentation, and is open to all persons working in economic geology. The SGA Young Scientist Award is awarded for research in economic geology published before the author's 35th birthday. The candidates must be less than 37 years of age on January 1 of the year in which the award is presented. Any Society member in good standing may nominate candidates for the award.

How to Nominate a Candidate: A brief biographical summary should be submitted by the person making the nomination to the SGA Executive Secretary by January 1, 2005. For more details see http://www.e-sga.org/sga.html.

The Best Paper Award

The Mineralium Deposita Best Paper Award is granted for the best paper published in the Journal in the two years preceding the Biennial SGA Meetings. For more details see http://www.e-sga.org/sga.html.

8th SGA BIENNIAL MEETING

Beijing,China August 18-21,2005

STUDENT GRANT APPLICATION FORM

You are recommended to submit this form on the web site www.sga2005.com
In case you prefer to send the form by fax or mail, please complete this form using block letters and send a signed copy to

Student Advisory Committee
Jorge Relvas(jorge.relvas@fc.ul.pt; jrelvas@fc.ul.pt)
Dep. Geologia,Fac. Ciencias,Univ. Lisboa Edificio C6,Piso 4,Campo Grande
1749-016 Lisboa,Portugal
Tel:+351-217500000 ext:26453 Fax:+351-217500064

This form must be received by January 31,2005

STUDENT GRANT APPLICATION FORM

First Name _____ Family Name _____
☐Male ☐Female Date of birth _____
Organization/Institute_____
Address _____
City _____ Country _____
Phone _____ Fax _____
Email _____
☐Undergraduate ☐Postgraduate student
Are you a member of SGA? ☐Yes ☐No
Type of requested subsidy(please check the most required.If you need support for more than one,number them in order of priority) **priority**
☐Registration fee ☐
☐Accommodation for ____ days, ☐
arrival date_____departure date_____
☐Travel costs - requested amount____US$ ☐
Title of submitted abstract_____
Authors_____
Number and title of session_____
List any(up to three) of your most recent publications_____
_____
_____
Signature_____ Date_____

SOCIAL PROGRAM

An exciting Guest Program has been put together for you to experience the best of Beijing's fascinating culture. You must be registered for the conference to attend all guest activities, which include the Icebreaker cocktail party, a marvelous conference banquet, an evening at the celebrated Beijing Opera, and the opportunity to join us on trips to Beijing's highlights.

Travel in air-conditioned coach with an English-speaking guide.

If the minimum number of 10 participants per tour is not achieved your payment will be refunded.

Tour #1: BEIJING HIGHLIGHTS

We start at Tiananmen Square, the largest square in the world, stopping to visit Chairman Mao in his repose. Then on to the Forbidden City, home to China's Ming and Ting Emperors since the early 15th century. Be sure to watch "The Last Emperor" before coming. Afterwards we go to the Lama Temple, Beijing's most colorful temple. Full-day tour. Lunch is included. 35US$

Tour #2: SHOPPING

Who can resist bargaining in one of the best shopping cities in the world? Finish birthday, holiday and Mother's Day shopping for years to come at the "Pearl Market" (pearls and MUCH more!) and at the Ya Xiu market. Floors and floors of fabulous shoes and purses, stunning cloisonné jewelry and trinkets, magnificent handicrafts. Bring an empty suitcase – or two! Half-day tour. Buy your own lunch as we take a break at Ya Xiu's excellent cafeteria. 16US$

Tour #3: THE GREAT WALL / THE GREAT WALL AND THE MING TOMBS

How many of the Wonders of the World have you seen? You can climb the fabulous Great Wall of China, the symbol of the country, the only manmade object visible from space. Half-day tour. 30US$ Full-day tour includes the Ming Tombs, the mausoleums of the 14th century Ming emperors. Lunch is included in the full day tour. 45US$

Tour #4: HUTONGS AND THE SUMMER PALACE

The hutongs (classic old neighborhoods) of Beijing are rapidly disappearing to make way for the new Beijing. We visit by rickshaw the charming, ancient alleyways. Then elude the summer heat like royalty did on a boat ride to the Summer Palace, where we stroll the ancient walkways. Full-day tour. Lunch is included.35US$

Specially designed tours for children will also be available, to Ocean Park, the Zoo, The Astronomical Observatory and the Science and Technology Museum.

Additional tours will be available to you to visit other parts of China, perhaps while your significant other is away on a field trip. Grab another "Field Widow" and see:

Hong Kong – This spectacular city outshines Las Vegas with its fabled neon lights. Terrific dining, fun market shopping, a cosmopolitan city of the first rank.

Guilin – Site of the beautiful, classic Chinese photos of misty skies, tree-covered limestone cliffs, and a lazy, winding river. Visit stunning terraced rice paddies – and feel like the Empress if you choose to be carried uphill in a sedan chair. Also some of the best shopping in China.

Xi'an – Home of the remarkable 2200-year-old terra cotta soldiers, only discovered in 1974. Some call it the Eighth Wonder of the World!

For information on kids' tours and China travel, write to: susanleach@aol.com

EXHIBITION

Exhibits from scientific publishing houses, mining companies, scientific equipment providers, university and government organization space will be present. Some local government officials in the provinces and regions will be invited to introduce the local policies for mineral resource development and investment.

Fee: 500US$ per standard exhibition space: standard exhibition space is 3X3M^2

Lighting/electrical connection: 200US$

Includes one complimentary registration to conference

Contacts:

Mr. Haiming Xu
Institute of Mineral Resources
Chinese Academy of Geological Sciences
26 Baiwanzhuang Rd., Beijing 100037, China
Tel: +86 10 68320708 Fax: +86 10 68336358
E-mail: zixiang@cagszx.com

8th SGA BIENNIAL MEETING

Beijing,China August 18-21,2005

EXHIBITION APPLICATION FORM

You are recommended to register on the web site www.sga2005.com
In case you prefer to send the form by fax or mail, please complete this form using block letters and send it to

Mr. Haiming Xu
Institute of Mineral Resources, Chinese Academy of Geological Sciences
26 Baiwanzhuang Rd., Beijing 100037,China
Tel:+86-10-68320708 Fax:+86-10-68336358
E-mail:zixiang@cagszx.com

This form must be received by January 31,2005

EXHIBITION APPLICATION FORM

Name _____ Family Name _____
☐Male ☐Female
Organization/Company_____
Address _____
City _____ Country _____
Phone _____ Fax _____
Email _____
Content to exhibit:_____
Exhibition area requested:_____ M^2

Accompanying Person(s)(if any):

Name _____ Family Name _____
☐Male ☐Female Year of Birth _____
Please indicate if you would like to join following activates:
☐Field Trips ☐Ice breaking Party and Banquet ☐Tours
And any requirements for accommodation:_____

REGISTRATION FORM

8th SGA BIENNIAL MEETING

Beijing,China August 18-21,2005

You are recommended to register on the web site www.sga2005.com
In case you prefer to send the form by fax or mail, please complete this form using block letters and send it to

Dr. Jingwen Mao
Institute of Mineral Resources, Chinese Academy of Geological Sciences
26 Baiwanzhuang Rd., Beijing 100037,China
Tel:+86-10-68999075 Fax:+86-10-68336358
E-mail:mail@sga2005.com

This form must be received by January 31,2005

REGISTRATION FORM

Name _____ Family Name _____
☐Male ☐Female Year of Birth _____
Title _____
Name for badge _____ Organization/Institute_____
☐Member of SGA/SEG/IAGOD/CSG Membership Number _____
☐Non Member ☐Student
Address _____
City _____ Country _____
Phone _____ Fax _____
Email _____

Accompanying Member(s)

Name _____ Family Name _____
☐Male ☐Female Year of Birth _____
Name _____ Family Name _____
☐Male ☐Female Year of Birth _____

Registration Fee	By 2005-4-30	/ After 2005-4-30
Members of SGA/SEG/IAGOD/CSG	300US$	400US$
Non-Members	350US$	450US$
Student Members	100US$	150US$
Student Non-Members	200US$	250US$
Accompanying guests	50US$	100US$

Total amount to be paid for Registration Fee US$_____

SESSION OPTIONS FORM

Please choose the Scientific Programs to attend

☐Program 1	☐Program 2	☐Program 3	☐Program 4
☐Program 5	☐Program 6	☐Program 7	☐Program 8
☐Program 9	☐Program 10	☐Program 11	☐Program 12
☐Program 13	☐Program 14	☐Program 15	

SHORT COURSES AND WORKSHOPS FORM

Please choose the Short Courses and Workshops to attend

☐Short Course 1	170US$ /20US$ for Students
☐Short Course 2	50US$
☐Short Course 3	170US$ /20US$ for Students
☐Workshop 1	100US$/20US$ for Students
☐Workshop 2	No charge

Total amount to be paid for Short Courses and Workshops US$_____

To be continued

FIELD TRIPS FORM

Please choose the Field Trips to attend

☐Field Trip 1	500US$	☐Field Trip 2	575US$
☐Field Trip 3	1300US$	☐Field Trip 4	900US$
☐Field Trip 5	1000US$	☐Field Trip 6	650US$
☐Field Trip 7	375/425US$	☐Field Trip 8	1300US$
☐Field Trip 9	650US$	☐Field Trip 10	1650US$
☐Field Trip 11	1200US$	☐Field Trip 12	600US$
☐Field Trip 13	1100US$	☐Field Trip 14	1250US$

Total amount to be paid for Field Trips USD_____

HOTEL ACCOMMODATION FORM

1. Beijing New Century Hotel ☆☆☆☆☆

☐Deluxe Room 90US$
☐Business Room 100US$
☐Executive Room 130US$
☐Deluxe Suite 150US$

Room bills include an American breakfast, 2 bottles of mineral water each day/room
Guests in Business and Executive Room enjoy free ADSL internet services
Fitness,swimming and Sauna services are free for guests

2. Xiyuan Hotel ☆☆☆☆☆

☐Standard Room (B) 60US$
☐Standard Room (A) 65US$
☐Deluxe Room 75US$

Breakfast to be paid separately
Western breakfast: 8US$/person, Chinese breakfast: 5US$/person

3. Xijiao Hotel ☆☆☆

☐Single Room 40US$
☐Apartment Room 45US$
☐Double Room 35US$
☐Standard Room 50US$
☐Deluxe Room 80US$

Room bills include breakfast,ADSL internet services

4. Fangxing Hotel

☐Standard Room(A) 30US$
☐Standard Room(B) 40US$

Room bills include breakfast,Guests enjoy free ADSL internet service

5. Student dormitory (for students only)

☐Single Room US$10 (One bed)
☐Single Room US$10 (Two beds)

Smoking or Non-smoking preference: ☐No smoking ☐Smoking
I reserve for __ nights stay from _____(arrival date) to _____(departure date

Total amount for Hotel Reservation Deposit US$_____

TOURS FORM

Please choose the tours to join

☐Tour 1 ☐Tour 2
☐Tour 3 ☐Tour 4

Total amount to be paid for Tours US$_____
Total amount to be paid for SGA meeting US$_____

Appendix 1

Typing Instructions

Main settings at a glance

Printer: 600 dpi laser printer for text and line figures; 1200 dpi
laser printer for halftones

Print area: 156×224 mm, 2 columns each at 74 mm with 8
mm space between the columns

Justified text, automatic hyphenation

Font: Times for text; Helvetica for headings

Type size: 10 pt for body text; line spacing 6 mm (=18 pt)

Small type: 8.5 pt; line spacing: 3.5 mm (= 10 pt); use for
-special text parts (less important, long quotes, etc.)
-lettering in figures and tables
-table headings, figure legends
-index

Pagination: front matter roman (I, II, etc.); main text arabic (1,
2, etc.)

Indent (for paragraphs in body text): 4 mm

Line spacing above and below displayed lists: at least 2 mm (6 pt)

Each contribution begins on a new page
Set all headings flush left

Chapter heading (title of contribution): Helvetica (or Times) 18 pt bold

Chapter heading 1st order: Helvetica (or Times) 11 pt bold

Chapter heading 2nd order: Helvetica (or Times) 10 pt bold

Chapter heading 3rd and 4th order: Helvetica (or Times) 10 pt bold italic; set chapter number in bold letters, not italic

Maximum number of pages per paper is 6, including references.

> In case of doubt, check the attached sample paper

1 Print Area, Font, Type Size

1.1 Format, Print Area, Justified Text (see enclosed sample)

Book format (STODOLA): 193×270 mm (width ×height)
Printed area:
156×224 mm (width×height)
In 2 columns with each 74 mm width
and 8 mm space between the columns

When inputting the text, always use the full height and width of the print area. Set it as justified text and use an English hyphenation program. A shorter print area is required when under a section heading there is only space for a maximum of three lines of text; in this case the section heading as well as the text should be set on the next page.

1.2 Font, Type Size, Type Quality

The preferred fonts are *Times* for body text and *Helvetica* for headings.

For body text please choose the type size 10 points (1 point = 0.376 mm, rough rule: 3 points = 1 mm) and for line spacing 12 points or
4 mm. For the type size to use for headings and the spacing to set above and below them, see Chap. 2 and the enclosed sample pages.

For readability and a good printed quality of your work please use a 600 dpi laser printer. If your work includes half-tone illustrations, you will need a 1200 dpi printer (and you should read Chap. 4).

2 The Main Text

The pages of the main text are assigned arabic page numbers. The text begins with page 1, which like all odd-numbered pages is a right-hand page. Every chapter should begin on a new right-hand page; for stylistic reasons the headers and page numbers are suppressed on chapter title pages, but these pages still have numbers.

2.1 Abstract and Keywords

The main text begins with the abstract which is identified by the word abstract in boldface type followed by a period. The text of the abstract, in normal type, begins on the same line after two spaces. At the end of the abstract insert two empty lines before listing a maximum of ten key words using the same format as for the abstract. Insert two empty lines after the keywords, followed by a horizontal line, and another two empty lines. Then type the first heading.

2.2 Headings

Set decimal classification numbers flush left and follow with the heading on the same line after two spaces. Do not use a period at the end of the heading. If the heading requires more than one line, it should be broken between groups of semantically linked words and set flush left, not justified.

Heading type sizes and spaces above and below are specified on sample pages. Note that if a heading is set immediately below a heading of the next-higher level, the space between them should be one blank line (4 mm).

2.3 Textual Emphasis

In running text, set emphasized words, phrases, or sentences in *italic* type. If absolutely necessary you may use **boldface** type for emphasis, but do so sparingly, as frequent use of boldface in running text reduces readability.

If it is necessary for you to assign a different visual weight to certain passages of text to distinguish them from normal running text, you may set them in smaller type (8.5 pt) with smaller line spacing (3.5 mm).

If these passages are your own text, then you may set them between the normal margins (see Sect. 2.3); if you wish to set long quotations in small type , then please inset them 10 mm (since this identifies them as quotations, you should delete initial and final quotation marks).

Example of text in small type

Case study. The housemaster of a large dormitory was seriously ill. None of the tests performed led to an unambiguous diagnosis. After a series of unsuccessful attempts at therapy a young assistant doctor discovered that the man had been infected by a female occupant of

2.4 Paragraphs

The first paragraph after a heading begins flush left, as does one with an integrated heading, for in these cases it is clear where the paragraph begins. All other paragraphs should begin with an indent of 4 mm.

2.5 Displayed Lists

Before and after a displayed list set extra line spacing of 2 mm. To indicate the listed items you may use either en dashes (-) or, for example, numbers or bold points (bullets, ●), but please style displayed lists in a uniform way throughout your work. Please do not treat such lists as tables (for which see Chap. 3).

Example with en dash

—The en dash is longer than a hyphen (-) and shorter than an em dash (—); see Sect. 2. 7.
—The space between en dash and text may be set with a tab stop at 4 mm.
—To ensure that the leaders stand free, format the item paragraphs with a hanging indent of 4 mm.

Example with numbers

1. The items may be one line or longer.
2. The space between number and text may be set with a tab stop at 4 mm (or let MS Word 7 automate the list formatting for you).
3. Format the item paragraphs with a hanging indent of 4 mm.

Example with bullets

- This example was generated by selecting the style from the dialog box in the Bullets and Numbering command on the Format menu in MS Word 7.
- The command sets a space after the item leader (here the bullet) and indents second and subsequent lines automatically.
- The method is quick and efficient, but the indent and leader style settings need to be set correctly

2.6 Small Type

the dormitory who had returned from the tropics but who so far showed no symptoms.

The cause of this disease is unknown. The example shows that a thorough anamnesis is sometimes more important than routine diagnostic procedures.

Example of a text passage containing a quotation in small type

We would like to describe the relationship-regulating function of affective communication and the defense function of resistance associated with it by referring to a passage from Krause. After describing the complicated blend of affects and instinctual acts in sexual interaction, he concludes:

> Before a terminal act of sexual nature can take place between two persons, they have to ensure that they get together at all, i. e., the distance between the partners must be reduced and finally eliminated. This can only happen if the anxiety affect generally accompanying such processes is outweighed by the antagonistic affects of joy, curiosity, interest, and security. This takes place by means of the mutual induction of positive affects. (Krause 1983, p. 1033)

Krause refers to a mutual induction of positive affects and to the reduction in an anxiety affect.

(Taken from H. Thomä and H. Kächele, *Psychoanalytic Practice,* Springer 1987, p. 110.)

Small type is principally used for: the list of references or bibliography (Chap. 5), running heads (Sect. 1.3), footnotes (Sect. 2.6), tables and their headings (Chap. 3), and figure legends (Sect. 3.1).

2.7 Footnotes

In running text footnotes are marked by superscript numerals (and in tables by superscript lowercase letters; see Chap. 3). Textual footnotes should be numbered from 1 for each new chapter. The footnote text 1 should end with a period and be separated from body text by a ruled line. Many word processing programs (e. g., MS Word 6 and 7) set this line automatically. The distance between this line and the last line of text should be at least one blank line.

[1] This is the footnote text. It begins after a tab stop at 2.5 mm following the footnote numeral and should be set in small type (8.5 pt, line spacing 3.5 mm). Set a hanging indent of 2.5 mm for second and subsequent lines, so that the footnote numeral stands free.

2.8 Hyphens, En Dashes and Em Dashes

- Hyphens at the end of a line are set automatically by a hyphenation program.
- Hyphens used to abbreviate or link word groups (e.g., in the phrase “pre-and post-apocalyptic”) look identical to line-end hyphens.
- En and em dashes are longer, en dashes about twice as long and em dashes about three times as long. En and em dashes must generally be set as special characters (e.g., in MS Word for Windows using the key combination control + minus for en dashes and control + alt + minus for em dashes).
- The en dash used as “from…to…” is set without spacing before and after (see sample pages).
- The en dash used as a phrase marker — Springer prefers not to use em dashes — is set with a blank space before and after. On the use of this dash as an item leader in a bulleted list see Sect. 2.4.
- The en dash is also used to link the names of two distinct people in phrases denoting concepts associated with them, e.g., Bose-Einstein condensate, Löwenheim — Skolem theorem.
- Another use for the en dash is to link distinct nouns, or concepts at least one of which is denoted by a multiword phrase, e.g., space-time, post-Cold War.

2.9 Opening and Closing Quotation Marks

Please do not use the ambiguous ditto mark (0) to open and close a quoted passage. Use the “typographical” marks available in all good word processing programs, and please check that they are English (raised “66” as opening mark, raised “99” as closing mark). On when to use single or double quotation marks consult a good style manual (e. g., The Chicago Manual of Style).

2.10 Abbreviations, Numbers, Units, Hard Spaces

2.10.1 Abbreviations

For bibliographic abbreviations see Chap. 5. For cross-references in your book please use the following:

- p. (page) and pp. (pages)
- Chap. (chapter) and Chaps.
- Sect. (section) and Sects.
- Fig. (figure) and Figs.

In all these cases use the abbreviation only when a number (or number range) follows, and never at the beginning of a sentence. The word “Table” is always written in full.

Recognized standard abbreviations: *AM, ca., cf., e. g., et al., etc., i. e., no., PM, VS.*

If you wish to use numerous specialized abbreviations you should include a list of abbreviations in the front matter (after the table of contents). If you prefer not to give such a list, then you should spell out frequently used abbreviations at their first appearance in the text. Example:

> Epidemiologically, coronary heart diseases (CHD) take first place. The occupancy of hospital beds with CHD patients last year was 15%.

A sentence should never begin with an abbreviation. In some cases, e. g., for reasons of emphasis or style, nonscientific words may be spelled out rather than abbreviated in other positions:

For example, The Chicago Manual of Style has approximately seven hundred pages.

2.10.2 Numbers

In scientific works, numerical values, even those from 1 to 10, should be given using arabic numerals whenever a unit follows. They should be spelled out at the beginning of a sentence (though this may be avoided by recasting the sentence) and may be spelled out more generally in nonscientific or informal contexts. Please set thousands without commas, set (thin, protected) spaces between numeral triples in numbers from 10 000 upward (from 1000 upward in tables, if 5-digit numbers are included), and set decimals either as 3.142 or as 3 ·142.

2.10.3 Units

Note that only internationally valid symbols should be used for the units in which numerical magnitudes and quantities are given (e.g., g for grams, m for meters, s for seconds). In medical texts SI (Système International) units are standard.

2.10.4 Hard Spaces

Between parts of an abbreviation that go together, or between numbers and units, you should set not normal word spaces but protected or hard spaces that do not allow line breaks between the elements.

Examples: 10:00 AM, 9.81m s^{-2}, Vol. I, p. 10, Fig. 2, et al.

2.11 Formulas

Formulas and equations are set with an indent of 4 mm or centered on separate lines with extra line spacing above and below of 2 mm. Example:

$$(a+b)^2=a^2+2\ ab+b^2.$$

If the formula or equation is part of a sentence, it should normally end with the appropriate punctuation mark (comma, semicolon, colon, or period). Alternatively, displayed equations may be set without the otherwise appropriate punctuation, so long as this is done consistently throughout the work. Further details are given in Sect. 5.4.

3 Tables

Tables should be set in small type (8.5 pt, line spacing 3.5 mm).
The word “Table” should not be abbreviated; in the table title it appears with the table number in **boldface** type before the title text (which is not set bold).

Please do not set simple enumerations or single-column lists as tables; set them instead as part of the running text (see Sect. 2.4).

Tables should be positioned near the textual references to them. Distance between text and table, both before and after: 8 mm. If possible, however, place tables at the top or the bottom of a page (in which cases, of

course, do not set extra spaces before or after, respectively).

3.1 Example

Table 3.1. cardiovascular parameters

Patient No	Psyst art • HR	Psyst art maxima (mm Hg)	HR (min-1)	CEG	CHD
5[a]	25038	214	214	ES	yes
8[b]	14220	237	60	ES	yes
14[a]	11350	165	111	ES	no(?)
23[b]	18128	175	90	ES	yes
39[b]	22785	218	68	ES	yes

p, blood pressure; *HR*, heart rate; *ECG*, electrocardiograph reading; *CHC*, preoperative diagnosis of coronary heart disease; ES, extrasystoles
[a]patients from group 1
[b]patients from group 2

3.2 Explanation

The table is structured by a head rule (under the heading), a cross rule (under the column headers), and a foot rule (under the columns). Spacing above and below each of these lines is 2 mm. Introduce further lines (vertical as well as horizontal) only when necessary for didactic reasons.

Set the columns flush left, but set numbers using decimal tabs so that all units, tens, hundreds, etc. are vertically aligned. Set metric or physical units in the column heads in parentheses.

Set explications of the abbreviations on the left margin under the foot rule; in this position the explicanda are set italic.

Footnotes in tables are referred to with superscript lowercase letters. Set the footnote texts directly under the table; begin them with an uppercase letter and end them with a period.

4 Illustrations

Given the sophistication of modern PC software, we assume that in most cases you will prepare your illustrations (figures) on the
screen and then integrate them with the text. Lf you are copying illustrations from other publications we urge you to read Sect. 7.3.

To help you in creating your own illustrations and to avoid technical problems during reproduction we offer the following basic guidelines.

- Font for lettering in figures: Helvetica.
- Size of smallest capital letters: 2.6 mm (7 pt).
- Scale illustrations so that they do not overstep the print margins.
- Check the contrast levels when using shading (cross-hatching, etc.) or screened areas: any lettering on such areas must be clearly readable.
- Avoid subtle effects or fussy details like shadowing, continuous tone shading, outline letters, or unnecessary frames.

If you wish to include color illustrations in your work, you must first discuss this with your contact person in the company; please do so also in case you plan to supply black-and-white or four-color illustrations as digital files.

4.1 Figure Legends

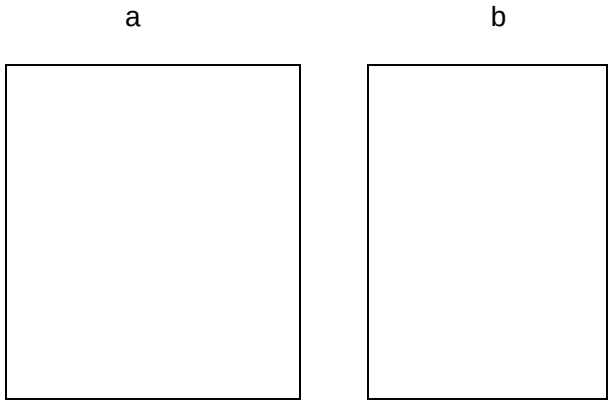
Set figure legends under the figures in small type (8.5 pt, line spacing 3.5 mm) across the full width of the print area. Set the leader **Fig**. and the figure number, as well as any part designator (**a**, **b**, etc.), in boldface type, but set the legend text in plain type.

Figure lettering that is explained in the legend should be set in italic type in the legend (see Table 3.1).

4.2 Positioning the Figures in the Text (see also sample pages)

Figures should normally be set at the top or bottom of the page so as to minimize disruption of the flow of the text. For spacing above and below figures see the following example (Fig. 4.1).

8 mm > >---



2 mm > >--

Fig. 4.1. Relative spectral sensitivity a and color density curves b for the layers of a fictional color slide film with

enhanced red sensitivity
8 mm > >

Do not set extra spacing before the figure or after the legend when the figure is positioned respectively at the top or the bottom of the page.

5 References

5.1 Citations in the Text

Literature may be cited in the text by either (but not both) of two methods: (1) by giving the author's name and the year the work was published in parentheses, or (2) by giving numbers set in square brackets. In either case, you can set the list of references in alphabetical order by author (but see Sect. 5.2). If you make changes to a numbered list, you will also have to revise all the reference numbers following the changes, as well as their citations.

Authors' initials should be given in citations only when the family name and publication year of two authors are identical. Separate two or more publication years after an author's name by commas, and entries for several authors by semicolons. Cite editors like authors.

Examples

- One author: "Indeed miller (1950) gave advice (see also Jones 1962; Smith 1962)…"
- One author, one co-author: "Indeed Miller and Smith (1950) gave advice (see also Miller and Jones 1962; Smith and West 1951, 1962)…"
- One author, many co-authors: "Indeed Miller et al. (1950) gave advice (see also Jones et al. 1962; Smith et al. 1962)…"

Note that "and" is used between two names and "et al." for three or more.

5.2 List of References

Style the heading "*References*" like a chapter title but do not number it. Set the list itself in small type (8.5 pt, line spacing 3.5 mm; Sect. 2.5) and position it at the end of the book between the text (or the appendices, if any) and the index. It should always begin on a right-hand (odd-numbered) page.

In most subject areas the cited works should be listed in alphabetical order by author. However, in some areas (e.g., chemistry) it is customary to number citations in order of their appearance in the text and list them in that order. Check with your Springer contact if you are unsure which order to use. In either case, set each item flush left, and indent second and subsequent lines by 4 mm. Do not set extra line spacing between the items.

Bibliographic Abbreviations: vol (volume), no (number), p (page), pp (pages), edn (edition), ed (editor), eds (editors)
Note that these are all set with periods in some subject areas (see Sects.
5.3-5.7).

Journals: Input of volume and page numbers for journal articles is treated in Sects. 5.3 -5.7, journal name abbreviations in Sects.
5.3.3, 5.4.3, and 5.5.3.

Numbered Citations: The examples in Sects. 5.3 - 5.7 are of unnumbered lists; for numbered lists the numbers should stand free (i. e., the first line of text following the number should be inset 4 mm like any subsequent lines), with units, tens, hundreds aligned, and appear with a period but without square brackets. Example:

1. Arkhipenko DK, Bokiy GB (1986) Factor-groups analysis and X-ray study of vermiculite and talc crystals (in Russian). J Struct Chem 16: 450-457.
2. Peters S, Jaffe HG (1991) Lactose synthesis and the pentose cycle. J Boil Chem 98: 15-33.

5.3 Examples for Styling References: Medicine, Psychology, Biology, Chemistry, Earth and Environmental Sciences, Engineering

If you would like more detailed instructions on the international standard styles used in the following examples, just ask your Springer contact.

5.3.1 Monographs

Snider T, Grand L (1982) Air pollution by nitrogen oxides. Elsevier, Amsterdam

5.3.2 Edited Works

Noller C, Smith VR (1987) Ultraviolet selection pressure on earliest organisms. In: Kingston H, Fulling CP (eds) Natural environment background analysis. Oxford University Press, Oxford, pp 211-219

5.3.3 Journal Articles

Journal names are abbreviated according to or analogous to the *Index Medicus*. If in doubt cite the full name.

Arkhipenko DK, Bokiy GB (1986) Factor-groups analysis and X-ray study of vermiculite and talc crystals (in Russian). J Struct Chem 16: 450-457.

Peters S, Jaffe HG (1991) Lactose synthesis and the pentose cycle. J Boil Chem 98: 15
-33.

5.3.4 Special Cases (Dissertations, Reports)

Cairns RB (1965) Infrared spectroscopic studies of solid oxygen. Dissertation, University of California

US Congress, Office of Technology Assessment (1985) Status of biomedical research and related technology for tropical diseases. OTA-H-258. US Government Printing Office, Washington DC

See also the remark on numbered citations in Sect. 5.2.

5.4 Mathematics and Physics

Mathematical formulas and expressions require especially careful typographic treatment. For most situations there are conventions governing how the material should be set. We limit ourselves here to the simplest cases and would ask you to direct any further questions you may have to your contact person at Springer, who will arrange for more detailed advice from someone with expertise.

Long or complicated formulas or equations are displayed on a separate line and either centered or indented (see Sect. 2.10), with an extra line or half-line space before and after. Number formulas chapterwise and set the numbers in parentheses flush to the right margin. Example:

$$E=mc^2 \tag{2.1}$$

Propositions, lemmas, theorems, corollaries, definitions, and similar items are also numbered chapterwise and set as follows:

Definition 2.1. The set N of natural numbers is the countable set

$$N=\{0,1,2,\ldots\}$$

Definition 2.2. The set N_+ of positive integers is the countable set

$$N_+=\{1,2,\ldots\}$$

Theorem 2.1. *The set of natural numbers is equal to the set of nonnegative integers:*

$$N=N_+\approx\{0\}$$

Proof. This follows directly from Definitions 2.1 and 2.2.

Note the use of boldface and italic type in Definitions 2.1 and 2.2 and Theorem 2.1 and absence of parentheses in references to them. Proofs should end with an open square set flush to the right margin. When displayed equations appear in running text, they should be set with the appropriate punctuation. Alternatively, you may set displayed equations without the otherwise appropriate punctuation, so long as you do so consistently throughout your work.

6 Supplementary Advice for Multiauthor Works

6.1 Advice for Contributing Authors

6.1.1 Contribution Headings

Font and type size of contribution title: Helvetica 14 pt bold. Set a line spacing of exactly 6 mm even when your title does not exceed one line in length.

Under the title, 8 mm below it, is a line set in type the same size as the main text giving the name (s) of the author (s). The names in the case of multiple authors are separated by commas. The address of the author (s) is set on the line following the name (s). If more than one address must be given, each address should begin on a new line, and the addresses should be linked to the corresponding names by means of superscript numerals.

The text begins 30 mm below the title in the case of one-line titles, and 24 mm below it in the case of two-line titles.

Example of a contribution heading

On Traditions in Marktoberdorf

Fred B. Schneider
Department of Computer Science, Cornell University, Ithaca, NY 14853, USA

Abstract. Origins are proposed for certain well-known traditions at the Marktoberdorf advanced courses in programming methodology. The evolution of these traditions, over the years, is also discussed.

Number headings inside the contribution using the decimal system.

6.1.2 Pagination

Since you do not know in advance which pages your contribution will occupy, you must give your printout temporary page numbers. You may do so in the top right-hand corner of the page, outside the 193 × 270 mm page outline surrounding the print area (see Sect. 1.1), by hand if necessary. Please do not make entries in the header or footer zones inside the page outline. The final pagination and the entry of any running heads will be arranged by Springer.

6.1.3 Literature Citations

The form of citations should be prescribed by the volume editor on the basis of the information given in Chap. 6. The list of references should be set at the end of the contribution as the last main section—*not* on a new page.

6.1.4 Figures, Tables and Formulas

Figures, tables, and formulas are respectively numbered from 1 in each contribution. Figures and tables should be placed consistently either on the left margin or centered. If your work contains many small figures, centering them may be best; otherwise we recommend setting them on the left margin. (Formulas, however, should not be set on the left margin; see Sects. 2.10 and 6.4.) On spacing before and after, see sample pages.

7 Legal Remarks

7.1 Tradenames

lf your book or contribution contains registered tradenames or trade marks, it is advisable to include a note of the fact that these names or marks are registered by the relevant firms or institutions. This note can appear in the preface or the acknowledgements or on the copyright page.

Example: T_EX is a registered trade mark of the American Mathematical Society.

7.2 Product Liability

The laws on product liability make great demands on the accuracy required of all those occupied with and involved in the compilation, reproduction, and distribution of manuscripts.

This also applies in particular to authors of scientific and technical books and journal articles. For this reason, please check your work carefully when writing it and when reading the final proof. It is necessary, and in your own interest, to ensure that all the information presented in your work is accurate and that all pertinent information is included (e.g., on risks or precautions).

When preparing the manuscript, you can simplify this task by having the contents counterchecked by colleagues who are experts in the field; the extent to which you will have to do this varies according to the degree of risk of material damage and injury to persons that might result from incorrect information.

This is the safest way to reduce your liability risk and to prevent any possible claims for compensation and damages.

7.3 Use of Illustrations

If you wish to include an illustration from another publication in your work, you must obtain permission from the owner of the rights to the illustration—generally the publisher of the work that includes it. A form letter for this purpose may be obtained from your contact person at Springer. You must then include a suitable acknowledgement in the figure legend for the illustration. You should either give complete details of the original publication or simply give the name of the owner and give complete details in the list of references or in a list of figure sources.

Appendix 2

A Comparison of Stable Platform and Strapdown Airborne Gravity

Chapter heading: Helvetica 16pt bold

C. L. Glennie, K.P. Schwarz, A. M. Bruton

Contributor(s) and their address (es): Time New Roman 9.5 pt text type

Department of Geomatics Engineering,

The University of Calgary, 2500 University Drive N. W., Calgary, Alberta, Canada, T2N lN4

(Put a space between them if there is more than one institution)

R. Forsberg, A. V. Olesen, K. Keller

MS, National Survey and Cadastre, Rentemestervej 8, DK-2400 Copenhagen NV, Denmark

Abstract. To date, operational airborne gravity results have been obtained using either a damped two-axes stable platform gravimeter systems such as the LaCoste and Romberg (LCR) S-model marine gravimeter or a strapdown inertial navigation system (INS), showing comparable accuracies. In June of 1998 three flight tests were undertaken which tested a LCR gravimeter and a strapdown INS gravity system side-by-side. To our knowledge this was the first time such a comparison flight was undertaken. The flights occurred in Disko Bay, off the west coast of Greenland. Several of the flight lines were partly flown along existing shipborne gravity profiles to allow for an independent source of comparison of the results.

This paper presents the results and analysis of these flight tests. The measurement method and error models for both the stable platform and strapdown INS gravity systems are presented and contrasted. The results of the flight tests show that the gravity estimates from the two systems agree at the 2-3 mGal level, after the removal of a linear bias. This near the combined noise levels of the two systems. It appears that a combination of both systems would provide and ideal airborne gravity survey system; combining the excellent bias stability of the LCR gravimeter with the higher dynamic range and increased spatial resolution of the strapdown INS.

Keywords. Airborne gravimetry, gravimeter, strapdown inertial navigation system (SINS)

1 Introduction

Section heading 1st order: Helvetica 9 pt bold

The use of a LaCoste and Romberg S-model marine gravimeter for airborne gravity surveys has been well documented in the past seven years, see for example Brozena (1992), Forsberg and Kenyon (1994), Brozena et al. (1997) and Bastos et al. (1998). Over the years these systems have been improved and are now showing an airborne gravity estimation accuracy at the 2-3 mGal level. The excellent results reported with the LCR gravimeters have made them the established method for airborne gravity disturbance determination. In the past four years successful airborne gravity flights have also been accomplished using a strapdown INS/DGPS system, see Wei and Schwarz (1998) and Glennie and Schwarz (1999). The strapdown system has shown the same level of gravity estimation accuracy as the LCR systems, but using significantly shorter averaging times. However, it is difficult to directly compare the results obtained by the two systems because the test conditions are seldom comparable. It is therefore desirable to fly the two systems side-by-side to provide a direct method of comparison.

The prototype strapdown INS/DGPS system developed at The University of Calgary consists of a Honeywell Laseref III (LRF III) inertial system. This is a navigation grade strapdown system with stand-alone performance of 1.0 nm/h. The LRF III contains QA-2000 accelerometers and GG1342 dithered ring laser gyroscopes.

The modified LCR air/sea gravimeter is a highly damped spring gravity sensor mounted on a two-axes stabilized platform. The major difference between the use of this platform system and a strapdown INS system is the maintenance of a direction in space (i.e. orientation). For the strapdown system the relationship between the body frame and the local-level frame is computed by numerically integrating the output of the gyroscopes. For a platform system, alignment with the local-level frame is realized mechanically by using the output of horizontal accelerometers and gyroscopes in a feedback loop. The feedback loop normally has a user selectable damping period of 4 to 18 minutes, Valliant (1992). In general, the longer

6 mm, 48 mm, 224 mm, 4 mm, 4 mm

74 mm, 74 mm, 8 mm, 156 mm

the damping period, the greater the reduction in error due to horizontal accelerations.

In addition to having entirely different methods of orientation control, the strapdown INS system and the LCR gravimeter also use significantly different methods of vertical specific force measurement. The QA 2000 accelerometers in the LRF III measure acceleration using quartz flexure suspension technology. Essentially, acceleration is measured by the displacement of a proof mass that is pendulously supported with only one degree of freedom. The acceleration sensed is proportional to the restoring force required to keep the proof mass in the null position. More details on the principle behind the QA accelerometer can be found in Foote and Grindeland (1992).

The vertical acceleration sensed by the LCR gravimeter is based upon the zero-length spring principle. The beam of the system is overdamped, and acceleration is determined by a combination of spring tension S, and beam velocity v_b, using the equation (Olesen et al. (1997)):

Equation Centred 4mm

$$f_u = S + Kv_b \qquad (1)$$

where K is a scale factor which is determined by laboratory calibration or in-flight through a regression technique. The beam is kept roughly at the center of its dynamic range (null position) by adjustment of the spring tension. The spring tension can be automatically adjusted or manually set by the user. More details on the zero-length spring gravimeter can be found in Valliant (1992) or LaCtose (1988).

Our objective in this paper is to compare these two different methods of airborne gravity disturbance determination. In the next section the mathematical formulations and error models for each approach are given and contrasted. Following that a comparison of the two systems flown side-by-side in an actual flight test is given.

Chapter heading 2nd order Helvetica 10 point

2 Mathematical Models for Airborne Gravity

2.1 Airborne Gravity by Strapdown INS/DGPS

In the local-level frame the model of airborne gravimetry can be expressed by Newton's equation of motion in the gravitational field of the earth.

When considering scalar gravimetry, only the vertical component of this equation is required. The equation can be rearranged for gravity disturbance determination, and is of the form:

$$\delta g = f_u - \dot{v}u + \left(\frac{v_e}{R_n + h} + 2\omega_e \cos\phi \right) v_e + \frac{v_n^2}{R_m + h} - \gamma \qquad (2)$$

where f_u is the upward component of specific force (from INS), v_e, v_n, v_u are the east, north and up components of the vehicle velocity (from GPS), R_m, R_n are the meridian and prime vertical radii of curvature, φ, h are geodetic latitude and height, ω_e is the earth rotation rate, and γ is normal gravity. A detailed derivation of this formula can be found in Schwarz and Wei (1997). The sum of the third and fourth terms in equation (2) is often called the Eötvös correction. This approach has become known as SISG (Strapdown Inertial Scalar Gravimetry).

A first-order error model for the SISG approach to airborne gravity can also be obtained. The error model of SISG has been derived in, for example, Schwarz and Wei (1994) and Schwarz and Li (1996), and is given as:

$$d\delta g = f_e \varepsilon_N - f_n \varepsilon_E - A df^b - d\dot{v}_u + (\dot{A} f^b + A \dot{f}^b) dT \qquad (3)$$

where A and $\dot{A}$ are row matrices of the form

$$A = [-\cos\theta \sin\phi \quad \sin\theta \quad \cos\theta \cos\phi] \qquad (4a)$$

$$\dot{A} = \begin{bmatrix} \dot{\theta} \sin\theta \sin\phi - \dot{\phi} \cos\theta \cos\phi \\ \dot{\theta} \cos\theta \\ -\dot{\theta} \sin\theta \cos\phi - \dot{\phi} \cos\theta \sin\phi \end{bmatrix}^T \qquad (4b)$$

and ϕ, θ are the roll and pitch angles of the transformation from the body frame to the local-level frame, dT is a synchronization error between the INS and GPS data streams, $\mathbf{f}^b$ and $\mathbf{df}^b$ are the specific force vector and the error in the specific force vector respectively, $d\dot{v}_u$ is the error in vertical GPS acceleration, f_e, and f_n are the east and north specific force measurements and ε_N and ε_E represent misalignment in the north and east directions. The dot above a quantity denotes time differentiation.

It should be noted that another method of gravity disturbance determinationcall RISG (Rotation Invariant Scalar Gravimetry) has also been tested for

the strapdown INS system, see Wei and Schwarz gravimeter. However, the actual synchronization error (i.e. value of dT) would be system dependent.

The strapdown INS system and the LCR gravimeter system have significant differences in orientation maintenance and acceleration measurement techniques. These differences are made evident by trying to relate the error models of the two approaches. Therefore, a flight test with the two systems operating side-by-side allows a unique opportunity to compare the two methods for consistency, and additionally to try to detect and eliminate design specific errors in each system. In the June 1998 test, for the first time, the two systems have been flown side-by-side.

3 Test Description

The Danish National Survey and Cadastre(KMS), and The University of Calgary undertook an airborne gravity test on June 6, 8, and 9 of 1998 in the Disko Bay area off the west coast of Greenland. The test was at the beginning of a larger airborne gravity survey campaign off the north coast of Greenland (Forsberg et al. (1999)). The major purpose of this flight test was a comparison of existing airborne gravity measurement systems, as well as a testing period for the LCR gravimeter in preparation for the north Greenland survey.

For the June 1998 test three airborne gravity systems were flown: a strapdown INS/DGPS system, a LaCoste and Romberg (LCR) modified 'S' type air/sea gravimeter, and an orthogonal triad of QA 3000 Q-Flex accelerometers. The strapdown INS system is the Honeywell Laseref III owned by Intermap Technologies Ltd. of Calgary, Canada. This strapdown system has been flight tested for airborne gravity determination twice by The University of Calgary, see Wei and Schwarz (1998) and Glennie and Schwarz (1999). The LCR gravimeter is owned by the University of Bergen, Norway and previously has been successfully flown in campaigns for the AGMASCO (Airborne Geoid Mapping System for Coastal Oceanography) project, see Hehl et al. (1997) and Bastos et al. (1998). The Q-Flex triad was developed by Dr. G. Boedecker at the Bavarian Academy of Sciences, Munich in cooperation with the AGMASCO project. The results from the Q-Flex triad will be reported elsewhere.

The three independent systems were mounted in a Twin Otter airplane. Two dual frequency GPS antennas were mounted on the fuselage of the aircraft. The front antenna was attached to a Trimble 4000 SSI receiver, while the rear antenna signal was split between another Trimble 4000 SSI and an Ashtech Z-XII receiver. The Ashtech receiver was required to provide time synchronization for the strapdown INS. Three days of testing were undertaken. The flight patterns for the three days are shown in Figure 1. For the first flight (June 6th) master GPS stations were located at Kangerlussuaq and Ilulissat (see Figure 1). Data for the Q-Flex unit was not collected on the first day. For June 8th and 9th, master GPS stations were located at Kangerlussuaq, Ilulissat and Aasiaat. The master stations at Kangerlussuaq and Aasiaat were equipped with Trimble 4000 SSI receivers while the Ilulissat site was occupied withan Ashtech Z-Surveyor receiver. All flights were performed during the afternoon (local time) over the ocean. Average flight heights were approximately 300 metres, with an average flight velocity of zapproximately 70m/s.

8 mm

Figures are placed at the bottom or top of a page if possible

2 mm

8 mm

Fig. 1 Flight Lines and Master Station Locations (*).

To provide an independent reference, four flight lines were flown over top of existing shipborne gravity data profiles, one on June 6, one on June 8, and two on June 9.

4 Test Results

Hardware problems plagued this initial test. The LCR gravimeter was affected by data loss and communications malfunctions that gave rise to occasional outages of data. It was later isolated as being due to power supply problems. Additionally, on the third day of testing a brief power problem in the airplane caused a malfunction of the strapdown INS data-logging computer. As a result, there is no strapdown inertial data available for the third day and therefore only the first two days of testing will be reported on .A total of five flight lines were flown for the first two days of testing. These lines will be denoted by A, B, C (June 6th) and F and G1 (June 8th), see Figure 1. Flight lines A and G1 were partly flown over top of existing shipborne gravity profiles, and therefore an independent reference is available for these lines.

In order to provide a common basis of comparison for the two system estimates similar filtering operations must be applied to each. The data processing scheme for the LCR gravimeter employs a 2nd order Butterworth low-pass filter with a cut-off frequency of 0.005 Hz, or a full-wavelength period of 200 seconds. For this flight test this corresponds to a spatial resolution of 6 km (half-wavelength).

The LRF III gravity estimates were also low-pass filtered to the same cut-off frequency. It should be noted that the identical filter was not used, only the same cut-off frequency. Therefore, distortion due to transfer function differences between the two filters may cause discrepancies in the results. However, it is expected that this effect will be negligible compared to the overall system errors.

The same DGPS position estimates were used to determine aircraft kinematic acceleration for both systems. Obviously, the position estimates must be differentiated twice to determine acceleration .KMS uses a first-order Taylor Series central difference approximation to differentiate the data. The U of C acceleration estimate is computed using a low-pass FIR differentiating filter. Bruton et al. (1999) describe and compare these two methods of differentiation. The conclusion in this reference is that the above two methods are nearly equivalent for the frequency band of interest in airborne gravity.

Therefore, differences in the estimates between the LCR and the LRF III systems should represent the combined noise levels of the two systems' specific force estimates plus any differences due to lever arm effects (due to different measurement origins). In order to compensate for the lever-arm effect the offset between the LCR and LRF III was used along with the strapdown INS angular velocities to compute a lever arm velocity. This velocity. This velocity was then differentiated to compute a relative lever-arm acceleration that was subsequently low-pass filtered to 200 seconds. The filtered lever-arm acceleration corrections were then applied to the LRF III data.

The results of the comparison between the LCR and the LRF III estimates for all five flight lines are displayed in Table 1. The RMS of the differences was computed, and therefore, these values are divided by $\sqrt{2}$ to get an idea of the standard deviation (σ) for each measuring unit, assuming the systems have the same accuracy. It should also be noted that a linear bias has been removed between the two system estimates. The linear biases have a slope of approximately 0.01 mGal/s. This linear bias is due mostly to the behaviour of the accelerometer biases for the LRF IIIstrapdown INS system, see Glennie (1999).

8 mm

Table 1. Comparison of LCR and LRF IIIGravity Estimates, in mGal (T_c=200 sec)

Flight line	RMS	σ
A	2.4	1.7
B	3.0	2.1
C	1.4	1.1
F	7.7	4.4
G1	4.0	2.9

Tables are also Placed at the Bottom or top of a page if possible. They are in small type (8.5 pt, line spacing 3.5 mm)

8 mm

The LCR gravimeter showed a very stable bias behaviour. Table 2 shows the RMS crossover errors for the LCR before and after applying a constant bias for each flight track for all three days of testing, based on a total of 15 crossovers. The small value of the crossover errors indicates LCR accuracies below 2 mGal, and illustrates the long-term stability of the spring gravimeter system. However, it should be noted that the low RMS after the bias adjustment is likely too optimistic due to the small number of crossovers. For all three days, a comparison of the LCR estimates to available ground truth yielded an overall RMS difference of 3.1 mGal for the unadjusted data set.

Two of the flight lines common to both systems during the Greenland test (A and G1) were partly

References

Bastos, L., S. Cunha, R. Forsberg, A. Olesen, A. Gidskehaug, U. Meyer, T. Boebel, L. Timmen, G. Xu, M. Nesemann, K. Hehl (1998). An Airborne Geoid Mapping System for Regional Sea-Surface Topography: Application to the Skagerrak and Azores Areas. In: *Proc of International Association of Geodesy Sy mposia 'Geodesy on the Move'*. Forsberg R Feissel M Dietrich R (eds) Vol. 119, Springer Berlin Heidelberg NewYork, pp 30-36.

indent 4 mm

Brozena, J.M. (1992). The Greenland Aerogeophysics Project: Airborne Gravity, Topographic and Magnetic Mapping of an Entire Continent. In: *Proc. Of IAG Symposium G3: Determination of the Gravity Field by Space and Airborne Methods*, Springer Verlag, pp. 203-214.

Brozena, J.M., M.F. Peters and V. A. Childers (1997). The NRL Airborne Gravity Program. In: *Proc. of International Symposium on Kinematic Systems in Geodesy, Geomatics and Navigation (KIS97)*, Banff, Canada, June 3-6, pp.553-556.

Bruton, A. M., C. Glennie, and K.P. Schwarz (1999). Differentiation for High Precision GPS velocity and Acceleration Determination. *GPS Solutions*, Vol 2, No. 4.

Foote, S. A., and D.B. Grindeland (1992). Model QA-3000 Q-Flex Accelerometer: High Performance Test Results. In: *Proc. Of IEEE PLANS 92*, IEEE, Piscataway, NJ, pp. 534-543.

Forsberg, R., A.V. Olesen, and K. Keller (1992). Airborne Gravity Survey of the North Greenland Shelf 1998. *Kort & Matrikelstyrelsen Technical Report*, in print.

Forsberg, R., and S. Kenyon (1994). Evaluation and Downward Continuation of Airborne Gravity Data -The Greenland Example. In: *Proc. of International Symposium on Kinematic Systems in Geodesy, Geomatics and Navigation (KIS94)*, Banff, Canada, August 30- September 2, pp. 531-538.

Glennie, C., (1999). An Analysis of Airborne Gravity by Strapdown INS/DGPS. Ph.D. Thesis, *UCGE Report #20???*, Dept. of Geomatics Engineering, The University of Calgary.

Glennie, C., and K.P. Schwarz (1999). A Comparison and Analysis of Airborne Gravimetry Results from Two Strapdown Inertial/DGPS Systems. Accepted by: *Journal of Geodesy.*

Hehl, K., L. Bastos, S. Cunha, R. Forsberg, A.V. Olesen, A. Gidskehaug, U. Meyer, T. Boebel, L. Timmen, G. Xu and M. Nesemann (1997). Concepts and First Results of the AGMASCO Project. In: *Proc. of International Symposium on Kinematic Systems in Geodesy, Geomatics and Navigation (KIS97)*, Banff, Canada, June 3-6, pp. 557-563.

LaCoste, L.J.B. (1988). The Zero-Length Spring Gravity Meter. *Geophysics*, 7, pp. 20-21.

Olesen, A. V., R. Forsberg and A Gidskehaug (1997). Airborne Gravimetry Using the LaCoste and Romberg Gravimeter - An Error Analysis. In: *Proc. of International Symposium on Kinematic Systems in Geodesy. Geomatics and Navigation (KIS97)*, Banff, Canada, June 3-6, pp. 613-618.

Schwarz, K. P., and M. Wei (1997). Inertial Surveying and INS/GPS Integration. *ENGO 623 Lecture Notes*, Department of Geomatics Engineering, The University of Calgary.

Schwarz, K. P., and Z. Li (1996). An Introduction to Airborne Gravimetry and its Boundary Value Problems. *Lecture Notes, IAG International Summer School*, Como, Italy, May 26-June 7.

Schwarz, K. P., and M. Wei (1994). Some Unsolved Problems in Airborne Gravimetry. *IAG Symposium 'Gravity and Geoid'*, Graz, Austria, September 11-17, pp. 131-150.

Valliant, H.D. (1992). The LaCoste and Romberg Air/Sea Gravity Meter: An Overview. *CRC Handbook of Geophysical Exploration at Sea*, 2nd Ed. Hydrocarbons, CRC Press Inc, pp. 141-176.

Wei, M., and K.P. Schwarz (1998). Flight Test Results from a Strapdown Airborne Gravity System.. *Journal of Geodesy*, 72, pp.323-332.