



2009 Annual Meeting of COMPRES

— June 19-22, 2009 at Bretton Woods, NH

Attended by 109 formal participants and another two dozen accompanying guests, the meeting was one of the most important events of COMPRES. Forty two institutions including thirty six US members of COMPRES

and six foreign institutions were presented. As a tradition of the annual meeting, one focus of the scientific agenda is interdisciplinary presentations. This year's keynote lectures include: "Seismic Observations



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of Mantle Discontinuities and their Mineral Physical Interpretation" by Arwen Deuss - Cambridge University, "Some Implications of Recent Progress in High P-T Mineral Physics for Earth's Deep Interior" by John Hernlund - University of British Columbia, "Mantle Viscosity and Climate (Really)" by Jerry Mitrovica - University of Toronto/Harvard University, "Seismically Imaging the Possible Presence of Water in the Mantle" by Michael Wysession - Washington University, "Deep Carbon Observatory" by Alexander Goncharev - Carnegie Institution of Washington, "The Role of Mineral Physics in the Study of Earth's Evolution" by Jun Korenaga - Yale University and "The Earth is not a Spherical Chicken" by Alex Navrotsky - University of California Davis. (continued on page 2)

President's Message

Bob Liebermann

Following are a number of items that may be of interest to you as members of the COMPRES community.

High Pressure Synchrotron Workshop at the APS: May 6-8, 2009

I attended the HiPreSS Workshop organized by Malcolm Guthrie and his colleagues at HPSynC [Y. Ding, and M. Lerche]. This workshop was co-sponsored by COMPRES, along with CDAC and the APS, and industrial sponsors Almax, easyLab and Oxford Lasers. Many members of the COMPRES community attended and the following gave talks: Evgeny Gregoryanz, Przemek Dera, Leonid Dubrovinsky, Reinhard Boehler, Thomas Duffy, Viktor Struzhkin, Wolfgang Sturhahn, Charles Lesher, Tetsuo Irifune, Natalia Dubrovinskaia, Wendy Mao, Alexander Goncharov, Stanislav Sinogeikin, and Vitali Prakapenka.

Details of the program may be found at: <http://www.hpsync.org/links/HiPreSS>

CIDER Workshop at Marconi Center, Marin County, California, May 17-20, 2009

The Cooperative Institute for Deep Earth Research [CIDER], a NSF-funded program for interdisciplinary research in Earth Sciences, held a strategic planning workshop at the Marconi Center in Califor-

nia., organized by Barbara Romanowicz, Adam Dziewonski, Stan Hart, Louise Kellogg, and Michael Manga. It was attended by 83 scientists from the disciplines of geodynamics, seismology, geochemistry, geomagnetism and mineral physics, as well as Sonia Esperanca and Robin Reichlin, Program Directors in the Division of Earth Sciences at NSF. Speakers from the mineral physics community included Marc Hirschmann, Jackie Li, Dan Frost, Steve Jacobsen, Wendy Panero, Greg Hirth, Dan Shim, and Wendy Mao. I presented at talk on the relationship(s) between COMPRES and CIDER and the opportunities for further collaboration.

Details of the program may be found at: <http://www.deep-earth.org/workshop09.html>

Visit by COMPRES President to China

In July, I visited Harbin Institute of Technology at the invitation of Professors Haozhe Liu and Luhong Wang and their colleagues. During this visit, I met with administrators, faculty, staff and students of HIT and presented a series of lectures on COMPRES activities and on "Indoor vs. Outdoor Geophysics."

In Harbin, I also presented an invited talk at a Workshop on Advanced Crystallography at High Pressure under the auspices of the International Union of Crystallography.

(continued on page 3)



COMPRES Annual Meeting *(cont'd from page 1)*

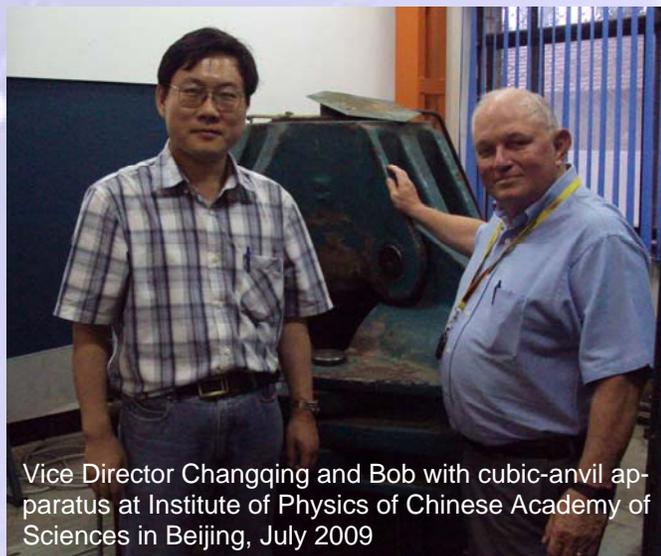
New additions started from this year's meeting are the selected graduate student talk session and the proposal writing workshop, both of which were recommended by the Grad Student Committee last year at Cheyenne Mountain annual meeting. Eight of the nineteen student participants made short presentations at the student talk session. Dr. Barbara Ransom, Program Director at the National Science Foundation presented the proposal writing workshop entitled: "Funding Your Science!". Two other Directors from NSF including Robert Detrick, the new Director of the Division of Earth Sciences attended the meeting as well. Dr. Detrick delivered an upbeat presentation on the current status and future prospects for funding of the Earth sciences. The meeting also attracted the ten industrial sponsors: Almax, Blake Industries, D'Anvils, Depths of the Earth, easyLab, Foxwoods, Leica Microsystems, MG63, Rockland Research, and Technodiamant, four of them sent representatives to Bretton Woods. ■■■

Photos on the left: Plenary Session of the meeting

President's message

(cont'd)

Following a week in Harbin, I visited the Institute of Physics of the Chinese Academy of Sciences at the invitation of Professor Changqing Jin. This visit included a tour of labs in IPCAS, discussions with staff and students, and a two-part seminar on mineral physics and the role of COMPRES.



Vice Director Changqing and Bob with cubic-anvil apparatus at Institute of Physics of Chinese Academy of Sciences in Beijing, July 2009

European High Pressure Research Group in Paris

On September 6-11, I attended the XLVIIth Conference of the EHPRG in Paris, France and presented an invited paper on "Indoor vs Outdoor Geophysics." This conference was organized by A. Polian, M. Gauthier and S. Klotz of the Institut de Minéralogie et Physique du Milieu Condensés. It was held at "Les Cordeliers", a former convent that now belongs to the Université Pierre et Marie Curie in the Quartier Latin, and included a "field trip" to the Chateau of Versailles and a dinner boat trip on the Seine. Additional details of the program may be found at: <http://www-int.imPMC.upmc.fr/imPMC/47ehprg>.

"Partnership for Extreme Conditions Science" at ILL and ESRF

On Friday September 11, I also attended a workshop on a "Partnership for Extreme Conditions Science" organized by the scientific staff from the Institut Laue-Langevin [ILL] and the European Synchrotron Research Facility [ESRF] in Grenoble. The goal of this partnership is to establish support facilities for extreme conditions research at these two European facilities which share the same campus. These developments appear to share some similarities to the Joint Photon Science Institute at the Brookhaven National Laboratory, a new initiative being spearheaded by Chi-chang Kao of BNL and

John Parise of Stony Brook University. Additional details on this new PECS initiative may be found at: <http://www.ehprg.org/docs/PECS2.doc>

Visits in Germany in September

Following the EHPRG meeting, I travelled to Potsdam, Germany [near Berlin] to visit the GFZ [GeoforschungsZentrum] German Research Centre for Geosciences of the Helmholtz Foundation at the invitation of Hans-Joachim Mueller. At the GFZ, I visited labs, including the Brillouin spectroscopy lab of Sergio Speziale, and gave a hybrid seminar on mineral physics and COMPRES.

While in Germany, Mueller drove me to Hamburg for a half-day visit to DESY [Deutsches Elektronen-Synchrotron, where I had a tour of the high-pressure facilities at the DORIS ring [MAX-80 and MAX-200X], which are operated by staff of the GFZ in Potsdam. I also met with the Vice Director for Photon Science, Dr. Edgar Weckert to discuss plans for high-pressure beamlines at Petra III, the new synchrotron ring now under development at DESY. See photo.



Hans-Joachim Mueller and Bob with MAX200X apparatus at DESY synchrotron in Hamburg in September 2009

GSA Annual Meeting in Portland, Oregon on October 17-21, 2009.

I attended the GSA Meeting this year, primarily to participate in a special session in honor of Alex Navrotsky convened by Gordon Brown, Abby Kavner, Nancy Ross and Glenn Waychunas, and presented another version of my talk on "Indoor vs Outdoor Geophysics."

At the MSA Awards luncheon on October 20, Alex received the 2009 Roebling Medal and Bob Hazen received the 2009 Distinguished Public Service Award. *(continued on page 4)*

President's message

(cont'd)

At the MSA business meeting on Oct 20, the following awards were announced:

2010 MSA Fellows: Thomas Duffy, David Kohlstedt, William McDonough Renata Wentzcovitch, Richard Wirth, Youxue Zhang.

2011 Dana Medal to Ross Angel.

The MSA also announced the appointment of Martin Kunz as the new Editor of *American Mineralogist*.

Awards and honors to members of the COMPRES community

David Kohlstedt from the University of Minnesota and Peter Shearer from the University of California San Diego were elected to the NAS in April 2009. We congratulate them both and appreciate that Peter considers himself to be an honorary mineral physicist.

At the 2009 AIRAPT Meeting in Tokyo in August, Russell Hemley received the Bridgman Award. Yasuhiro Kuyayama won the 2009 Jamieson Award for his work in ultrahigh-pressure mineralogy based on *in situ* X-ray diffraction measurements; he is now at Ehime University. Takehiro Kunimoto, a PhD

student at Ehime University, won an outstanding poster award

At the Joint Assembly: The Meeting of the Americas, in Toronto, Canada from May 24-27, 2009, the following were inducted as Fellows of the AGU from the mineral physics community: Jay Bass, Donald Dingwell, Kei Hirose and Frederic Ryerson.

David Kohlstedt received the 2009 Murchison Medal of the Geological Society of London.

At the Goldschmidt Conference in Davos, Switzerland in July, Ronald Cohen received the 2009 Dana Medal of the MSA and Charles Prewitt received the first IMA Medal.

The European Geosciences Union has just announced that Teng-fong Wong has been selected to receive the 2010 Louis Néel Medal at a ceremony in Vienna in May 2010. Previous recipients of the Néel Medal include Subir Banerjee, Brian Evans, Yves Gueguen, David Kohlstedt, and David Price.

These awards, in addition to recognizing the significant achievements and contributions of each awardee, bring honor and visibility to the community of mineral and rock physicists throughout the world.



Alex Navrotsky and Robert Hazen received medal/award from MSA



Alex Navrotsky accepting Roebing Medal and Robert Hazen accepting the Distinguished Public Service Award from MSA President Nancy Ross in October 2009. DPSA citationist Russell Hemley looking on.

“...Alex Navrotsky is quite simply one of the outstanding scientists of our generation. Starting as an experimentalist with a specialty in high-temperature solution calorimetry, she has also exploited a diversity of other experimental as well as theoretical techniques to understand structure property-process relations in materials.... She helped to spearhead the effort that eventually led to the creation a NSF Center for High-Pressure Research (CHiPR)... Alex's accomplishments and interests have developed and further broadened following her move to Davis... Alex has also a highly developed sense of service toward the U.S. and international mineral science community. Ever since her early years in academia, she led numerous workshops, conferences, symposia, and short-courses that broke new ground in understanding the energetics, structures, and bonding in minerals and related materials...Her research is truly interdisciplinary and has successfully bridged many scientific divides, and that has enriched all of them.”

From citation by Nancy Ross

“Bob Hazen has worked tirelessly to promote scientific literacy in numerous monographs and articles, for example in 1991, in the widely successful *Science Matters: Achieving Scientific Literacy*, which was coauthored with James Trefil and is now in its sixth edition... He has spearheaded a long-term dialog about national scientific learning and education standards through the major national TV, radio, and print media, and through lectures, seminars and workshops he has organized at over one hundred colleges and universities across the country... Bob has been an articulate spokesperson in the creationism and intelligent design debates. He most recently helped write *Science, Evolution, and Creationism*, published by the National Academies...”

From citation by Russell Hemley

New COMPRES website now "live" at www.compres.us

A more professional appearance of the COMPRES website is now "live" at www.compres.us. This new website has been designed by a consulting company in Stony Brook, based on advice and guidance of a special subcommittee chaired by Quentin Williams and including Tom Duffy and Nancy Ross.

The website now becomes easier for readers to browse and for the webmaster to maintain. The motivation for seeking a new design and format came from comments of the Infrastructure Development Committee and the Executive Committee in December 2008. The COMPRES central office was strongly urged to engage a professional website design firm, and to make the website easier for our staff and volunteers to maintain.

Glenn Richard, Michael Vaughan and Ken Baldwin of the Mineral Physics Institute at Stony Brook have offered valuable consultations to the outside company during the development. The new website will be maintained by Emily Vance and Glenn Richard, with oversight by the President of COMPRES.



COMPRES WEBSITE



Russell Hemley accepting the 2009 Bridgman Award of AIRAPT from Takehiko Yagi, the winner of the 2007 award.

Russell Hemley received the 2009 Bridgman Award

"...Hemley's research areas range over a very large range, from solid-state chemistry to planetary science, condensed matter physics, and material science and his achievements are truly outstanding. In mineral physics Hemley contributed significantly to the better understanding of structural transformation of silica using Raman spectroscopy...He pioneered a number of synchrotron techniques for high pressure Raman, Mössbauer, infrared, absorption and diffraction studies...Many researchers throughout the world have been educated by him and have benefitted from his personal qualities, his talents, his leadership and his productivity.

From citation by Reinhard Boehler

Prewitt received the first IMA Medal

"Charlie Prewitt has been at the forefront of systematic crystal chemistry crystallographic technique development since the 1960's... The list of young colleagues Prewitt has worked with, trained, and influenced reads like a who's who: Cameron, Brown, Hazen, Finger, Angel, Ross, Palmer and many others... Prewitt was a founding editor of Physics and Chemistry of Minerals. He has helped define mineral physics as a field. As Director of the Geophysical Laboratory at the Carnegie Institution of Washington for a decade, he has helped shape its agenda and that of the community. As a co-director of CHiPR, the NSF Science and Technology Center in High Pressure Research, he has helped develop both research and facilities for synchrotron based crystallography."

From nomination letter by Alex Navrotsky.



Charles Prewitt accepting the first IMA Medal from MSA President Nancy Ross at the Goldschmidt Conference in Davos, Switzerland in July 2009. With Larissa Dobrzynetska looking on.

AWARDS AND HONORS



New Committee Members

At the 8th Annual Meeting of COMPRES in Bretton Woods, NH, the following new COMPRES committee members have been elected:

James van Orman

Member of Executive Committee, 2009-2012.

Wendy Panero

Chair of the Facilities Committee, 2009-2011,

Member of the Facilities Committee, 2009-2012

Wendy Mao

Member of Facilities Committee, 2009-2012

Abby Kavner

Member of Infrastructure Development Committee, 2009-2012

New Member Institutions

The Executive Committee has approved the applications for membership from following institutions:

US Member Institution

Brookhaven National Laboratory, with Lars Ehm as Elector and Markus Hücker as Alternate Elector.

Foreign Affiliated Member Institution

Jilin University in Changchun, China, with Xiaoyang Liu as Representative.

These new additions bring the total number of U. S. member institutions to 54 and the number of foreign affiliate members to 34.

NEW TO COMPRES



Ronald Cohen accepting the 2009 Dana Medal from MSA President Nancy Ross at the Goldschmidt Conference in Davos, Switzerland in July 2009.

Ronald Cohen received the 2009 Dana Medal

“With training in experimental petrology, field geology, and meteoritics, Ron moved into computational mineralogy, where he overturned the prevailing view that such work was of limited utility and lacked predictive capability, particularly for the deep Earth... Perhaps more than anyone, he showed geoscientists that calculations in mineralogy could have the accuracy, quality, and impact of those done in physics, and he showed physicists that there is a world of problems and complexity in nature beyond simple crystals.”

From citation by Russell Hemley

AWARDS AND HONORS



David Kohlstedt accepting the Murchison Medal of the Geological Society of London from the President Lynne Frostick in June 2009

David Kohlstedt received the Murchison Medal

“David Kohlstedt’s research has focused on the mechanical properties of rocks on Earth and other planets, and the way that they influence geodynamic processes and geochemical evolution ... Kohlstedt’s background as a materials scientist has proved a key jumping-off point for his work in geophysics... David Kohlstedt, your science emphasizes how carefully designed and constructed experimentation, backed by rigorous theoretical analysis, remains crucial to the resolution and illumination of many important outstanding problems in planetary geology.”

From citation by Ted Nield





Recent PhDs

Bin Chen, Ph.D. 2009

Department of Geology,
University of Illinois at Urbana-Champaign

Dissertation: *Nature and dynamics of Earth and planetary cores from high-pressure properties of iron-rich alloys*



My dissertation addresses a number of issues concerning the nature and dynamics of Earth and planetary cores, including the thermal equation of state of iron-rich alloys, the melting behavior of the iron-sulfur system at moderate pressures, and the thermal transport properties of Earth and planetary materials under high pressure.

In Chapter 2, I report the unit-cell parameters of the candidate inner core component Fe₃S using synchrotron x-ray diffraction techniques and externally-heated diamond anvil cells at pressures up to 42.5 GPa and temperatures up to 900 K. The zero-pressure thermal expansivity of Fe₃S is determined in the form $\alpha = a_1 + a_2T$, where $a_1 = 3.0 \pm 1.3 \times 10^{-5} \text{ K}^{-1}$ and $a_2 = 2.8 \pm 1.5 \times 10^{-8} \text{ K}^{-2}$. The temperature dependence of isothermal bulk modulus $(\partial K_{T,0} / \partial T)_P$ is estimated at $-3.75 \pm 1.80 \times 10^{-2} \text{ GPa K}^{-1}$. Our data at 42.5 GPa and 900 K suggest that ≈ 2.1 at. % (1.2 wt. %) sulfur produces 1% density deficit in iron. The results allow us to examine the candidacy of this constituent as a component of the Earth's core and estimate the sulfur content in the core.

I have conducted multi-anvil experiments to investigate the melting behavior of the iron-sulfur system at moderate pressures (Chapter 3). The data reveal a positive departure from ideal solution behavior at 14 GPa, as indicated by the presence of two inflection points on the liquidus curve of iron-rich compositions. In contrast, the shape of the liquidus curve at 10 GPa is consistent with nearly ideal mixing between end member components. Combined with existing data at lower pressures and above 20 GPa, the results suggest a negative liquidus temperature gradient under conditions found at shallow depths in Mercury's core. At the present time, the core is most likely precipitat-

ing solid iron in the form of snow, at a single depth or in two distinct zones. Formation and segregation of iron snow would alter the thermal and chemical state of the core and influence the origin and surface expression of the planet's magnetic field.

I studied the high-pressure melting behavior of iron-sulfur mixtures containing 9 wt% sulfur using the synchrotron x-ray radiographic method in a large volume press (Chapter 4). By opening two graphite windows along the X-ray path and using boron nitride capsules, I was able to observe segregation of sulfur-rich liquid and iron-rich solid upon initial melting and determine the eutectic temperature of the iron-sulfur system at pressures between 13 and 16 GPa. My results are in excellent agreement with the existing data from quench experiments, and are further supported by in situ X-ray diffraction measurements. The liquidus temperatures of this composition, determined on the basis of the disappearance of the solid phase on the radiographs, are also consistent with literature values. By observing radiographic changes with time, I monitored the approach to equilibrium and obtained preliminary data on the kinetics of the melting process.

To measure the thermal conductivity of compressed materials, I employed the time-domain thermoreflectance (TDTR) method combining with the diamond anvil cell technique (Chapter 5). I report high-pressure thermal conductivity data of water and ice phases up to 11 GPa and at 300 K. The thermal conductivity of Ice VII increases by more than a factor of ~ 4 from 3.3 to 11 GPa. The data help constrain the internal structure and thermal evolution of large icy satellites such as Ganymede and Callisto. The successful TDTR measurements at high pressures make a solid step towards obtaining the thermal transport properties of iron and iron-rich alloys under extreme conditions.

Personal Statement:

It had been my great privilege to work with my Ph.D. thesis advisor Prof. Jie Li and my colleagues at University of Illinois and the Advanced Photon Source, Argonne National Laboratory. Prof. Li first introduced me into the field of experimental mineral physics by motivating me with the words "a good experiment is forever". I was fortunate to be exposed to both diamond anvil cell and large volume press techniques in synergy with many synchrotron techniques, by which I have conducted high-pressure experiments to understand the Earth and planetary interiors. I am currently a Texaco postdoctoral fellow at the Division of Geological and Planetary Sciences at California Institute of Technology working with Jennifer Jackson. My current research interests include equation-of-state and sound velocities of iron-rich alloys and mantle minerals, melting behavior of iron-(nickel)-light-element systems to extreme conditions, and diapirism as a core formation mechanism. Finally, I would love to collaborate with the mineral physics community and beyond to tackle some of the challenges in geosciences by investigating microscale material properties and thus peering through many macroscale geological and planetary phenomena.

— Bin Chen

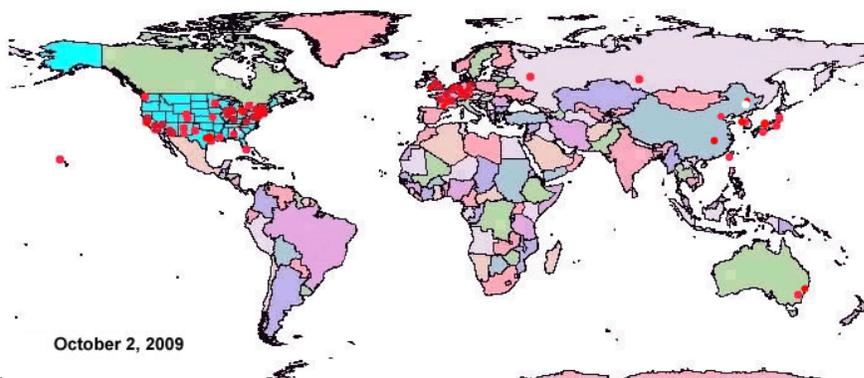
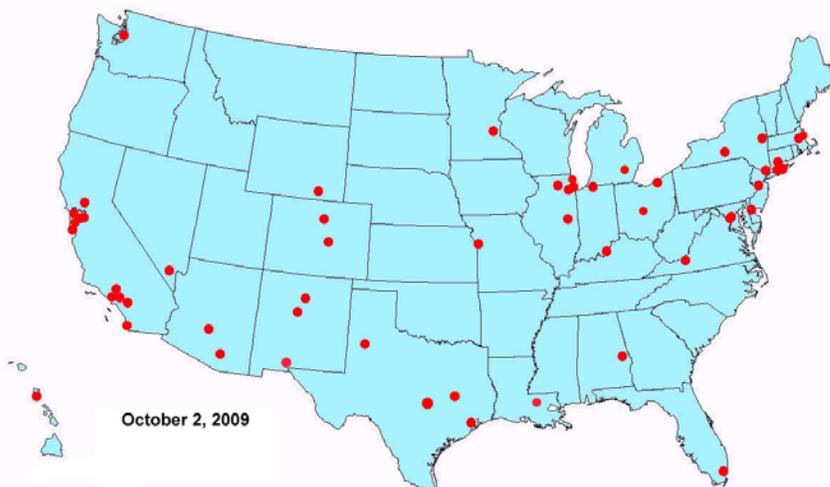
COMPRES Membership

Institutional Members

COMPRES is community based. Educational and not-for-profit US Institutions are eligible to become members, and each institution is entitled to one vote in the decision process. The membership defines policy and charts the future of the consortium. Other organizations and non-US institutions are eligible to be affiliated members with a non-voting representative to all COMPRES business meeting.

Membership in COMPRES brings a voice in the decision-making process of the organization and financial support for the representative to attend the annual meeting. There is no financial cost to the Institution. The only obligation that the Institution assumes is an active interest and participation in the organization. Thus, becoming a member offers only gains with little cost to the Institution.

Currently active members of COMPRES include 54 U. S. institutions and 34 foreign affiliated members.



COMPRES MEMBERSHIP

Earth Probe

COMPRES Newsletter
 Editor: Jiuhua Chen
 Photographer: Michael T. Vaughan, Glenn A. Richard
 Published electronically on www.compres.us
 Hardcopies are available upon request at
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