Newsletter of the Global COE program

Deep Earth Mineralogy

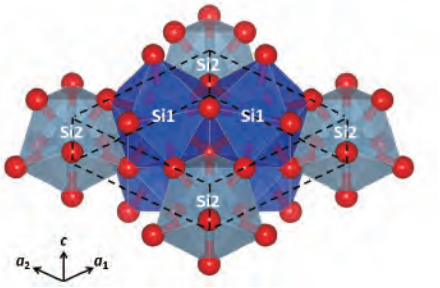
Center for Advanced Experimental and Theoretical Deep Earth Mineralogy
先進的実験と理論による地球深部物質学拠点

No. 7, January 31, 2011

News & Events

A new high-pressure form of silica

Prof. Taku Tsuchiya of GRC and Dr. Jun Tsuchiya of the Senior Research Fellow Center (SRFC), Ehime Univ., announced that they found a new high-pressure form of SiO_2 at extremely high pressures in the tera-pascal regime on the basis of first-principles calculations. SiO_2 is one of the most common mineral in the Earth's crust, which undergoes successive transitions to various forms: coesite (~2 GPa), stishovite (~9 GPa), $CaCl_2$-type (~60 GPa), and α-PbO_2-type (~120 GPa), and finally pyrite-type phase (~270 GPa). The present work by Taku and Jun Tsuchiya predicted that this structure should further transform to the Fe_2P structure, and suggested that this phase may be important in some massive terrestrial exoplanets called "super Earths" after the breakdown of $MgSiO_3$ post-perovskite. These results were reported in *Proc. Natl. Acad. Sci. U. S. A.* in early January. Also the new phase change was successfully confirmed experimentally in some low-pressure analog dioxides by collaborative researches with Dr. Yasuhiro Kuwayama in the experimental group of GRC.

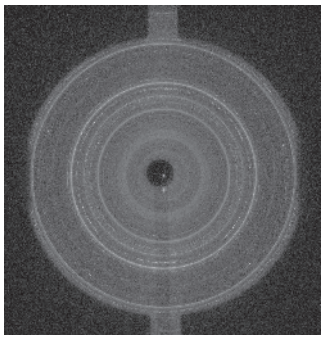


New results on olivine deformation mechanism

Dr. Tomohiro Ohuchi, a post-doctoral fellow of GRC, found a new fabric transition pass in olivine under the pressure and temperature conditions of the upper mantle, using the MA-6-6 system in a large-volume deformation DIA apparatus (MADONNA-1500) at GRC. Dr. Ohuchi and the members of the Rheology group of GRC conducted simple-shear deformation experiments on olivine aggregates at pressures P = 2.1-7.6 GPa, temperatures T = 1493-1673 K, and shear strain rates of 1.5-7.5×10^{-5} s^{-1} under dry conditions, and found that the rapid decrease in seismic anisotropy is caused by the fabric transition from A-type to B-type-like fabric at 7.6 GPa. They conclude that the variations of CPO with pressure and temperature in olivine under dry conditions can explain the seismic anisotropy signatures observed in the upper mantle, without invoking other mechanisms. This paper is currently in press in a major international journal *Earth and Planetary Science Letters.*

D-DIA experiments at SPring-8

The DIA-type guide blocks of a multianvil apparatus, SPEED-MkII, at BL04B1 at SPring-8 have been replaced by a deformation-DIA (D-DIA) type blocks of MADONNA-1500 at GRC for *in situ* X-ray measurements on uniaxially deformed samples at high pressure and high temperature. Initial testing of this system combined with synchrotron radiation by Drs. Takaaki Kawazoe, Tomohiro Ohuchi, Norimasa Nishiyama of GRC, and Dr. Yu Nishihara of the SRFC, with the help of Drs. Ken'ichi Funakoshi, Yuji Higo, Takehiro Kunimoto of JASRI, was successful and proved that this system is quite useful in rheological studies of high-pressure phases under deep mantle conditions. They have already succeeded in producing pressures and temperatures of the mantle transition region using this system, and are currently pursuing deformation experiments under such high P-T conditions.



The 7th JSPS prize to Prof. Tsuchiya

The Japan Society for Promotion of Science (JSPS) announced that Prof. Taku Tsuchiya is selected as one of the 25 awardees of the 7th JSPS prize in all research fields in Japan. This prize was founded to encourage the outstanding young researchers (<45 y.o.), who are expected to become world-class leaders in the individual research fields. Only Prof. Tsuchiya was selected in Earth sciences this year, who is also the first to receive this prize in the Shikoku region (one of the four major islands in Japan). The award ceremony will be held on 3rd March in the Japan Academy, attended by the Prince Akishino of the imperial family.

Prof. Kagi elected as MSA Fellow

Prof. Hiroyuki Kagi of the Geochemical Research Center (GCRC), who is the representative of the allied member of our global COE program at the Univ. Tokyo, was elected as the Fellow of the Mineralogical Society of America. MSA is the world largest society in mineral sciences and annually elects Fellows from the members who made significant contributions in the advancement of mineralogy. The number of the fellows elected each year is limited to less than 0.5% of MSA membership.

Global COE
DEEP EARTH MINERALOGY
EHIME UNIVERSITY JASRI, UNIV.TOKYO, SBU

JSHPST award for young scientists to Drs. Nishihara and Tange

Drs. Nishihara & Tange

Dr. Yoshinori Tange, an assistant professor at GRC, and Dr. Yu Nishihara, a senior research fellow of the SRFC, Ehime Univ., independently received the Japan Society of High Pressure Science and Technology (SHPST) award for young scientists. This award is annually given to one or two outstanding young scientists working in various research fields, such as physics, chemistry, Earth sciences, materials science, biology, etc., where high-pressure is used as the main tool. Dr. Tange was awarded mainly because of his achievements in development of multianvil techniques with sintered diamond anvils, while Dr. Nishihara was highly evaluated for his works on the rheological studies of mantle minerals at high pressure. This is the very first case where the awardees are selected from the same institute (and the same research field).

Flinn-Hart award to Dr. Spengler

The 2011 Flinn-Hart award has been announced to be presented to Dr. Dirk Spengler, a post-doctoral fellow of the SRFC of Ehime Univ., who has been working at GRC under the supervision of Dr. Y. Nishihara of the SRFC. This international award is presented by the Bureau of the International Lithosphere Program (ILP) to an outstanding young scientist for contributions to the solid Earth sciences covered by the ILP. 11 awardees (including the previous Flinn Award winners from 1991) were selected in the past 20 years, and Dr. Spengler is the first winner from a Japanese institute. The award ceremony will be held in Vienna during the annual meeting of the European Geoscience Union in April.

Other awards to young scientists

Mr. Futoshi Isobe, a PhD student supervised by Prof. T. Irifune of GRC, received the student poster award during the 51st High Pressure Conference of Japan, held in Sendai and organized by the JSHPST, for his presentation on the synthesis of large bodies of high-quality nano-polycrystalline diamond. Mr. Masashi Arakawa, a PhD student supervised by Prof. H. Kagi of the GCRC, Univ. Tokyo, received the best student presentation award during the fall meeting of the Japan Society of Planetary Sciences held in Nagoya, and also the outstanding student award during the Joint meeting of the Japanese Society of Snow and Ice and the Japan Society for Snow Engineering in Sendai. Mr. Arakawa has made great advances in the structure and properties of ice XI. Meanwhile, Dr. Tomohiro Ohuchi, a COE post-doctoral fellow at GRC, and Mr. Chunyin Zhou and Mr. Fulong Wang, PhD students at GRC, received the best presentation award during the 2nd TANDEM symposium held in Wuhan.

Hydrogen quantum atomics seminar at GRC

Dr. Jun Tsuchiya of the SRFC, Ehime Univ., organized the 8th meeting of the Hydrogen quantum atomics research group at GRC, partly supported by our global COE program. About 30 participants, mostly working in the fields of both experimental and theoretical physics, gathered and discussed various aspects of behaviours of hydrogen and hydrogen-bearing substances under pressure. During the meeting, 16 oral presentations were given, followed by intensive discussions from both theoretical and experimental points of views. A lab tour at GRC was also organized after the meeting.

Interim evaluation of the GCOE programs

The results of the mid-term evaluation of the individual global COE program were reported on 7 January, where our program on "Deep Earth Mineralogy" is rated as the A rank, meaning that "it should be possible to achieve the project's original objectives by continuing the current effort". In this year, 68 programs in Earth Sciences, Physics, Mathematics, Medical Sciences, Engineering, Social Sciences, etc. have been evaluated by the committee based on the reports and hearings and the results are open to public on the JSPS web page, where the percentages of the programs for the ratings are reported as A = 70%, B = 25%, and C =4 % (one program is being suspended for the final decision).

A new research project approved

A 4-year research project from Ehime University on the new materials synthesis using the 6000-ton multianvil (BOTCHAN-6000) and other facilities at GRC has been picked up by the MEXT (Ministry of Education, Culture, Sports, Science and Technology, of Japanese government) and decided by the Cabinet meeting on 27 December, 2010. The project aims at producing new materials, such as ultrahard and high-temperature superconducting materials, using the large volume multianvil apparatus and techniques developed in deep Earth mineralogy. Nano-polycrystalline diamond, or HIME-DIA, invented at GRC is one of the successful examples of such novel materials, which are being applied to various types of high-pressure apparatus and used as some industrial tools.

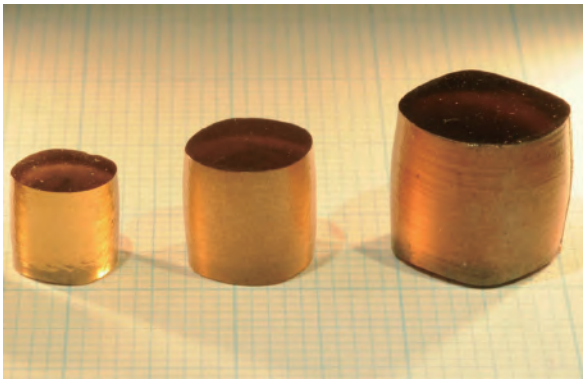
News & Events

10th anniversary of GRC

GRC was funded in April of 2001, and will soon have the 10th anniversary. A committee, consisting of the university council members, deans of relevant faculties, and some external members outside the university, has been organized to evaluate the achivement and performance of GRC in the last 10 years, and to discuss its future directions toward the next decade. The new directions may include further advancements of science and technology relevant particularly to 1) planetary interiors, 2) materials science, and 3) dynamics and evolution of the Earth. Another important agenda is whether GRC to reform as the national center for high-pressure mineral physics and related sciences. These issues are currently being intensively discussed in the committee, and the final decision will be made at the end of March 2010. A ceremony celebrating the anniversary will also be held later in this year.

Successful synthesis of 1cm HIME-DIA

Mr. Futoshi Isobe, a PhD student at GRC, succeeded to synthesis a flawless nano-polycrystalline diamond (NPH or HIME-DIA) rod of 1cm in both diameter and length, using 6000-ton multianvil apparatus (BOTCHAN-6000) at the SOSEKI Lab, GRC. The run was made at a press load of 4700-ton, using the second-stage anvils of 75mm edge length, truncated by 22 mm on the corners, under the condition of 15 GPa and 2600K. It is expected that HIME-DIA as large as 1.5 cm may be synthesized if the press capacity of BOTCHAN is fully used. Collaborations using HIME-DIA anvils have already started with several research groups in Japan and other countries, utilizing the outstanding features of NPD.



Forthcoming Events

The 4th International Special Lecture & Internship Program "Tutorial for Ultrasonic Interferometry Measurements of Sound Velocities at High Pressure"

Date: 21 (Lecture), 22- 23 (Execise) February, 2011
Venue: GRC, Ehime University
Lecturer:**Prof. Baosheng Li**
(Mineral Physics Institute, Stony Brook University, USA)
Supporting staffs: Matthew L. Whitaker (Assist. Prof., GRC),
Yoshio Kono: Global COE Assist. Prof., GRC)

Elasticity of materials at high pressure is of great importance in many scientific fields, such as materials science, physics, and of course, Earth science. This internship is an introductory course about the principles and methods of ultrasonic velocity measurements and their implementation in a high pressure apparatus to make precise sound velocity measurements for materials behavior and properties characterization at high pressure.

This tutorial course is targeted at undergraduate and graduate students, postdocs, and young scientists, with or without prior experience, who would like to incorporate this advanced technique into their research program.

The internship will include the following agenda.

1. Lectures on elasticity of materials, principles of ultrasonic interferometry, and implementation in high pressure apparatus.
2. Hands-on exercise of ultrasonic measurement at ambient pressure.
3. Hands-on exercise using high pressure apparatus for ultrasonic measurements.
4. Data analysis for the derivation of elasticity (bulk and shear moduli, Young's modulus, Poisson's ratio, etc) as well as their pressure derivatives.

No limitation for number of "Lecture" participants (21st), but the number of "Hands-on exercise" participants (22nd and 23rd) is limited to 10.

International sessions on Deep Earth Mineralogy at JpGU 2011 Meeting

Several international sessions will be held on deep Earth mineralogy during the Japan Geoscience Union (JpGU) Meeting 2011 in Makuhari on May 22 - 27. Among them, a session entitled "Mineral physics and dynamics of deep mantle", convened by Dr. M. Kameyama, Assoc. Prof. of GRC, solicits contributions from various disciplines on mineral physics and geodynamics of the planetary interiors, with special focuses on (1) thermal/chemical structure, (2) behaviours of fluids and/or hydrous minerals, and (3) rheology of the deep mantle. Also will be held a session entitled "Structure, Dynamics & Composition of Earth & Planetary Cores", convened by Dr. M. Whitaker, Assist. Prof. of GRC, aiming at deepening the understanding of the innermost part of our planets from seismological, mineralogical and fluid-dynamical aspects. Those who are interested in deep Earth mineralogy are greatly encouraged to join the discussions in these sessions. We particularly welcome researchers/students of TANDEM laboratories, to enhance mutual communications and collaborations in Asian countries. For further details, see the JpGU website (http://www.jpgu.org/) or directly contact Dr. Kameyama (kameyama@sci.ehime-u.ac.jp) or Dr. Whitaker (matt@sci.ehime-u.ac.jp).

International Frontier Seminar

20th (23rd February)
Lecturer : **Prof. Gabriel Gwanmesia**
Department of Physics & Pre-Engineering, Delaware State University
21st (early in April)
Lecture: **Prof. Robert C. Liebermann**
Department of Geosciences, Stony Brook University

Internship Report

Yoshio KONO (GCOE Research Fellow)

I visited Professor Ian Jackson's laboratory at the Research School of Earth Sciences (RSES), The Australian National University, for ~3 months (from September to December 2010). I studied frequency dependence of elastic properties using forced oscillation experiment. Knowledge on frequency dependence of elastic properties is important to close the gap of available frequency between laboratory ultrasonic experiments (~MHz) and seismic observation (~Hz). Ian Jackson has worked on frequency dependence of shear modulus and its attenuation by using torsional forced oscillation technique. In addition, he is recently developing flexure oscillation experiment to measure frequency dependent Young's modulus. Combination of these two techniques gives us important knowledge on the the frequency dependence of both P- and S-wave velocities.

During my stay at RSES, we carried out both torsional and flexure forced oscillation experiments for sapphire single crystal and melt-bearing olivine polycrystal samples. Forced oscillation experiment is very time-consuming work, and it took 5-10 hours to obtain a forced oscillation data at a given condition. Since torsional forced oscillation experiment is an established technique, I successfully obtained good results for frequency dependence of shear modulus and its attenuation. In contrast, because it was the first attempt for flexure oscillation experiment at high temperature conditions, we made many efforts to obtain successful flexure measurements. Although we still need further study to research frequency dependence of Young's modulus, this experience was good for me to study the technique of forced oscillation measurement.

Because I have had great interest in forced oscillation experiments for a long time, I am so grateful to the Global COE overseas internship program, which gave me the opportunity to visit RSES. I also greatly appreciate Prof. Ian Jackson and his colleagues for their supports in my stay at RSES.

Facility at GRC (I): ORANGES

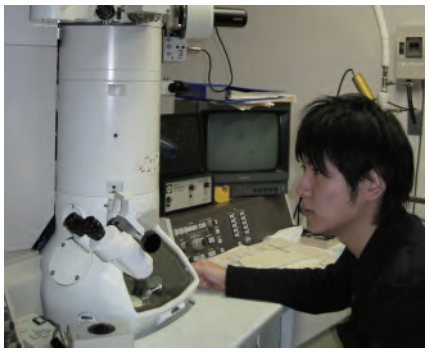
GRC has a variety of high-pressure apparatus for deep Earth mineralogy and relevant experimental studies. The ORANGE-1000 and ORANGE-2000 were constructed in 1996, five years before GRC was founded, supported by the MEXT (Ministry of Education, Culture, Sports, and Technology; Mombu-sho at that time), while ORANG-3000 was installed in 2003, at the same time as the Integrated Research Building was constructed mainly for GRC and other research centers. These multianvil apparatus are mostly used for "conventional" experiments at pressures up to 30 GPa and temperatures up to 3000 K by using a Kawai-type cell with WC second-stage anvils. The name "ORANGE" comes from the fact that oranges are the most famous products from Ehime prefecture. Another meaning for ORANGE is "Over the RANGE", indicating the challenging spirit in high-pressure technology to overcome the limitations of the pressure and temperature ranges in this type of apparatus.

COLUMN: Bloom of plum trees on the castle hill

Matsuyama castle, one of the most famous "mountain castles" (or more correctly "die Burgen" in German) in Japan, constructed some 400 years ago, is located on the top of a hill within a walking distance from Ehime University. Actually, it takes only 20 minutes on foot from GRC headquarters to the castle, and provides an ideal opportunity for daily exercise and refreshment. You can particularly enjoy spectacular views of the sunset on the Seto island sea and Mt. Ishizuchi, the highest mountain in western Japan, covered with snow, through the chilly but clear air of winter. At the end of winter, plum trees start to bloom first, followed by mountain cherries, and then Somei-yoshino cherries, under which people enjoy Hanami parties – drinking lots of sake, singing Karaoke songs, shouting... The Japanese fiscal year begins on 1st April, and so does the first semester in schools and Universities. This "renewal" season is now approaching, hopefully bringing another exciting decade for GRC, which was established in FY2001, just ten years ago.

Si - Al interdiffusion in majoritic garnet

Masayuki Nishi
(JSPS postdoctoral Fellow)



The transformation kinetics of mantle minerals would be the key to construct metastable phase relations in the subducting plate. Especially, the pyroxene-garnet transformation is likely very slow because this transformation is controlled by slow chemical diffusion of $Si^{4+} + M^{2+} \leftrightarrow 2Al^{3+}$ (M = Mg + Fe + Ca) in garnet. In this study, we measured the $Si^{4+} + M^{2+} \leftrightarrow 2Al^{3+}$ diffusion coefficient in garnet at high-pressure and high-temperature conditions in order to clarify kinetics of the pyroxene-garnet transformation.

Single crystals of natural pyropic garnet and polycrystalline majoritic garnet were used as the diffusion couples. Diffusion experiments were performed at 16 GPa and 1550-1700˚C for 5 - 50 hours with a multi-anvil high-pressure apparatus. Diffusion profiles in the garnet of recovered samples were examined by Transmission Electron Microscopy (TEM, JEM-2010; JEOL) equipped with EDS. TEM samples were prepared by using a focused ion beam (FIB) system (JEM-9310FIB; JEOL). Diffusion profiles obtained at 1550˚C for 50 hours are shown in Fig.1. The diffusion coefficients at various temperature conditions were determined by concentration gradient caused by the $Si^{4+} + M^{2+} \leftrightarrow 2Al^{3+}$ diffusion in garnet.

The pyroxene-garnet transformation requires long-distance $Si^{4+} + Mg^{2+} \leftrightarrow 2Al^{3+}$ diffusion comparable to the grain size of original garnet. If we consider the grain size of 1 mm for the parental garnet before the pyroxene-garnet transformation, the transformation requires high temperatures of more than 1500˚C comparable to a normal mantle geotherm. This suggests that the pyroxene-garnet transformation would be kinetically inhibited in cold subducting plates and the phase relations of a subducting plate are possibly different from equilibrium phase relations. These metastable phase relations of a subducting plate are sensitive to temperature conditions and may provide significant implications for the dynamics of plates by changing the density relation and mechanical properties.

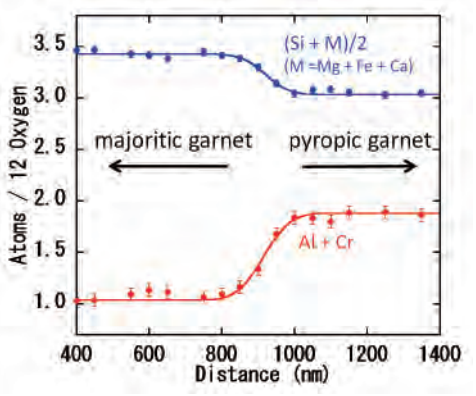
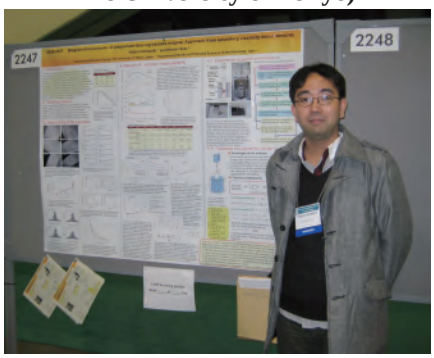


Fig. 1. Representative concentration profile measured by TEM-EDS on recovered sample at 1550˚C for 3000 minutes. Concentration gradient caused by the $Si^{4+} + M^{2+} \leftrightarrow 2Al^{3+}$ diffusion were observed between two garnet diffusion couples.

Textural petrology for understanding formation processes of rocks and rheological properties of magmas; experimental and analytical approaches

Hidemi Ishibashi
(Postdoctoral Fellow,
Geochemical Research Center,
The University of Tokyo)



The mechanisms of crystallization from magma and fluid are sensitive to environmental conditions during solidification. Given an adequate calibration of natural materials forming at controlled conditions, the textures of igneous rocks can provide information about physicochemical conditions in regions of the Earth inaccessible to direct observation. Conversely, the rheological properties of magmas, which influence transport processes, are strongly influenced by textural characteristics. "Textural petrology" is a field of study fundamental for understanding both formation processes and rheological properties of rocks and magmas, and hence to myriad related geological processes. I summarize here two analytical and experimental investigations in textural petrology, one aimed at the linkage between crystal morphology and formation environment of natural polycrystalline diamond, and the other establishing a quantitative relationship between rheology and crystallinity in basaltic magma.

We performed textural analyses of samples using FESEM and TEM to understand the formation processes of natural polycrystalline diamond, carbonado, the origin of which has been vigorously debated. We found negative crystals in single diamond crystals, interfaces between diamond-diamond and diamond-void boundaries dominated by {111}, and crystal size distribution patterns very similar to those of volcanic rocks. These observations suggest that carbonado was formed under diamond-stable and fluid-coexisting conditions in mantle, and are inconsistent with other leading hypotheses for their formation, such as phase transformation of organic carbon induced by impact or irradiation or chemical vapor deposition in interstellar space.

The rheology of crystal-bearing magma is a topic at the frontier of magma science, made exceptionally difficult to study because of the high temperatures at which experiments must be performed on natural materials. We performed laboratory viscosity measurements of magmas at magmatic conditions, and combined these in situ measurements with textural analyses of cooled samples to clarify the effects of crystals on rheology of magma. Our results showed that magma viscosity increases more sharply, and that the critical crystallinity for onset of non-Newtonian behavior is lower for tabular crystals than equant ones. To better understand the relation between crystal shape and magma viscosity, additional experiments are required. The starting point of my continued experimental and analytical research, to be conducted at the University of Hawaii (January- March, 2011), is to study the textural characteristics of basaltic magma crystallizing in response to various dynamic thermal histories.

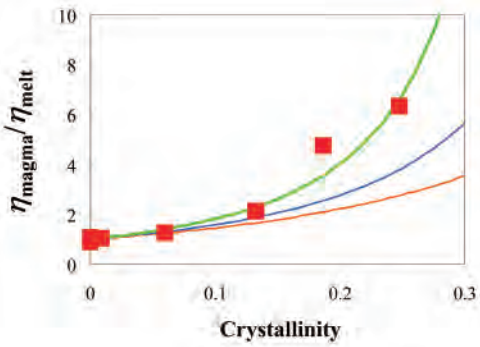


Fig. 1. The ratio of viscosity of magma to that of melt against crystallinity for a tabular-plagioclase bearing magma. The blue and orange curves indicate relations respectively predicted by Einstein-Roscoe and Costa's equations which describes the effect of isotropic shaped crystals on viscosity of magma. The best fit line for our result (green curve) significantly deviates upward from them; the deviation is attributed to shape difference of suspended crystals.

News & Events

2nd TANDEM symposium at CUG in Wuhan

The 2nd symposium of the TANDEM, the Asian network organization on Deep Earth Mineralogy, was held at China University of Geosciences, Wuhan, during 5-7 Novermber, 2010, with about 130 participants from China, Japan, Korea, Taiwan, USA, and Germany. About 70 oral/poster presentations were given, including keynote talks by Profs. T. Irifune (GRC, Ehime Univ.), Y. Wang (GSECARS, Chicago Univ.), Y. Fei (GL. CIW) and 8 invited talks.

The meeting of representatives of the TANDEM laboratories was also held during the symposium, and it was agreed that the next symposium will be held in Matsuyama, Japan, in 2012.

Outstanding presentation awards for young scientists (Ph.D. students and PD fellows) were selected by senior professors. The awardees are as follows.

- Ms. Tingting Gu (Peking Univ.), "In situ high-pressure study of FeP: implications for planetary cores"
- Dr. Tomohiro Ohuchi (GRC Ehime Univ.), "Simple-shear deformation of olivine using a deformation-DIA apparatus: implications for upper mantle seismic anisotropy"
- Ms. Sutao Zhao (CUG Wuhan), "Subducting lithosphere does not weaken as it crosses the 660 km discontinuity"
- Mr. Fulong Wang (GRC Ehime Univ.), "P-V-T equation of state of stishovite up to mid lower mantle conditions"
- Mr. Chunyin Zhou (GRC Ehime Univ.), "Phase relations in (Mg0.93Fe0.07)SiO3 to 24GPa: implications for seismic velocities of subducted harzburgite"
- Dr. Xinzhuan Guo (ISEI Okayama Univ.), "Electrical conductivity anisotropy of deformed talc rocks and serpentinite at 3 GPa"

Internship students from Peking Univ. to GRC

G-COE is making large efforts on the education not only of students at Ehime Univ but also of interinstitutional and international students. The short course internship program at GRC will accept new foreign graduate students from late February. Two Peking Univ students are going to visit the Theoretical Mineral Physics group for a month and work with Prof. Tsuchiya. They plan to learn some latest ab initio computation techniques on the finite temperature thermodynamics and study high-P,T behaviors of some oxides and silicates. One of them is also now trying to stay at GRC for a longer time with help from a Chinese scholarship program.

A visit to HP lab of Peking University

Prof. Tsuchiya and 3 Post-doc researchers of the Theoretical Mineral Physics Group of GRC visited the high-pressure lab of the Peking University after the 2nd TANDEM meeting. They had a joint seminar on the high-pressure theoretical mineral physics together on 9 November, 2010. 7 speakers in total (4 from GRC and 3 from the Peking Univ) reported their latest impressive research results including a new high-P,T phase change in silica, ab initio lattice dynamics of the iron-bearing post-perovskite, high-pressure phase relations of core-related materials, etc. Also various things from fundamental ab initio computation techniques to applications were discussed. This special joint seminar was definitely a great opportunity for all the young scientists and students to expand their expertise and also to cultivate international experiences.

Call for Special PhD course at GRC

A special PhD course in deep Earth mineralogy at GRC, Ehime University, is open for students from Asian countries with financial supports from the University. The candidates should complete their master's (or equivalent) thesis by the time of entrance. The course offers educational programs for advanced experimental, theoretical and computational studies on Earth's deep structure and related sciences and technologies. The exam and enrollment for FY2011 will be May and September, 2011, respectively. On the application of the Special PhD course for FY2010, see
http://deep-earth-mineralogy.jp/g-coe2008/english/positions/

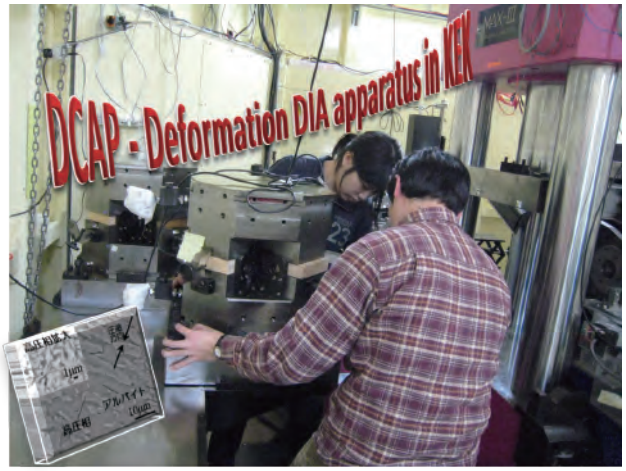
Application information for FY2011 will be announced March 2011 on the website above and the mailing list of the TANDEM.

Contact: Prof. Toru Inoue (inoue@sci.ehime-u.ac.jp)
Dr. Akira Yamada (yamada@sci.ehime-u.ac.jp)

Research Group for Earth and Planetary Material Science in Department of Earth and Planetary Science (DPES), Kyushu University

Kyushu-University was established in 1911 as Kyushu Imperial University and celebrated centennial anniversary in this year. Kyushu University, sometimes abbreviated to Kyudai, is the largest public university on the island of Kyushu and has near-city airport Hakozaki and several other campuses in Fukuoka City, Fukuoka prefecture. In its history, two major serious events are medical experimentation on living US military captives in 1945 and US Air Force Phantom crash on computer center in 1968. There are 11 undergraduate schools with 12,000 students and 17 graduate schools with 3,800 master course students and 2,700 doctor course students. Department of Earth and Planetary Sciences (DEPS) belong to Faculty of Science on duty to educate 51 undergraduate, 41 master course and 14 doctor course graduate students every school year. Our department was originally established as Department of Geology and reorganized in 1990 as DEPS in joint with part of Department of Physics, which made atmospheric and electromagnetic physics to their specialty. Nowadays, about half of 14 research groups in DEPS work on solid earth geophysics and geochemistry.

Research group for Earth and planetary material sciences has started high pressure experimental studies, since 2003 when Takumi Kato has moved to Fukuoka from University of Tsukuba. Tomoaki Kubo has joined in the next year from Tohoku University to establish the high pressure laboratory on mineral physics, which is specialized to clarify the transport properties of the Earth and planetary materials in extreme conditions. Other department members in the deep Earth related fields are Masao Nakada (Geodynamics), Satoshi Kaneshima (Seismology), and Atsushi Toramaru (Volcanology). Accordingly, in their research groups, there is no difficulty to find out a person, with whom we can discuss the origin and evolution of the Earth and the process and phenomena occurring in the Earth, planets and satellites. Two multi-anvil apparatus are used for the high pressure and high temperature conditions. MAX90 is 400 ton single stage DIA system, once used for the in-situ X-ray diffraction experiment at the beam lines of KEK in 1990's. Another system is the 700 ton double stage multi anvil system once located at Ehime University as EUDES. This system has the novel split cylinder type guide blocks designed in middle 1980's and is now renamed "QDES". It is capable of realizing the condition at the top of the lower mantle. Kinetics of the phase transitions and grain growth, and diffusion in the silicate and metallic materials are target of the studies using



Guide block exchange labor for DCAP deformation DIA apparatus installed at PFAR-NE7 beam line in KEK

these apparatus, as well as the starting material synthesis for the synchrotron X-ray diffraction experiments in SPring-8 and KEK. Diamond anvil cell is used to study the rheological properties of high-pressure ices at room and low temperatures. In the synchrotron facilities, we have studied on transformation kinetics and rheology of silicate minerals and ices at high pressures. We have been also actively promoting some collaborative researches with Drs. Eiji Ohtani and Akio Suzuki (Tohoku Univ.) on the transformation and rheology using a newly developed DCAP deformation DIA apparatus, with Drs. Shuguang Wang (China Earthquake Administration) and Jieyuan Ning (Peking Univ.) on the olivine transformation kinetics, with Dr. Tadashi Kondo (Osaka Univ.) on DAC experiments, with Dr. Sumit Chakraborty (Ruhr Univ.) on atomic diffusion in high-pressure minerals, and with Dr. William Durham (MIT) on rheology of planetary ices. Most of state-of-the art analytical facilities (FE-EPMA, FE-SEM, TEM, and STEM) are available in department and school sharing in Kyushu University. In near future possibly in 3 years, science, technology and related faculties are going to move to a new Ito campus, which is located at the west end of Fukuoka town.

Further information: http://www.geo.kyushu-u.ac.jp/

Correspondences:
Takumi Kato (tkato@geo.kyushu-u.ac.jp)
Tomoaki Kubo (kubotomo@geo.kyushu-u.ac.jp)

Christmas year ending party 12/24/2010 with field base mineralogy people and guest participants at Hakozaki Fujiyoshi wherein they served Yakitori, Cake, and Motsunabe.

High Pressure Laboratory of Peking University

Founded in 1898, Peking University (PKU) was originally known as the Imperial University of Peking. It was the first national university covering comprehensive disciplines in China, and has been a leading institution of higher education in China since its establishment. It also served as the highest administration for education at the beginning of its founding. In 1912, the university adopted its present name. At the end of the 20th century, the Chinese government put Peking University at the top of its agenda for promoting higher education, with the aim to build a world-class university in the 21st Century. After merging with Beijing Medical University in 2000, Peking University once again was strengthened in its disciplinary structure. Peking University has continually played the essential role of pioneers in the course of China's modernization. The university's traditional emphasis on patriotism, progress, democracy, and science, together with its educational standards of diligence, precision, factualism, and innovation, have been passed down from generation to generation. Peking University has been regarded as a symbol of modern Chinese education. It has become a center for teaching and research and a university of a new type, embracing diverse branches of learning such as basic and applied sciences, social sciences and the humanities, and sciences of medicine, management, and education. Its aim is to be one of the world's best universities.

The Department of Geology, a branch of the School of Earth and Space Sciences, was originally founded in 1909. It was the first department for geology in Chinese universities and first geological academy in China. More than 4000 students graduated from the Department of Geology in the past 100 years. The Department of Geology covers a range of disciplines including mineralogy, petrology, mineral deposit, tectonics, palaeontology, and geochemistry. The high-pressure and high-temperature research in PKU started in the 1980's, focused on hydrothermal experimental researches using high-pressure vessels. The diamond-anvil cell techniques were introduced in 2000 for in-situ measurements at high pressure and temperature.

The expansion and development of the high-pressure and high-temperature research program in Peking University was officially initiated in June 2008 with new faculty hires and substantial university investment of high-pressure facility. The new high-pressure and high-temperature laboratory focuses on understanding the deep structure and dynamic process of the Earth and other planets via high-pressure experimentation, thermodynamic calculations, and theoretical computation (molecular dynamics and ab initio simulations). The laboratory currently consists of 8 staff with various scientific backgrounds in high-pressure research, 2 postdocs, and about 20 graduate students. High-pressure equipment includes some hydrothermal diamond-anvil cells, a servo rock mechanics tester, two piston-cylinder apparatus, a multi-anvil press, and some high-pressure diamond-anvil cells. The research interests of the high-pressure group broadly cover geochemistry, experimental petrology, mineral physics, rheology, solid state chemistry, crystallography, high-pressure technology, and novel materials synthesis. The routinely used analytical techniques include EMPA, LA-ICPMS, IR, Raman, XRD, SEM, TEM, and XAFS.

In addition to the research at our own laboratory, we frequently use synchrotron facilities, including SPring-8, NSLS, PF, BSRF and SSRF, to perform in-situ X-ray diffraction and XAFS measurements to examine the physical properties and determine phase equilibria of minerals and other materials at high pressure and temperature. We have also developed broad international collaborations with researchers from the Carnegie Institution of Washington, the Stony Brook University, the University of Michigan, the University of Minnesota, the University of Western Ontario, the Australian National University, the Bayerisches Geoinstitute, and the Okayama University. We appreciate collaborations with the members of TANDEM, and welcome researchers and students to visit our laboratory.

For more information, please visit our homepage:
http://sess.pku.edu.cn/organization/gwgy//EN/indexEn.html

Correspondence: Shuangmeng Zhai (zhai@pku.edu.cn)

TANDEM
The Asian Network in Deep Earth Mineralogy

EHIME UNIVERSITY GRC GEODYNAMICS RESEARCH CENTER

SCHOOL OF SCIENCE THE UNIVERSITY OF TOKYO

SPring-8

STONY BROOK STATE UNIVERSITY OF NEW YORK

Global COE Newsletter, issued Jan., May and Sep.
Geodynamics Research Center, Ehime University
2-5 Bunkyo-cho, Matsuyama 790-8577, Japan
Tel & Fax : +81-89-927-8405
E-mail : g-coe@sci.ehime-u.ac.jp
URL: http://deep-earth-mineralogy.jp/
Edited by Akira Yamada and Megumi Yashiro