Bruce Goleby

SEISMIX 2006

HAYAMA JAPAN

12th International Symposium on Deep Seismic Profiling of the Continents and their Margins

September 24-29, 2006
Shonan Village Center, Hayama, Japan

SPONSORS

We acknowledge with thanks the financial support of:

Japan Society for the Promotion of Science,
InterMARGINS,
Earthquake Research Institute, the University of Tokyo (ERI)
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
National Research Institute for Earth Science and Disaster Prevention (NIED)
International Geoscience Programme (IGCP) 474
Ministry of Science, Culture and Sport, Japan
The Graduate University for Advanced Studies
Tokio Marine Kagami Memorial Foundation
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*Financial support from the IGCP 474 was spent for discount the registration fee of students and for the support of travelling cost of invited presenters in the Classic Transect session.

We acknowledge with thanks the sponsorship of our scientific program by:

International Association of Seismology and Physics of the Earth's Interior (IASPEI)
International Lithosphere Program (ILP)
Japan Geoscience Union
Seismological Society of Japan
Geological Society of Japan

The 12th International Symposium on

Deep Seismic Profiling of the Continents and their Margins

September 24 -29, 2006

Shonan Village Center, Hayama, Japan

General Information

Welcome

On behalf of the Earthquake Research Institute (ERI) at The University of Tokyo, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and the National Institute for Earth Science and Disaster Prevention (NIED), the Organizing Committee of the 12th International Symposium on Deep Seismic Profiling of the Continents and their Margins welcomes you to the Shonan Village Center, Hayama. We thank all participants for attending the meeting, and wish you to enjoy the conference and your stay in Japan.

Organizing Committee

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Hiroshi Sato (Secretary in general: ERI, The University of Tokyo)

Shuichi Kodaiara, Narumi Takahashi (Japan Agency for Marine-Earth Science and Technology)
Takashi Iidaka, Naoko Kato (ERI, The University of Tokyo)
Kiyoshi Ito (Kyoto University)
Masaki Kanao (National Institute of Polar Research)
Takanobu Yokokura (National Institute of Advanced Industrial Science and Technology)
Keiji Kasahara (National Institute for Earth Science and Disaster Prevention)

Thanks to the Advisory Committee,
Mizuho Ishida* (National Institute for Earth Science and Disaster Prevention)
*Present affiliation JAMSTEC
Kiyoshi Suyehiro (Japan Agency for Marine-Earth Science and Technology)
Naoshi Hirata (ERI, The University of Tokyo)
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Masanori Saito (OYO Corporation)

Youichi Norisugi (Japan Oil, Gas and Metals National Corporation)
Yutaka Aoki (JGI, Inc)

Additional thanks to

Yuko Izaki, Sumiko Ogino (ERI, The Univ. of Tokyo), Shintaro Hanzawa (Village Shonan Inc) and David Okaya (Univ. Southern California) for preparing this symposium and all the session chairs.

LOGISTICS

Meals

All meals will be served at the restaurant of the Shonan Village Center, except Wednesday's Dinner which will be served at a restaurant in Kamakura city.

Meal hours are:	Breakfast	07:00-08:15
	Lunch	12:00-13:00 (except Wednesday 12:20-13:00)
	Dinner	19:00-20:00

*You will need to present your nametag (see in your Registration packet) for every meal.

Refreshment breaks

Coffee, tea and refreshments will be served at the Conference Center during coffee breaks. An open cash bar will also be available during the poster sessions.

Daily announcements

Program changes and any other announcements will be posted beside the front desk in the lobby of the Shonan Village Center.

Conference office

The Conference Office is in the Conference Room 1 of the Conference floor. It will be staffed by members of the Organizing Committee, normally from 13:15 – 14:00 and from 18:00 – 19:00.

Social and tourist activities

On Sunday evening (19:30-21:30) there will be an Icebreaker party at the Shonan Village Center.

On Wednesday afternoon (after lunch) there will be an excursion to visit the city of Kamakura. This excursion includes a tourist trip around the city and a conference dinner.

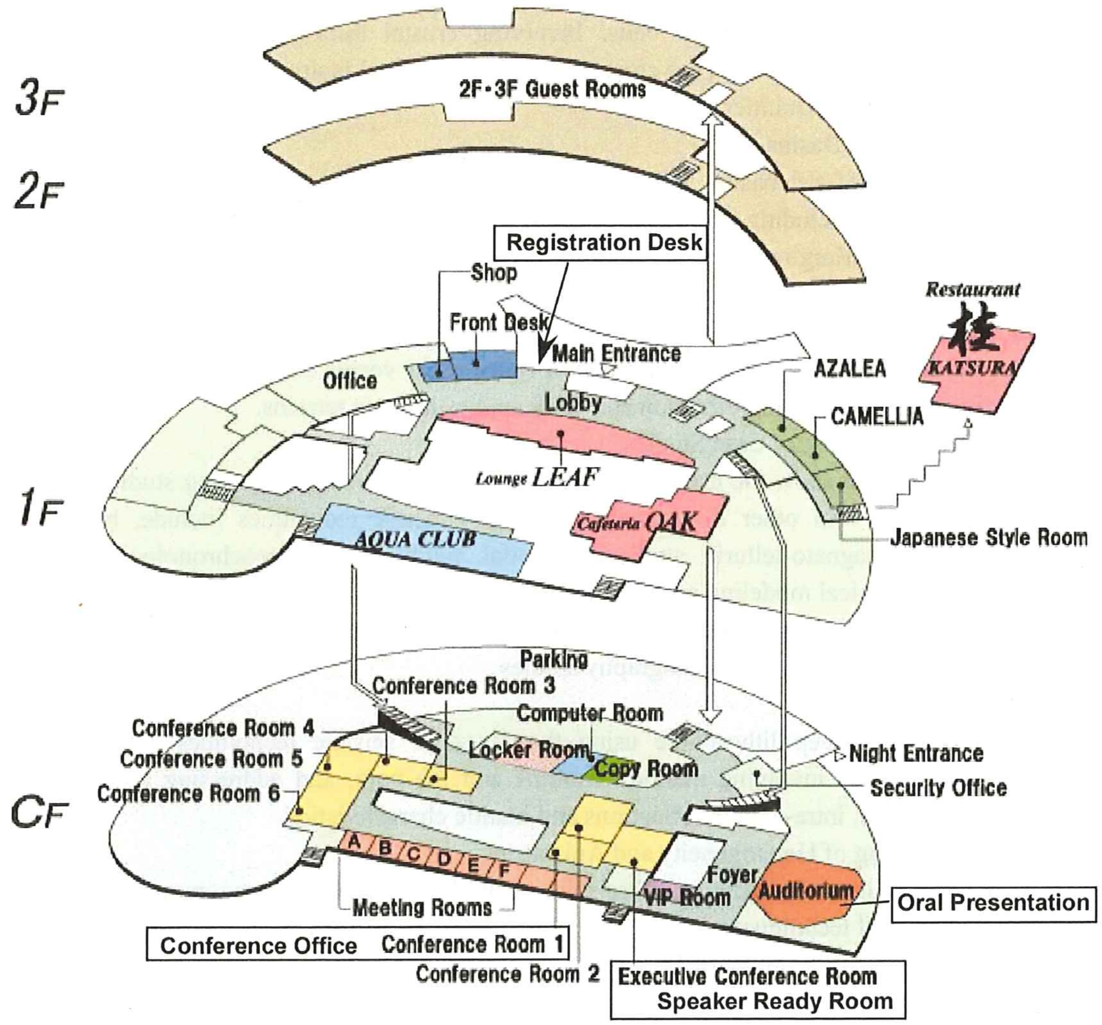
Hotel facilities

An 18-meter indoor heated pool is free of charge.

Internet access is available by LAN at guest rooms and by wireless LAN at the Lobby (1F) and the Conference floor.

At the end of the conference

There will be Conference-organized transport to Zushi station on Friday 29th September. Details on departure time will be announced during the conference.



Scientific Program

All oral and poster presentations concern deep seismic techniques for imaging and constraining the structure, composition and tectonics of the continental lithosphere. The focus of the scientific program will be on studies of the Earth's crust and lithosphere using the full range of seismic imaging methods, and on the integration of these studies with other geophysical techniques (e.g., MT and passive seismology) and geological data.

Science Themes

1. Japan Session

   Outlines of geophysical features and geological evolution of Japanese islands (Key note only).

2. Active Continental Margins

   Including results from subduction zones, accretionary complexes, forearc basins, volcanic island arcs, back arc basins / ridges and vertical transform orogens. Including, but not limited to, reflection, refraction and OBS studies in these terrains.

3. Intra-continental Collision and Accretion

   Continent-continent collisional belts. Involving crustal thickening, heating and internal deformation, the dynamics at the crust-mantle interface, and faults and fault zones which may define major discontinuities.

4. Continental Rifts and Basins

   The geometry of rift basins, their extensional fault systems, bounding faults and internal structures. Also including features of the underlying layered lower crust.

5. Passive Continental Margins

   Focusing on the geometry of passive margins (symmetrical or asymmetrical) their internal faults, the role of the middle / lower crust, the amount and distribution of extension on a crustal and lithospheric scale, deformation (pure shear versus simple shear). Including, but not limited to, reflection, refraction and OBS studies in these terrains.

6. Integrated Multidisciplinary Case Studies

   Case studies that show the use of the wide angle range of seismic imaging studies that have been coupled with other disciplinary techniques. These techniques include, but are not limited to, magneto-telluric studies, potential field surveys, geochronological studies, thermo-mechanical modeling and rock properties analysis. The seismic imaging can include a range of techniques including 'high-resolution' surveys, passive and active source surveys, two- and three-dimensional tomography studies.

7. The Continental Mantle

   Studies of the deep lithosphere using the range of seismic techniques available. Also including studies involving mantle xenoliths and the core, and addressing issues such as nature of Moho, intra-mantle reflections and mantle characteristics.

8. Numerical Modeling of Heterogeneity and Anisotropy

   Forward and inverse modeling of seismic attributes; synthetic seismogram modeling, and other numerical techniques.

9. Innovative Seismic Acquisition and Processing Techniques.

   Those topics related to data collection and processing. Covering deep seismic survey design, 3D deep seismic data collection and processing, full wave-field recording and processing, wide-angle surveys and three component data. Including topics such as the meaning of deep reflectivity, differences between vertical-incident and wide-angle data sets, velocity differences, imaging steep faults, improving single/noise and active and passive sources.

10. Seismic Investigations Related to Mineral Resources and Volcano-plutonic System

    The role of deep seismic surveys in understanding the role of the deeper crust in mineral and energy distribution. Including issues involving global metallogeny, geodynamics and ore deposit evolution, beyond oil exploration – the basement, mineral deposits and seismic studies. Also addressing the fundamental issues of imaging and modeling of field systems.

11. Subduction Structures of Megathrust Zones (sponsored by JAMSTEC and NIED)

    Seismic images at the subduction megathrust zones from reflection and wide-angle reflection/refraction surveys, and tomography studies. Addressing the detailed mapping of the source areas of megathrust earthquake.

12. Seismic Investigations for Disastrous Earthquake Areas (sponsored by NIED, ERI and JAMSTEC)

    Results from seismic investigation in disastrous earthquake areas. Imaging and mapping of source and active faults and regional characterization in disastrous earthquake areas by seismic surveys using active and passive sources.

13. Classic Transect (sponsored by IGCP 474 project)
    The process of documentation and description of 'Classic' seismic transects throughout the world. Covering issues including 'what are their characteristics' and 'what we have learnt from them'.
14. Japan Transect (poster session only)
    Results of seismic imaging and geological surveys in Japan to traverse Japanese islands from trench to back arc. The seismic imaging with high-resolution surveys, passive and active source surveys, two- and three-dimensional tomography studies. This is a poster session only.

Oral presentations

All talks will be held in the auditorium (at the Conference floor, see the map of Shonan Village Center). The time allotted to each presentation is 20 minutes including the short questions (except for Japan session).

Audio-visual equipment

The Conference Center is equipped with one projector for digital computer presentations (e.g., Powerpoint), one 35 mm slide projector, one overhead projector and two screens.

Speaker ready room

A room in the Conference Center is available for pre-projection. Speakers should bring the file containing their talk to a meeting organizer in the pre-projection room via CD or memory stick. Speakers presenting in the morning should hand in their file at least a day before their presentation. Speakers presenting in the afternoon should hand in their file before the beginning of lunch break.

Poster displays

Posters will be displayed in the Conference Center. All posters are allocated one side of 2.40 m width x 1.20 m height board (The exact size of the poster board is 2.40mx0.9m, however a poster with a size of 2.40m width x 1.20 m height can be displayed). Poster presentations will be held in two periods. In Poster Session 1, posters should be put up on Monday 25th morning and must be taken down before 22:00 on Tuesday 26th. In Poster Session 2, posters should be put up on Wednesday 27th morning and must be taken down before 12:00 on Friday 29th. Poster presenters may locate their poster board by their number in the program.

Special announcements

Changes to the program and any announcements will be posted in the Conference Center and in the Reception Hall of the Hotel.

Ad hoc meetings and presentations

Following previous Symposia as in Mont-Tremblant/2004, it is also our aim to stimulate debate on key points that can have important influence in our future research. Therefore, three special interest group discussions have been planned. Anyone wishing to raise additional topics for discussion should contact one of the conference organizers before dinner on the Monday night.

Monday 25, 20:00-21:30 Seismic investigations in Asia: upcoming efforts and opportunities for collaborations (Hiroshi Sato and David Okaya).

Tuesday 26, 20:00-20:30 Next and Future Meetings (Organizing Committee)
20:45-22:00 TopoEurope and EuroArray (Hans Tybo)

Wednesday 27, 21:30-23:00 Organizing the next CCSS workshop (Colin Zelt and John Hole)

The subject of our meeting would be to discuss plans for organizing the next "CCSS" workshop (Commission on Controlled-Source Seismology). This meeting has been going for many years and is the "techniques" meeting for the deep seismic community. J. Hole and C. Zelt organized the previous workshop in 2003 (http://crust.geol.vt.edu/hole/ccss/) and they need to find someone (or group) who would be interested to host the next meeting.

Thursday 28, 20:15-22:00 IGCP474 Business Meeting (Bruce Goleby)

IGCP Project 474, "Images of the Earth's Crust & Upper Mantle" is aimed at providing ready access to seismic images of the Earth's basement geology, deep crust and upper mantle, with interpretations of these data contributing to more informed debate on tectonic processes, the natural environment, natural hazards and the sustainable use of natural resources. IGCP Project 474's seismic images of the Earth's basement geology, deep crust and upper mantle are available via its web site http://www.earthscrust.org/. This business meeting will discuss IGCP Project 474 future plans.

Proceeding volume

The Organizing Committee has made preliminary arrangements with the publisher of Elsevier journal *Tectonophysics* for a Special Symposium Proceedings issue. This issue will be similar to those already published from previous Symposia. In order to ensure the widest dissemination of the results presented in this Symposium we strongly encourage the participants to publish their presentations.

All those planning to submit a paper to the Proceedings Volume will be asked to indicate the probable authorship and title during the meeting.

Because the time to publication is controlled mainly by the speed on initial submission and because we wish to publish the volume one year after the meeting, we require the papers be submitted no later than December 15th. All manuscripts will undergo rigorous external review, following the standard *Tectonophysics* procedure.

Next and future meetings

Scientists willing to host the 13th or later International Symposium on Deep Seismic Profiling in 2008 must communicate their interest, with estimated costs, to the Organizing Committee before the evening of Monday September 25, at the 12th Symposium. An announcement will be made at the Symposium Dinner.

SEISMIX 2006

HAYAMA JAPAN

PROGRAM

Oral Presentations Summary

Monday		Tuesday		Wednesday		Thursday		Friday	
8:30-8:45	Announcement	8:30-8:50	White	8:30-8:50	Fernandez Viejo	8:30-8:50	Gross	8:30-8:50	Sato
8:45-9:25	Key note,Hasegawa	8:50-9:10	Goleby	8:50-9:10	Mjelde	8:50-9:10	Moore	8:50-9:10	Wu
9:25-10:05	Key note, Ito, T.	9:10-9:30	Mints	9:10-9:30	Robert	9:10-9:30	Ito, K.	9:10-9:30	Ikeda
10:05-10:20	Discussion	9:30-9:50	Korja	9:30-9:50	Goncharov	9:30-9:50	Tsumura	9:30-9:50	Knapp, C.C.
		9:50-10:00	Discussion	9:50-10:00	Discussion	9:50-10:00	Discussion	9:50-10:00	Discussion
10:20-10:50	Break	10:00-10:30	Break	10:00-10:30	Break	10:00-10:30	Break	10:00-10:30	Break
10:50-11:10	Scott	10:30-10:50	Brown	10:30-10:50	Key note, Thybo	10:30-10:50	L'Heureux	10:30-10:50	Koketsu
11:10-11:30	Palomeras	10:50-11:10	Kodaira	10:50-11:10	Knapp, J. H.	10:50-11:10	Hobbs	10:50-11:10	Hole
11:30-11:50	Yoon	11:10-11:30	Snyder	11:10-11:30	Artemieva	11:10-11:30	Okaya	11:10-11:30	Mooney
11:50-12:00	Discussion	11:30-11:50	Key note Iwasaki	11:30-11:50	Key note, Goleby	11:30-11:50	Carpentier	11:30-11:50	Gallart
		11:50-12:00	Discussion	11:50-12:10	Key note, Kodaira	11:50-12:00	Discussion	11:50-12:00	Discussion
				12:10-12:20	Discussion				
12:00	Lunch	12:00	Lunch	12:20	Lunch	12:00	Lunch	12:00	Lunch
13:00-14:00	Poster Session 1	13:00-14:00	Poster Session 1	13:00-14:30	Poster Session 2	13:00-14:00	Poster Session 2		
14:00-14:20	Krawczyk	14:00-14:20	Coffin	14:30	Excursion	14:00-14:20	Zelt		
14:20-14:40	Averill	14:20-14:40	Takahashi			14:20-14:40	Bleibinhaus		
14:40-15:00	Grobys	14:40-15:00	Bannister			14:40-15:00	Buske		
15:00-15:10	Discussion	15:00-15:10	Discussion			15:00-15:10	Discussion		
15:10-15:40	Break	15:10-15:40	Break			15:10-15:40	Break		
15:40-16:00	Stephenson	15:40-16:00	Pavlenkova			15:40-16:00	Abe		
16:00-16:20	Thybo	16:00-16:20	Iidaka			16:00-16:20	Flecha		
16:20-16:40	Li, S. L.	16:20-16:40	Shiomi			16:20-16:40	Jones		
16:40-17:00	Kim	16:40-17:00	Morozov			16:40-17:00	Carbonell		
17:00-17:15	Discussion	17:00-17:15	Discussion			17:00-17:15	Discussion		
17:30-19:00	Poster Session 1	17:30-19:00	Poster Session 1	18:00	Dinner at Kamakura	17:30-19:00	Poster Session 2		
19:00	Dinner	19:00	Dinner		Prince Hotel	19:00	Dinner		
20:00-22:00	Poster Session 1	20:00-22:00	Poster Session 1	21:00-22:00	Poster Session 2	20:00-22:00	Poster Session 2		

ORAL PRESENTATION PROGRAM

September 25th, Monday

8:30-8:45 WELCOME

Japan session

Chair T. Iwasaki
8:45-9:25 JPS-O01 Key note talk
EARTHQUAKES IN JAPAN – THEIR ACTIVITY, GENERATION MECHANISM AND RELATIONSHIP WITH INHOMOGENEOUS LITHOSPHERIC STRUCTURE
Hasegawa, A.

9:25-10:05 JPS-O02 Key note talk
OUTLINES OF THE GEOLOGICAL STRUCTURES AND THEIR EVOLUTION OF THE JAPANESE ISLANDS
Ito, T.

10:05-10:20 Discussion

10:20-10:50 Break

Continental rifts and basins

Chair R. Mjelde
10:50-11:10 CRB-O01
EXTENSIONAL HISTORY OF THE EASTERN BLACK SEA BASIN
Scott, C., Shillington, D., Minshull, T., Edwards, R. and White, N.

11:10-11:30 CRB-O02
WIDE ANGLE SEISMIC REFLECTION CONSTRAINTS ON THE LITHOSPHERE OF SW-IBERIA: IBERSEIS-WA
Palomeras, I., Flecha, I., Carbonell, R., Simancas, F., Ayarza, P., Lovato, F., Lovato, F., Azor, A., Poyatos, D., Gonzales-Lodeiro, F. and Pérez-Estaún, A.

11:30-11:50 CRB-O03
REPROCESSING OF SEISMIC REFLECTION DATA WITH THE COMMON REFLECTION SURFACE STACK METHOD (CRS): NEW INSIGHT INTO THE CRUSTAL STRUCTURE OF NORTHERN GERMANY
Yoon, M., Baykulov, M., Dümmong, S., Brink, H.-J. and Gajewski, D.

11:50-12:00 Discussion

12:00- Lunch

13:00-14:00 Poster session 1

Chair H. Thybo
14:00-14:20 CRB-O04
SUB-SEISMIC STRUCTURE AND DEFORMATION QUANTIFICATION ON DIFFERENT SCALES FROM 3D REFLECTION SEISMICS IN THE NORTH GERMAN BASIN
Krawczyk, C.M., Lohr, T., Tanner, D.C., Endres, H., Trappe, H., Oncken, O. and Kukla, P.

14:20-14:40 CRB-O05
CRUSTAL STRUCTURE AND EVOLUTION OF THE SOUTHERN RIO GRANDE RIFT, USA
Averill, M.G. and Miller, K.C.

14:40-15:00 CRB-O06
SEISMIC ANALYSIS AND MODELS FROM A RIFTED SUBMARINE PLATEAU OF CONTINENTAL ORIGIN: GREAT SOUTH BASIN AND BOUNTY TROUGH (NEW ZEALAND)
Grobys, J., Gohl, K., Uenzelmann-Neben, G., Davy, B., Barker D. and Deen, T.

15:00-15:10 Discussion

15:10-15:40 Break

Chair B. Goleby
15:40-16:00 CRB-O07
THERMAL REFRACTION AND THE RHEOLOGICAL BASIS OF "COLD" INTRAPLATE DEFORMATION: SEISMICALLY AND GEOLOGICALLY CONSTRAINED NUMERICAL MODEL OF THE DONBAS FOLDBELT
Stephenson, R.A. , Hansen, D.L. and Nielsen, S.B.

16:00-16:20 CRB-O08
BAIKAL EXPLOSION SEISMIC TRANSECTS
Thybo, H., Nielsen, C., Jensen, M.-B., Suvorov, V.D. and Perchuc, E.

16:20-16:40 CRB-O09
CRUSTAL STRUCTURE OF MAINLAND CHINA FROM DEEP SEISMIC SOUNDING DATA
Li, S.L., Mooney, W.D. and Fan, J.C.

16:40-17:00 CRB-O10
CRUSTAL STRUCTURE OF THE SOUTHERN KOREAN PENINSULA FROM LARGE EXPLOSIONS
Kim, K.Y., Hong, M.H., Lee, J.M., Moon, W., Baag, C.E. and Jung, H.

17:00-17:15 Discussion

17:30-19:00 Poster session 1

19:00- Dinner

20:00-22:00 Poster session 1

September 26th, Tuesday

Chair S. Bannister
8:30-8:50 CRB-O11
MELT INTRUSION IN THE CRUST AT RIFTED MARGINS AND BACK-ARC BASINS
White, R.S., Smith, L.K, Harrison, A.J. and iSIMM Working Group

Intra-continental collision and accretion

8:50-9:10 ICA-O01
THE AUSTRALIAN CRUST, ARCHAEAN TO PALAEOZOIC ARCHITECTURE: RESULTS FROM AUSTRALIA'S DEEP SEISMIC PROGRAM

Goleby, B.R., Jones, L.E.A, Fomin, T., Barton, T., Costello, R. and Tassel, H.

9:10-9:30 ICA-O02
DEEP CRUSTAL STRUCTURE, ORIGIN AND EVOLUTION OF THE PALAEOPROTERO-ZOIC LAPLAND-MIDRUSSIA-SOUTH BALTIA INTERCONTINENTAL COLLISION OROGEN, EAST-EUROPEAN CRATON
Mints, M.V., Suleimanov, A.K., Philippova, I.B., Zamozhniaya, N.G., Stupak, V.M., Babayants, P.S., Blokh, Yu.I. and Trusov, A.A.

9:30-9:50 ICA-O03
SEISMIC IMAGES OF THE SVECOFENNIAN OROGEN
Korja, A., Heikkinen, P., Tiira, T., Hyvönen, T. and FIRE Working Group

9:50-10:00 Discussion

10:00-10:30 Break

Seismic investigations related to mineral resources and volcano-plutonic system

Chair M. F. Coffin
10:30-10:50 SMV-O01
4DEEP SEISMIX: TIME LAPSE IMAGING OF MAGMA BENEATH MONTESERRAT- A FEASIBILITY STUDY
Brown, L., Maheshwari, R., and Stephenson, M.

10:50-11:10 SMV-O02
VARIABLE GROWTH OF CONTINENTAL CRUST IN THE IZU–BONIN INTRA-OCEANIC ARC REVEALED BY ACTIVE SORUCE SEISMIC STUDIES
Kodaira, S., Sato, T., Takahashi, N., Miura, S., Ito, A. and Kaneda, Y.

11:10-11:30 SMV-O03
TECTONIC AND METALLOGENIC IMPLICATIONS OF REGIONAL SEISMIC PROFILES IN THE TIMMINS MINING CAMP, CENTRAL SUPERIOR CRATON OF CANADA
Snyder, D.B. and Bleeker, W.

Japan session

11:30-11:50 PS-O03 Key note talk
JAPAN TRANSECT – OVERVIEW OF RECENT SEISMIC EXPEDITIONS IN JAPAN –
Iwasaki, T.

11:50-12:00 Discussion

12:00- Lunch

13:00-14:00 Poster session 1

Active continental margins

Chair R. S. White
14:00-14:20 ACM-O01
ACTIVE OBDUCTION OF OCEANIC LITHOSPHERE: THE UPPER CRUST OF THE ONTONG JAVA PLATEAU
Coffin, M.F., Inoue, H., Mann, P. and Taira, A.

14:20-14:40 *ACM-O02*
SEISMIC SECTIONS ACROSS IZU-OGASAWARA (BONIN)-MARIANA ARC: FORMING CONTINENTAL CRUST IN OCEANIC ISLAND ARCS
Takahashi, N., Kodaira, S., Kaiho, Y., Miura, S., Sato, T., Yamashita, M., No, T., Takizawa, K. and Kaneda, Y.

14:40-15:00 *ACM-O03*
IMAGING THE SUBDUCTION DECOLLEMENT, HIKURANGI SUBDUCTION ZONE, NEW ZEALAND
Bannister, S., Toulmin, S., Sutherland, R., Henrys, S., Reyners, M., Pecher, I., Barker, D., Uruski, C. and Maslen, G.

15:00-15:10 Discussion

15:10-15:40 Break

Chair L. Brown
15:40-16:00 *ACM-O04*
CRUSTAL STRUCTURE IN CHILE AND OCHOTSK SEA REGIONS
Pavlenkova, N.I., Pilipenko, V.N., Verpachovskaja, A.O. and Pavlenkova, G.A.

16:00-16:20 *ACM-O05*
HETEROGENEOUS STRUCTURE AT NKTZ REVEALED BY THE RECEIVER FUNCTION AND SHEAR-WAVE SPLITTING ANALYSES WITH THE DATA OF THE JOINT SEISMIC OBSERVATIONS.
Iidaka, T., Igarashi, T., Iwasaki, T., Shibutani, T., Hiramatsu, Y. and Japanese University Group of the Joint Seismic Observations at NKTZ

16:20-16:40 *ACM-O06*
COMPLEX GEOMETRY OF PHILIPPINE SEA SLAB BENEATH CENTRAL AND SOUTHWESTERN JAPAN AND THE RELATIONSHIP WITH LOCAL SEISMICITY
Shiomi, K., Matsubara, M. and Obara, K.

16:40-17:00 *ACM-O07*
RECEIVER FUNCTIONS FROM TRENCH-ZONE SCATTERING: RESULTS FROM 1D AND 3D FINITE-DIFFERENCE MODELLING
Morozov, I. B. and Zheng, H.

17:00-17:15 Discussion

17:30-19:00 Poster session 1

19:00- Dinner

20:00-22:00 Poster session 1

September 27th, Wednesday

Passive continental margins

Chair J. H. Knapp
8:30-8:50 *PCM-O01*
SEISMIC EVIDENCES OF THE CONSUMPTION OF THE SOUTHERN MARGIN OF BAY OF BISCAY DURING THE ALPINE COMPRESSION
Fernández Viejo G., Pulgar, J.A., Gallastegui, J., Gallart, J. and MARCONI Team.

8:50-9:10 *PCM-O02*

CRUSTAL TRANSECT ACROSS THE NORTH ATLANTIC
Mjelde, R., Breivik, A.J. and Faleide, J.I.

9:10-9:30 PCM-O03
CRUSTAL STRUCTURE OF THE FAROES NORTH ATLANTIC MARGIN FROM WIDE-ANGLE SEISMIC DATA
Roberts, A.W., White, R.S. and iSIMM team

9:30-9:50 PCM-O04
BASEMENT AND CRUST IN THE SW AUSTRALIA FROM ONSHORE/OFFSHORE SEISMIC EXPERIMENT: IMPLICATIONS FOR HYDROCARBON MATURATION
Goncharov, A., Deighton, I., Petkovic, P., Tassell, H. and McLaren, S.

9:50-10:00 Discussion

10:00-10:30 Break

The continental mantle

Chair ~~W. D. Mooney~~ Fred Davey
10:30-10:50 TCM-O01 Key note talk
FINE SCALE HETEROGENEITY IN THE EARTH'S CRUST AND MANTLE
Thybo, H.

10:50-11:10 TCM-O02
EVIDENCE FOR ACTIVE LOWER-CRUSTAL CONTINENTAL DELAMINATION IN THE VRANCEA SEISMOGENIC ZONE OF ROMANIA FROM PROJECT DRACULA
Knapp, J. H., Fillerup, M. A. and Knapp, C. C.

11:10-11:20 TCM-O03
COMPOSITIONAL VARIATIONS IN THE CONTINENTAL LITHOSPHERE CONSTRAINED BY SEISMIC TOMOGRAPHY DATA
Artemieva, I.M.

Classic transect

11:20-11:50 CTS-O01 Key note talk
IGCP PROJECT 474: IMAGES OF THE EARTH'S CRUST & UPPER MANTLE
Goleby, B., Brown, L., Cook, F., Oncken, O., Fuis, G., Hobbs, R., Li, S. and Finlayson, D.

Japan session

11:50-12:10 JPS-O04 Key note talk
MEGATHRUST EARTHQUAKES AND SUBDUCTION STRUCTURES: LESSONS FROM THE NANKAI SEISMOGENIC ZONE
Kodaira, S.

12:10-12:20 Discussion

12:20- Lunch

13:00-14:30 Poster session 2

14:30- Excursion

18:00- Dinner at Kamakura Prince Hotel

21:00-22:00 Poster session 2

September 28th, Thursday

Subduction structures of megathrust zones

Chair H. Sato
8:30-8:50 *SSM-O01*
REFLECTION SEISMIC IMAGING OF THE SUBDUCTION ZONE IN SOUTHERN CENTRAL CHILE
Gross, K., Buske, S., Wigger, P. and TIPTEQ Research Group, Seismics Team

8:50-9:10 *SSM-O02*
3D IMAGES OF THE KUMANO BASIN REGION, JAPAN: NANTROSEIZE IODP SURVEY
Moore, G.F., Yoro, T., Bangs, N.L. and Tanaka, H.

9:10-9:30 *SSM-O03*
VELOCITY STRUCTURES, REFLECTORS, SEISMICITY AND LOW-FREQUENCY TREMORS RELATING TO SUBDUCTION OF THE PHILIPPINE SEA PLATE IN THE KINKI DISTRICT, SOUTHWEST JAPAN
Ito, K., Sato, H., Ito, T., Hirose, I., Shibutani, T., Umeda, Y., Hirata, N., Abe, S., and Ikawa T.

9:30-9:50 *SSM-O04*
CRUSTAL STRUCTURE ASSOCIATED WITH THE SUBDUCTING PHILIPPINE SEA PLATE BENEATH THE SOUTHERN PART OF THE BOSO PENINSULA, JAPAN
Tsumura, N., Komada, N., Sano, J., Kikuchi, S., Ito, T., Miyauchi, T., Sato, T., Kikuchi, Y., Kawamura, T., Sato, H., Iwasaki, T., Shishikura, M., Abe, S., Kawanaka, T., S. Suda, S., Higashinaka, M. and Ikawa, T.

9:50-10:00 Discussion

10:00-10:30 Break

Numerical modeling of heterogeneity and anisotropy

Chair C. A. Zelt
10:30-10:50 *NHA-O01*
HETEROGENEITY AND SEISMIC SCATTERING IN EXPLORATION ENVIRONMENTS
L'Heureux, E., Milkereit, B. and Vasudevan, K.

10:50-11:10 *NHA-O02*
PRIDE & PREJUDICE IN THE INVERSION OF LONG-OFFSET SEISMIC DATA
Hobbs, R. W., Flecha, I. and Carbonell, R.

11:10-11:30 *NHA-O03*
IMPRINT OF CRUSTAL SEISMIC ANISOTROPY ONTO MANTLE SHEAR-WAVE SPLITS: CALIBRATED NUMERICAL TESTS
Okaya, D.A. and Wu, F.T.

11:30-11:50 *NHA-O04*
CONSERVATION OF LITHOLOGY POWER LAW STRUCTURE IN SEISMIC REFLECTION DATA UNDER VARIOUS CIRCUMSTANCES
Carpentier, S.F.A. and Roy-Chowdhury, K.

11:50-12:00 Discussion

12:00- Lunch

13:00-14:00 Poster session 2

Innovative seismic acquisition and processing techniques

Chair R. W. Hobbs
14:00-14:20 IAP-O01
FINITE-FREQUENCY TRAVELTIME TOMOGRAPHY FOR ACTIVE-SOURCE SEISMIC DATA
Zelt, C.A.

14:20-14:40 IAP-O02
APPLYING FULL WAVEFORM INVERSION TO WIDE-ANGLE SEISMIC SURVEYS
Bleibinhaus, F., Lester, W.R. and Hole, J.A.

14:40-15:00 IAP-O03
FRESNEL-VOLUME-MIGRATION OF DEEP SEISMIC REFLECTION DATA
Buske, S., Chalbaud, D., Gross, K., Sick, C., Shapiro, S. and Wigger, P.

15:00-15:10 Discussion

15:10-15:40 Break

Chair D. A. Okaya
15:40-16:00 IAP-O04
PRESTACK IMAGING OF TELESEISMIC BODY WAVES: A COMPARISON OF RECEIVER FUNCTION ANALYSIS AND SEISMIC INTERFEROMETRY
Abe, S., Kurashimo, E., Sato, H., Hirata, N., Iwasaki,T., Ito, T. and Kawanaka, T.

16:00-16:20 IAP-O05
SOME IMPROVEMENTS ON SEISMIC IMAGING BY PRE-STACK DEPTH MIGRATION
Flecha, I., Palomeras, I., Carbonell, R., Zeyen, H. and Hobbs, R. W.

16:20-16:40 IAP-O06
IMAGING STEEP DIPS: EXAMPLES FROM AUSTRALIAN SEISMIC SURVEYS
Jones, L.E.A.

16:40-17:00 IAP-O07
HIGH-RESOLUTION SEISMIC CHARACTERIZATION IN A COMPLEX URBAN AREA
Martí, D., Font-Capó, J., Flecha, I., Palomeras, I., Vázquez-Suñé, E., Carbonell, R. and Pérez-Estaún, A.

17:00-17:15 Discussion

17:30-19:00 Poster session 2

19:00- Dinner

20:00-22:00 Poster session 2

September 29th, Friday

Seismic investigations for disastrous earthquake areas

Chair J. A. Hole

8:30-8:50 SDE-O01

REGIONAL CHARACTERIZATION OF THE CRUST IN THE TOKYO METROPOLITAN AREA, CENTRAL JAPAN

Sato, H., Hirata, N., Abe, S., Okaya, D., Iwasaki, T., Ito, T., Kasahara, K., Kato, N., Koketsu, K., Hagiwara, Ikawa, T., Kawanaka, T., Wu, F. and Matsubara, M.

8:50-9:10 SDE-O02

HIGH RESOLUTION TOMOGRAPHY OF KANTO-IZU AND ITS IMPLICATIONS ON TECTONICS AND SESIMIC HAZARDS

Wu, F.T., Okaya, D.A., Hirata, N. and Sato, H.

9:10-9:30 SDE-O03

SEISMIC REFLECTION PROFILING ACROSS THE ITOIGAWA-SHIZUOKA TECTONIC LINE, CENTRAL JAPAN: ACTIVE NAPPE WITH A HIGH SLIP RATE

Ikeda, Y., Iwasaki, T., Kano, K., Ito, T., Sato, H., Tajikara, M., Higashinaka, M., Kozawa, T. and Kawanaka, T.

9:30-9:50 SDE-O04

SOUTHEASTERN CARPATHIAN FORELAND DEFORMATION IN RELATION TO THE VRANCEA SEISMOGENIC ZONE OF ROMANIA: RESULTS FROM PROJECT DRACULA

Knapp, C. C., Knapp, J. H. and Mucuta, D. M.

9:50-10:00 Discussion

10:00-10:30 Break

Integrated multidisciplinary case studies

Chair R. Carbonell

10:30-10:50 IMC-O01

INTEGRATED MODELING OF A 3-D VELOCITY STRUCTURE FOR STRONG GROUND MOTION SIMULATION

Koketsu, K., Miyake, H., Tanaka, Y. and Hikima, K.

10:50-11:10 IMC-O02

STRUCTURE OF THE SAN ANDREAS FAULT AT THE SAFOD DEEP DRILL SITE

Hole, J. A., Bleibinhaus, F., Ryberg, T. and Fuis, G. S.

11:10-11:30 IMC-O03

FAULT ZONES FROM TOP TO BOTTOM: A GEOPHYSICAL PERSPECTIVE

Mooney, W. D., Beroza, G. and Kind, R.

11:30-11:50 IMC-O04

HIGH RESOLUTION SEISMIC IMAGING OF THE IBERIAN LITHOSPHERE: THE TOPO-IBERIA RESEARCH INITIATIVE

TOPO-Iberia/PICASSO Working group, (Carbonell, R., Gallart, J., Fernandez, M., Gonzalez-Lodeiro, F., Levander, A., Hausmann, G., Jones, A. G. and Thybo, H.)

11:50-12:00 Discussion

12:00- Lunch

POSTER PRESENTATION PROGRAM

Poster session 1 September 25th, Monday - September 26th Tuesday

Continental rifts and basins

CRB-P01
ESTRID-1: REFRACTION SEISMIC INVESTIGATIONS OF THE DANISH BASIN
Sandrin, A., Nielsen, L. and Thybo, H.

CRB-P02
ESTRID-2: REFLECTION SEISMIC PROFILING IN THE DANISH BASIN
Nielsen, C., Shulgin, A., Nielsen, L. and Thybo, H.

CRB-P03
SUB-SEISMIC STRUCTURE AND DEFORMATION QUANTIFICATION ON DIFFERENT SCALES FROM 3D REFLECTION SEISMICS IN THE NORTH GERMAN BASIN
Krawczyk, C.M., Lohr, T., Tanner, D.C., Endres, H., Trappe, H., Oncken, O. and Kukla, P.

CRB-P04
DEEP SEISMIC IMAGING AND CRUSTAL STRUCTURE IN THE ZONES OF MAJOR OIL FIELDS
Trofimov, V. A.

CRB-P05
SEISMIC TOMOGRAPHY MODELLING OF THE EASTERN BLACK SEA BASIN.
Scott, C., Shillington, D., Minshull, T., Edwards, R. and White, N

CRB-P06
BAIKAL EXPLOSION SEISMIC TRANSECTS
Thybo, H., Nielsen, C., Jensen, M.-B., V.D.Suvorov, V.D. and Perchuc, E.

CRB-P07
TECTONIC SUBSIDENCE AND CRUSTAL STRUCTURE OF XIHU DEPRESSION, EAST CHINA SEA BASIN
Li, C.-F., Zhou, Z., Ge, H. and Mao, Y.

CRB-P08
TOMOGRAPHIC IMAGES OF THE UPPER CRUST FROM THE YANYUAN BASIN TO THE DALIANG MOUNTAINS, SOUTHWEST SICHUAN PROVINCE: RESULTS FROM THE XICHANG REGION SEISMIC REFRACTION EXPERIMENT
Wang, F., Duan, Y. and Yang, Z.

CRB-P09
SEISMIC REFLECTION AND GPS EVIDENCE FOR DISTRIBUTED CRUSTAL EXTENSION IN THE EASTERN BASIN AND RANGE, WESTERN USA
Velasco, M.S., Johnson, R.A., Bennett, R.A. and Porter, R.C.

CRB-P10
METAMORPHIC CORE COMPLEX EMPLACEMENT AND BASIN FORMATION IN SOUTHEASTERN ARIZONA, USA
Arca, M.S., Wagner, F.H., III and Johnson, R.A.

CRB-P11
COMPLEXITIES OF THE WESTERN MARGIN OF THE TRANS-HUDSON OROGEN IN SASKATCHEWAN, CANADA

Hajnal, Z., Pandit, B., Sule, S. and White, D.

CRB-P12
STRONG SEISMIC REFLECTIONS FROM THE UPPER MANTLE OF A CONTIENTAL BACK-ARC
Benson, A.B., Stern, T.A. and Bannister, S.C.

Intra-continental collision and accretion

ICA-P01
3D STRUCTURE OF THE EASTERN ALPS FROM DEEP SEISMIC WIDE-ANGLE DATA
Bleibinhaus, F., Behm, M., Brückl, E. and ALP 2002 Working Group

ICA-P02
SEISMIC IMAGES OF THE SVECOFENNIAN OROGEN
Korja, A., Heikkinen, P., Tiira, T., Hyvönen, T. and FIRE Working Group

ICA-P03
COMBINED CDP-DSS STUDIES ALONG PROFILE 1-EB (EAST-EUROPEAN CRATON)
Suleimanov A.K., Samozhnyaya N.G. and Pavlenkova N.I.

ICA-P04
MIDRUSSIA SEGMENT OF THE PALAEOPROTEROZOIC LAPLAND-MIDRUSSIA-SOUTHBALTIA INTERCONTINENTAL COLLISION OROGEN, EAST-EUROPEAN CRATON: INTEGRATION OF REGIONAL POTENTIAL FIELDS AND CDP DATA ALONG THE 1-EU GEOTRAVERSE
Mints, M.V., Suleimanov, A.K., Philippova, I.B., Zamozhniaya, N.G., Babayants, P.S., Blokh, Yu.I. and Trusov, A.A.

ICA-P05
FINE UPPER CRUSTAL STRUCTURE IN EASTERN KUNLUN ACTIVE FAULT BELT AND ITS ADJACENT AREA
Zhang, X., Xu, Z. and Wang, F.

ICA-P06
CRUSTAL STRUCTURE OF THE NORTHEASTERN MARGIN OF THE TIBETAN PLATEAU FROM THE SONGPAN-GANZI TERRANE TO THE ORDOS BASIN
Liu, M.J., Mooney, W.D., Li, S.L., Okaya, N. and Detweiler, S.

ICA-P07
ACTIVE TECTONIC FEATURES IN THE NORTHERN PART OF THE IZU COLLISION ZONE, CENTRAL JAPAN
Kato, N., Sato, H., Imaizumi, T. and Ikawa, T.

ICA-P08
WOLLASTON LAKE REFLECTOR REVISITED: FLUIDS, MASSIVE FRACTURED DIABASE INTRUSION, OR SILICIFIED SHEAR ZONE?
Morozov, I. B. and Ma, J.

ICA-P09
THE AUSTRALIAN CRUST, ARCHAEAN TO PALAEOZOIC ARCHITECTURE: RESULTS FROM AUSTRALIA'S DEEP SEISMIC PROGRAM
Goleby, B.R., Jones, L.E.A, Fomin, T., Barton, T., Costello, R. and Tassel, H.

ICA-P10
REFLECTION IMAGING OF THE CRUST AND THE LITHOSPHERIC MANTLE IN THE LUTZOW-HOLM COMPLEX, EASTERN DRONNING MAUD LAND,

ANTARCTICA, DERIVED FROM SEAL TRANSECT
Kanao, M., Fujiwara, A., Miyamachi, H., Toda, S., Ito, K., Tomura, M., Ikawa, T. and SEAL Geotransect Group

Seismic investigations related to mineral resources and volcano-plutonic system

SMV-P01
CRUSTAL STRUCTURE OF THE KYUSHU-PALAU RIDGE, THE REMNANT OF THE PROTO IZU-BONIN-MARIANA ISLAND ARC
Nishizawa, A., Kaneda, K., Katagiri, Y. and Kasahara, J.

SMV-P02
COMBINING DATA FROM DYNAMITE AND VIBROSEIS SOURCES: DEEP SEISMIC TRANSECT IN THE CURNAMONA PROVINCE, AUSTRALIA
Fomin, T., Korsch, R.J. and Goleby, B.R.

SMV-P03
TECTONIC AND METALLOGENIC IMPLICATIONS OF REGIONAL SEISMIC PROFILES IN THE TIMMINS MINING CAMP, CENTRAL SUPERIOR CRATON OF CANADA
Snyder, D.B. and Bleeker, W.

Active continental margins

ACM-P01
WHOLE STRUCTURE OF THE MEDIAN TECTONIC LINE (MTL) FROM KYUSHU TO CENTRAL JAPAN
Ito, T., Sato, H., Ikawa, T., Tsutsumi, H., and Yamamoto, S.

ACM-P02
ACTIVE TECTONICS IN AND AROUND THE BOSO PENINSULA, SOUTH KANTO, JAPAN, ANALYZED BY THE NETWORK OF SEISMIC REFLECTION PROFILES
Miyauchi, T., Asao, K., Ito, T., Sato, H., Suda, S. and Kawasaki, S.

ACM-P03
CHALLENGING SEISMIC EXPLORATION TO THE COMPLICATED STRUCTURES AND OPERATIONAL DIFFICULTIES IN ACTIVE MARGIN OF JAPAN ISLANDS
Ikawa T., Aoki Y. and Ohta, Y.

ACM-P04
HIGH SEISMIC ATTENUATION IN THE REFLECTIVE LAYERS OF THE PHILIPPINE SEA SUBDUCTION ZONE, JAPAN
Petukhin, A. and Kagawa, T.

ACM-P05
HETEROGENEITY OF PHYSICAL CONDITIONS AND PROPERTIES ALONG THE UPPER SURFACE OF THE PHILIPPINE SEA PLATE OFF THE KANTO DISTRICT
Kimura H., Kasahara, K. and Takeda, T.

ACM-P06
A DETAILED TOMOGRAPHIC IMAGE OF THE PHILIPPINE SEA PLATE BENEATH THE KANTO DISTRICT, CENTRAL JAPAN, BY DENSE SEISMIC ARRAY OBSERVATION
Hirata N., Hagiwara, H., Igarashi, T. and Sakai, S.

ACM-P07

RELATIONSHIP BETWEEN SHALLOW SEISMICITY AND SEAFLOOR TOPOGRAPHY —ACCRETIONARY PRISM EARTHQUAKE AND OUTER-RISE EARTHQUAKE—
Ito, Y., Obara, K., Takeda, T. and Kasahara, K.

ACM-P08
THREE-DIMENSIONAL VELOCITY STRUCTURE BENEATH THE JAPAN ISLANDS
Matsubara, M., Sekine, S., Obara, K. and Kasahara, K.

ACM-P09
THREE-DIMENSIONAL ATTENUATION STRUCTURE BENEATH THE JAPAN ISLAND BY TOMOGRAPHIC METHOD
Sekine S., Matsubara, M., Obara, K. and Kasahara, K.

ACM-P10
COMPLEX GEOMETRY OF PHILIPPINE SEA SLAB BENEATH CENTRAL AND SOUTHWESTERN JAPAN AND THE RELATIONSHIP WITH LOCAL SEISMICITY
Shiomi, K., Matsubara, M. and Obara, K.

ACM-P11
SEISMIC STRUCTURE OF THE NORTHERNMOST RYUKYU SUBDUCTION ZONE OFF THE SOUTHERN KYUSHU, JAPAN
Nishizawa, A., Kaneda, K., Katagiri, Y. and Kasahara, J.

ACM-P12
CRUSTAL STRUCTURE OF THE MARIANA VOLCANIC ARC
E. Kurashimo, Klemperer, S., Calvert, A. and Takahashi, N.

ACM-P13
SEISMIC VELOCITY MEASUREMENTS ACROSS A HIGHLY OBLIQUE SUBDUCTION ZONE – THE FIORDLAND REGION, SOUTH ISLAND, NEW ZEALAND
Davey, F.J.

ACM-P14
ECLOGITIC MOHO, CRATON STABILIZATION, AND THE SIGNATURE OF FOSSIL SUBDUCTION IN NORTHWESTERN CANADA
Mercier, J.-P., Bostock, M.G., Audet, P., Garnero, E., Gaherty, J. and Revenaugh, J.

ACM-P15
CRUSTAL STRUCTURE IN CHILE AND OCHOTSK SEA REGIONS
Pavlenkova N.I., Pilipenko V.N., Verpachovskaja A.O. and Pavlenkova G.A.

ACM-P16
FIRST DEEP IMAGES OF SEISMIC REFLECTION ALONG THE PROFILE IN NORTH-EASTERN VENEZUELA (64° W)
Sánchez, C., Schmitz, M., Sánchez, J., Liuzzi, D., Andara, E., Cova, R. and Roomer, J.

ACM-P17
ISLAND ARC ACCRETION BY OBLIQUE COLLISION: THE RESULTS OF THE BOLIVAR PROJECT ALONG THE SE CARIBBEAN PLATE BOUNDARY
Magnani, M.B., Zelt, C., Guedez, M., Clark, S., Arogunmati, A., Niu, F., Levander, A. and Christeson, G.

Japan Transect

JPT-P01
CRUSTAL EVOLUTION OF THE SOUTHWESTERN KURIL ARC
Nakanishi, A., Kurashimo, E., Tatusmi, Y., Yamaguchi, H., Miura, S., Kodaira, S., Obana, K.,

Takahashi, N., Tsuru, T., Kaneda, Y., Iwasaki, T. and Hirata, N.

JPT-P02
SEISMIC SECTIONS ACROSS HOKKAIDO - CRUSTAL DEFORMATION ASSOCIATED WITH ARC-ARC COLLISION -
Iwasaki, T., Ito, T., Sato, H. and Kato, N.

JPT-P03
SEISMIC SECTIONS ACROSS NORTHERN HONSHU, JAPAN: A CLASSIC TRENCH-ARC-BACK ARC SYSTEM
Sato, H., Iwasaki, T., Takahashi, N. and Kato, N.

JPT-P04
SEISMIC SECTIONS ACROSS THE CENTRAL PART OF NORTHERN HONSHU, JAPAN: A TRANSECT ACROSS A CHAIN OF HAZARD EARTHQUAKES.
Yokokura, T., Fujie, G., Ito, A., Tsuru, T., Sato, H. and Kato, N.

JPT-P05
SEISMIC SECTIONS ACROSS THE IZU COLLISION ZONE, CENTRAL JAPAN: ON-GOING ARC-ARC COLLISION SYSTEM
Sato, H., Iwasaki, T., Kodaira, S., Kato, N., Abe, S. and Ito, T.

JPT-P06
SEISMIC SECTIONS ACROSS THE TOKAI-CHUBU REGION, CENTRAL JAPAN: AN AREA OF FUTURE MEGATHRUST EARTHQUAKES
Iidaka, T., Kodaira, S., Nakanishi, A., Park, J.-O., Iwasaki, T., Kaneda, Y., Sato, H., and Ito, T.

JPT-P07
SEISMIC SECTIONS ACROSS THE KINKI DISTRICT: SUBDUCTING PHILIPPINE SEA PLATE FROM THE NANKAI TROUGH
Ito, K., Sato, H., Ito, T., Nakanishi A., Kodaira, S., Umeda, Y., Hirose, I., Hirata, N., Miura, S., Ito, A., Sato, T., Park, J., Kaneda, Y., Abe, S., Kawanaka, T., and Ikawa, T.

JPT-P08
SEISMIC SECTIONS ACROSS SHIKOKU-CHUGOKU DISTRICT, SOUTHWEST JAPAN: A TYPICAL CRUSTAL STRUCTURE OF THE JAPANESE ISLAND ARC
Ito, T., Kodaira, S., Sato, H., Kaneda, Y., Iwasaki, T., Kurashimo, E., Miller, K., Harder, S., Abe, S., Sato, T. and Onishi, M.

JPT-P09
SEISMIC SECTIONS IN AND AROUND THE KYUSYU ISLAND: ACCRETION PROCESSES AT THE WESTERN EDGE OF THE NANKAI TROUGH
Kodaira, S., Ito, T., Iwasaki, T., Park, J.-O,, Ikawa, T., Takemura, K. and Kaneda, Y.

JPT-P10
SEISMIC SECTIONS IN AND AROUND RYUKYU ISLAND ARC – SUBDUCTION SYSTEM WITH ONGOING BACKARC SPREADING -
Iwasaki, T. and Kodaira, S.

JPT-P11
SEISMIC SECTIONS ALONG THE IZU-BONIN ARC: VARIABLE GROWTH OF CONTINETAL CRUST IN AN INTRA OCEANIC ARC
Sato, T., Kodaira, S., Takahashi, N., Miura, S., Ito, A. and Kaneda, Y.

JPT-P12
SEISMIC SECTIONS ACROSS IZU-OGASAWARA (BONIN)-MARIANA ARC: FORMING CONTINENTAL CRUST IN OCEANIC ISLAND ARCS
Takahashi, N., Kodaira, S., Kaiho, Y., Miura, S., Sato, T., Yamashita, M., No, T., Takizawa, K. and

Kaneda, Y.

Classic transect

CTS-P01
IGCP PROJECT 474: IMAGES OF THE EARTH'S CRUST & UPPER MANTLE
Goleby, B., Brown, L., Cook, F., Oncken, O., Fuis, G., Hobbs, R., Li, S. and Finlayson, D.

CTS-P02
PROTEROZOIC INTRA-CONTINENTAL COLLISIONS – ARUNTA-TANAMI AND THE GAWLER-CURNAMONA
Goleby, B.R., Lyons, P., Jones, L.E.A. and Fomin, T.

CTS-P03
CLASSIC TRANSECT: INDEPTH PROFILE ACROSS THE HIMALAYA-TIBET PLATEAU
Brown, L., Wenjin, Z. and Project INDEPTH Team

CTS-P04
FINE CRUST STRUCTURE IN NORTHERN MARGIN AREA OF TIANSHAN MOUNTAINS REVEALED BY DEEP SEISMIC REFLECTION PROFILING
Liu, B., Shen, J., Zhang, X., Song, H. and Fang, S.

CTS-P05
THE AGULHAS-KAROO GEOSCIENCE TRANSECT: UNRAVELLING A BILLION YEAR HISTORY OF CONTINENTAL ACCRETION AND SEPARATION IN SOUTHERN AFRICA
Parsiegla, N., Gohl, K., Ritter, O., Weckmann, U., Ryberg, T., Stankiewicz, J., de Wit, M. and Uenzelmann-Neben, G.

Poster session 2 September 27th, Wednesday - September 29th Friday

Passive continental margins

PCM-P01
SEISMIC PROFILING ACROSS THE ARCTIC: DISTINGUISHING CONTINENTAL AND OCEANIC CRUST
Lebedeva-Ivanova N.N., Gee, D.G., Langinen, A.E. and Zamansky, Yu.Ya.

PCM-P02
DEEP SEISMIC INVESTIGATIONS IN THE BARENTS AND KARA SEAS
Roslov, Yu.V., Sakulina, T.S. and Pavlenkova, N.I.

PCM-P03
SEISMIC EVIDENCE OF THE CONSUMPTION OF THE SOUTHERN MARGIN OF BAY OF BISCAY DURING THE ALPINE COMPRESSION.
Fernández Viejo G., Pulgar, J.A., Gallastegui, J., Gallart, J. and MARCONI Team.

PCM-P04
DEEP CRUSTAL STRUCTURE OF THE SHEARED SOUTH AFRICAN CONTINENTAL MARGIN
Parsiegla, N., Gohl, K. and Uenzelmann-Neben, G.

The continental mantle

TCM-P01
EVIDENCE FOR ACTIVE LOWER-CRUSTAL CONTINENTAL DELAMINATION IN THE VRANCEA SEISMOGENIC ZONE OF ROMANIA FROM PROJECT DRACULA
Knapp, J.H., Fillerup, M. A. and Knapp, C. C.

TCM-P02
DEEP EUROPE TODAY: GEOPHYSICAL SYNTHESIS OF THE UPPER MANTLE STRUCTURE AND LITHOSPHERIC PROCESSES OVER 3.5 GA
Artemieva, I.M., Thybo, H. and Kaban, M.K.

TCM-P03
CAN TEMPERATURE VARIATIONS ALONE EXPLAIN LARGE-SCALE Vs AND Qs VARIATIONS IN THE CONTINENTAL LITHOSPHERE?
Artemieva, I.M., Billien, M., Lévêque, J.J. and Mooney, W.D.

TCM-P04
COMPOSITIONAL VARIATIONS IN THE CONTINENTAL LITHOSPHERE CONSTRAINED BY SEISMIC TOMOGRAPHY DATA
Artemieva, I.M.

TCM-P05
FINE SCALE HETEROGENEITY IN THE EARTH'S CRUST AND MANTLE
Thybo, H. and Nielsen, L.

TCM-P06
DIFFERENCES IN DEPTH OF UPPER MANTLE DISCONTINUITIES BENEATH THE ALPS AND THE VARISCIDES FROM WAVEFORM ANALYSIS OF SELECTED EARTHQUAKES
Nita, B., Perchuc, E. and Thybo, H.

TCM-P07
CHARACTERISTIC DIFFERENCES IN TRAVELTIME CURVES FOR 'COLD' AND 'HOT' MODELS OF THE UPPER MANTLE FROM SELECTED EARTHQUAKES FROM THE NORTH AMERICA AND EUROPE
Perchuc, E., Malinowski, M., Nita, B. and Thybo, H.

TCM-P08
UPPER MANTLE STRUCTURE OF NORTHERN EURASIA FROM PEACE NUCLEAR EXPLOSION DATA
Pavlenkova, N.I. and Pavlenkova, G.A.

TCM-P09
THE STRUCTURE OF MOHO BOUNDARY FOR RUSSIA, ADJOINING REGIONS & SEAS
Erinchek, Yu. M., Milshtein, E. D. and Egorkin, A.V.

Subduction structures of megathrust zones

SSM-P01
DEVELOPMENT OF HORST–GRABEN STRUCTURE AT THE IZU-BONIN (OGASAWARA) TRENCH
Takeda, T., Ito, Y., Kasahara, K. and Kimura, H.

SSM-P02
CRUSTAL STRUCTURE BENEATH THE SOURCE REGION OF M7-CLASS EARTHQUAKES OFF IBARAKI PREFECTURE
Mochizuki, K., Yamada, T., Shinohara, M. and Kanazawa, T.

SSM-P03
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ABSTRACTS

September 25th, Monday

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EARTHQUAKES IN JAPAN – THEIR ACTIVITY, GENERATION MECHANISM AND RELATIONSHIP WITH INHOMOGENEOUS LITHOSPHERIC STRUCTURE

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Japanese Islands are located at subduction zones; beneath eastern Japan the Pacific plate is subducting in the WNW direction along the Kuril and Japan trenches, while the Philippine Sea plate is subducting in the NW direction along the Sagami, Suruga and Nannkai troughs beneath western Japan. Furthermore, an emerging plate boundary was found at the eastern margin of the Japan Sea, and it bears the function of convergence of the North American and Eurasian (or Amurian) plates. Because of this tectonic environment, Japan and its vicinity are significantly seismically active areas. There are two main types of seismic activities in and around Japan; the first is the interplate earthquake, which directly reflects relative plate motions, and the other is the intraplate earthquake, which occurs in order to release the stress accumulated by the convergence between plates.

Large interplate earthquakes have frequently occurred beneath the Pacific Ocean east off eastern Japan due to the subduction of the Pacific plate and south off western Japan due to the subduction of the Philippine Sea plate. Waveform inversions of recurrent earthquakes that occurred in common source areas on the plate boundary east off eastern Japan have revealed that large slip areas of successive ruptures are in the same place (asperities) on the plate boundary (Nagai et al., 2001; Yamanaka & Kikuchi, 2003, 2004). Space-time distribution of quasi-static slip on the plate boundary estimated from back slip inversions of GPS data on land is approximately consistent with that estimated from activity of repeating earthquake sequences detected over a wide area on the plate boundary (Uchida et al., 2003; Suwa et al., 2006). The obtained distribution shows that asperities once ruptured by past large earthquakes are locked at present. These observations strongly suggest that the asperity model (Kanamori, 1981; Boatwright & Cocco, 1996) is applicable to the process of seismic and aseismic slip occurring on the plate boundary east off eastern Japan.

Dense seismic and GPS networks were deployed in the whole Japan after the 1995 M7.2 Kobe earthquake with an average station separation of ～20km, which has brought important findings on diversity of interplate coupling and slip on the subducting plate boundaries east off eastern Japan and south off western Japan. GPS data give us opportunity to estimate precise spatio-temporal distribution of asesimic slip on the plate boundary, showing the details of temporal evolution of postseismic slip after some large interplate earthquakes that have occurred recently (Miyazaki et al., 2004; Yui et al., 2006). Dense network data of GPS and tiltmeters have also detected episodic slow slips frequently occurring on the subducting plate boundary south off western Japan. Long-term slow slip events lasting for a few years were detected on the plate boundary downdip from and next to the locked area of the anticipated Tokai earthquake (Ozawa et al., 2002). Dense seismic network data brought the detection of deep low-frequency tremors occurring near the plate boundary at ～30km depth next to the locked areas of anticipated Tokai, Tonankai and Nankai earthquakes (Obara, 2002). Short-term slow slip events on the plate boundary lasting for several days were also found at nearly the same locations as those of low-frequency tremor events. These slow slip events are synchronized with the tremor activity (Obara et al., 2006).

Recent studies on tsunami deposits and tsunami simulation have also shown the diversity of interplate coupling and slip on the plate boundaries in several subduction zones (Satake & Atwater, 2006). It emerged that a megathrust earthquake with multi-segment rupture of fault length >300km occurred in 17th century on the plate boundary along the Kuril trench, where interplate earthquakes with Mw7.8-8.2 are the largest for the last 200 years (Nanayama et al., 2003). Paleoseismological studies have further shown that the megathrust earthquakes with multi-segment rupture have repeatedly occurred every ～500 years. Such variation in rupture mode was first identified along the Nankai trough south off western Japan based on written records for the past 1300 years (Imamura,

1928; Ando, 1975). Similar variability in earthquake size on the subducting plate boundary is also seen in several other subduction zones: a typical example is the 2004 Sumatra-Andaman earthquake, suggesting that such variation in rupture mode is not a special phenomenon on the subducting plate boundary (Satake & Atwater, 2006).

Those multi-segment (or multiple-asperity) ruptures would be caused and controlled by interactions between segments or asperities. Recent studies have tried to reproduce such variation of rupture area, earthquake size and recurrence time by numerical simulations of earthquakes cycles based on laboratory-derived rate- and state-dependent friction laws (Hori, 2006; Kato, 2003), providing the possibility that the observed diversity of interplate coupling and slip can be understood in terms of the rate- and state-dependent friction laws.

Studies on spatial distribution of intermediate-depth earthquakes and seismic velocity structure within the slab provide the evidence which supports the dehydration embrittlement hypothesis for the generation of intraslab earthquakes. Intermediate-depth earthquakes within the subducted Pacific plate form a clear double-planed deep seismic zone over the area from Hokkaido to Kanto, eastern Japan. Estimated dehydration loci of metamorphosed oceanic crust and serpentinized mantle using experimentally derived phase diagrams produce a double- planed structure, suggesting that the upper plane seismicity represents dehydration embrittlement in the oceanic crust and the lower plane seismicity is caused by dehydration of serpentine at the middle of the mantle (Yamasaki & Seno, 2003). A tomographic study on the internal structure of the subducted Pacific slab shows the existence of a narrow low-velocity zone within the slab over a length of ~200km beneath Kanto, which partly penetrates into the mantle portion of the slab (Nakajima & Hasegawa, 2006). Linear alignment of intraslab earthquakes along it is clearly seen, suggesting that the dehydration embrittlement along the fossil fracture zone is the cause of the narrow low-velocity zone and linear alignment of seismicity along it.

Shallow intraplate earthquakes in the northeastern Japan arc are confined to the upper ~15km of the crust. Seismic tomography studies in this arc have revealed the existence of an inclined sheet-like seismic low-velocity zone in the mantle wedge at depths < 150 km (Nakajima et al., 2001). This sheet-like low-velocity zone is oriented sub-parallel to the subducted slab, and is considered to correspond to the upwelling flow portion of the subduction-induced convection. The low-velocity zone reaches the Moho immediately beneath the volcanic front (or the Ou Backbone Range) running through the middle of the arc nearly parallel to the trench axis, which suggests that the volcanic front is formed by this hot upwelling flow (Hasegawa & Nakajima, 2004). Aqueous fluids supplied by the subducted slab are probably transported upward through this upwelling flow to reach shallow levels beneath the Backbone Range where they are expelled from solidified magma and migrate further upward. The existence of aqueous fluids may weaken the surrounding crustal rocks, resulting in local contractive deformation and uplift along the Backbone Range under the compressional stress field of the volcanic arc. A strain-rate distribution map generated from GPS data (Sato et al., 2002) reveals a notable concentration of east-west contraction along the Backbone Range, consistent with this interpretation. Shallow inland earthquakes are also concentrated in the upper crust of this locally large contraction deformation zone. These observations suggest that generation of these shallow inland earthquakes is closely related with the local weakening of the crust by aqueous fluids originated from the slab dehydration (Hasegawa et al., 2005).

The nationwide dense GPS network has also revealed the existence of a linear zone with high strain rates along the backarc side of central Honshu, which is called the Niigata-Kobe Tectonic Zone (Sagiya et al., 2000). Many large earthquakes have occurred along this zone for the last 200 years including the recent 2004 M6.8 Niigata-Chuetsu earthquake. Some researchers proposed that this zone is a plate boundary between the Eurasian and North American (Okhotsk) plates (Shimazaki & Zhao, 2000; Heki & Miyazaki, 2001). Iio et al. (2002) proposed that this zone is an intraplate deformation zone with the lower crust having locally low viscosity, which is caused by dehydration from the subducted Pacific slab. Yamasaki& Seno (2005) claimed that this high strain rate zone is caused by viscosity heterogeneities either in the crust or mantle, the latter being their preferred model. Recent seismic tomography study showed the existence of a locally low velocity zone in the crust along this zone (Nakajima & Hasegawa, 2006).

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OUTLINES OF THE GEOLOGICAL STRUCTURES AND THEIR EVOLUTION OF THE JAPANESE ISLANDS

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1. Structural framework

The basements of the Japanese islands had been basically constructed before middle Miocene when the Japan Sea was opened as a marginal sea of the Eurasian continent. They were drastically destroyed and rearranged during the opening. Thus it is essentially important to separate at first the surface geology of the Japanese islands into the two, pre-lower Miocene basements and post-middle Miocene covers in the discussion of the structural framework of the Japanese islands.

(1) Pre-lower Miocene basements (Fig.1)

Pre-lower Miocene basements are divided into the two, those of southwest Japan and those of northeast Japan by the Tanakura Tectonic Line (TTL).

1) Southwest Japan

The basements of southwest Japan are divided into the two, the Inner and the Outer zones, by the Median Tectonic Line (MTL). The Inner zone is composed mainly of Paleozoic to Jurassic strata forming a nappe structure. For simplification, they are grouped into the pre-Jurassic and the Jurassic. The Latter is called the Mino-Tamba-Ashio belt which consists of Jurassic accretionary complex (AC). As the southern part of the belt was metamorphosed in low P/T condition by the Cretaceous granite, it is often named the Ryoke belt independently. The Hida belt composed of the continental crust thrusts over the nappe of the Inner zone along the Japan Sea coast. On the contrary, the Outer zone is characterized by the seaward younging zonal arrangement of AC; the Sambagawa belt of the metamorphosed Cretaceous strata in high P/T condition, the Chichibu of Jurassic AC, the northern Shimanto of Cretaceous AC, and the southern Shimanto of Paleogene to lower Miocene AC. The MTL which dips at about 45 degrees northward cuts the whole crusts of the Inner and the Outer zones, and juxtaposes the low P/T metamorphic rocks (Ryoke belt) of the Inner zone with the high P/T metamorphic rocks (Sambagawa belt) of the Outer one.

The original structures of the basements have been considerably preserved in southwest Japan under the less influence of the opening of the Japan Sea in middle Miocene. Thus the structures provide fundamental information to reconstruct the framework of the Japanese islands.

2) Northeast Japan

The basements of northeast Japan basically connect with those of southwest Japan, although they were dislocated and complicated by the Tanakura Tectonic Line (TTL). The northern Kitakami-Oshima belt corresponds to the Chichibu belt of Jurassic AC, and the Idon'nappu to the northern and southern Shimanto of Cretaceous to Paleogene AC. The Rebun-Kabato belt corresponding to the Cretaceous volcanic front is superposed along the eastern margin of the northern Kitakami-Oshima belt. The Sorachi-Yezo belt corresponds to the Cretaceous fore-arc basin and its basement. However, it is difficult to find a belt in southwest Japan corresponding to the Abukuma belt. The southern Kitakami has the same difficulty. Both belts are considered to be exotic, that is, outside the framework of southwest Japan, probably associated with the continental bodies in the Yangtze craton, South China.

3) Geological correlation between the Japanese islands and Sikhote-Alin

Sikhote-Alin, Far East of Russia, also has a zonal arrangement of geologic belts, the Zhravlevka, the Taukha, and the Samarka belt which correspond to the Yezo group of the Sorachi-Yezo belt, the northern Kitakami-Oshima, and the Mino-Tamba-Ashio belts, respectively. Some components of the Khanka belt are correlative to those of the pre-Jurassic bodies of southwest Japan, and the south Kitakami and the Abukuma belts. The Central Sikhote-Alin Fault (CSF) probably connected to the MTL before the opening of the Japan Sea. These facts are essential to reconstruct the geological relationship between the Eurasian continent and the basements of the Japanese islands before the opening of the Japan Sea.

(2) Middle Miocene to Recent covers (Fig.2)

The structural framework of the middle Miocene to Recent is defined by five major components. The first is, of course, the relative motions among the four plates, the Pacific, the Eurasian, the North American (Okhotsk?, Seno et al., 1995) and the Philippine Sea plates. The second is the Fossa Magna (Great graben), its western margin, Itoigawa-Shizuoka Tectonic Line (ISTL) and the Akaishi Tectonic Line (ATL), all of which played an important role on the breakup of the Japanese islands necessary to the opening of the Japan Sea. The third is the rift margins during the opening of the Japan Sea. The fourth is the MTL which has repeated to activate. The fifth is two on-going arc-arc collisions, the Izu and the Hidaka collisions.

The distribution of the middle Miocene to Recent covers is controlled by the above-mentioned components. As for second and third components, the largest area of the covers is located between the rift margins in northeast Japan and the ISTL where rift basins were developed during the opening of the Japan Sea in middle Miocene. The area changed from the extensional into the compressional field in late Miocene due to the Pacific plate, and the structural inversion has continued to occur there since then (Sato, 1994; Sato et al., 2004).

The longitudinal basins were formed close to the MTL on its hanging wall two times and filled with the middle Miocene First Setouchi and the Plio-Pleistocene Second Setouchi groups. And now the Seto Inland Sea, a kind of a longitudinal basin occurs on the hanging wall of the western-half segment of the active MTL. The Beppu-Shimabara graben (BSG) has been developing west of the western termination of the MTL. The MTL also played an important role on the opening of the Japan Sea. A huge flexural slip occurred along the MTL associated with the bending the Japanese islands in central Japan (Kano, 2002). The MTL functioned as a southern border of the rifting area in Kanto, together with a listric normal faulting (Sato, 1994). These are related deeply to the reactivation of the MTL mentioned as fourth component.

Fifth component has made peculiar structures in the two collision zones. The Hidaka collision zone (HCZ) has been growing with a delamination structure in the lower crust since middle Miocene. A typical fold-and-thrust belt has been developing with foreland vergence on the west of the HCZ, involving the basement rocks of the Sorachi-Yezo belt. The Izu collision zone (ICZ) forms a cusp structure on the northern termination of the Izu-Bonin arc. Three island blocks of the Izu-Bonin arc and trough-fill sediments have been accreted forming major thrusts around the cusp since middle Miocene.

2. Controversial problems on the structural evolution in the Japanese islands

There are still lots of controversial problems on the structural evolution in the Japanese islands. Here two essential problems are introduced.

(1) Strike-slip tectonics vs. nappe tectonics

Many exotic bodies that cannot be explained by the common accretionary process are reported in the Japanese islands. The Abukuma and the south Kitakami belts are the largest and next to the largest in the exotic bodies. What tectonics could be responsible to the emplacement of exotic bodies? Following two models were presented and discussed in the 1980's; one is the strike-slip tectonics (Taira et al., 1983), and the other is the nappe tectonics (Isozaki and Maruyama, 1991). The former insists that strike-slip faults have play a major role in emplacement of exotic bodies into accretionary regions, while the latter does that continental bodies have been transported into accretionary regions as nappes.

(2) Where does the boundary between the Eurasian and the North American (Okhotsk?) plates run?

Chapman and Solomon (1976) firstly proposed that the boundary between the Eurasian and the North American plates reaches the Japan trench off the Erimo Cape through the Hidaka mountains. Nakamura (1983), however, presented a new hypothesis that the boundary has already shifted from the HCZ to the eastern margin of the Japan Sea and continues to the ISTL. Seno et al. (1995) separated a microplate from the southernmost part of the North American plate, and named it the Okhotsk plate. According to Seno et al. (1995), Nakamura (1983)'s hypothesis mentions the boundary between the Eurasian and the Okhotsk plate. Although the hypothesis has found a wider acceptance, there is no essential fact supporting it.

3. Deep contribution of seismic profilings to the research in the geology of the Japanese islands.

We would like to present in this symposium how deeply recent seismic profilings have contributed the progress of the research in the geology of the Japanese islands. Here only solutions are brought up for the two controversial problems mentioned above.

(1) Solution for the first problem

Yamakita and Otoh (2000, 2002) already proposed a splitting process of the Japanese islands from the continent. It is notable that the process is composed of the two kinds of tectonics, strike-slip and nappe tectonics. However there was a question whether a huge strike-slip motion is possible along a major thrust plane. The solution is obtained from the seismic profile of the MTL (See Japan Transect "Shikoku-Chugoku"). Although the MTL cuts the whole crust with a dip of 40 degrees, it has the long reactivation history composed of thrusting, normal and strike-slip (left- and right-lateral) faulting. Thus the solution for the first problem is that the real tectonics is the combination of both the strike-slip and the nappe tectonics.

(2) Solution for the second problem

The deep seismic profiling across the HCZ makes clear that the collision is still on-going and shares a half of the convergent rate between the Eurasian and the North American (Okhotsk) plates. This indicates that the plate boundary zone must include the HCZ. The active zone along the eastern margin of the Japan Sea off the northeast Japan has been growing by the structural inversion due to the Pacific plate as shown in Japan Transect "Northeast Japan".

Recent seismic profilings across the Fossa Magna (Sato et al., 2004; Ikeda et al., this symposium) reveal the following facts. (1) The active fault zone associated with the ISTL (A-ISTL) is composed of the three segments, the northern, the middle, and the southern. (2) The northern segment is an eastward dipping thrust, whereas the southern a westward dipping thrust. Between the two, the middle segment inevitably has a left-lateral motion. The thrusting along the northern segment is caused by the structural inversion due to the Pacific plate. However the thrusting along the southern segment is caused by the Izu collision due to the Philippine Sea plate. Both the thrusts are controlled by the different plates.

It is impossible to connect the active zone along the eastern margin of the Japan Sea with the A-ISTL as a single plate boundary. In reality, the 200-km-wide zone covering the eastern half of Hokkaido, the western half of northeast Japan including the eastern margin of the Japan Sea, and the Fossa magna accommodates convergent motions among the four plates.

Fig.1: Pre-lower Miocene basements.

1.Hida belt, 2.Pre-Jurassic, 3.Mino-Tamba-Ashio belt, 4.Sambagawa belt, 5.Chichibu belt, 6.Northern Shimanto belt, 7.Southern Shimanto belt, 8.Abukuma belt, 9.Southern Kitakami belt, 10.Northern Kitakami-Oshima belt, 11.Rebun-Kabato belt, 12.Sorachi-Yezo belt, 13.Idon'nappu belt, 14.Zhravlevka belt, 15.Taukha, 16.Samarka belt, 17.Khanka. MTL: Median Tectonic Line, ATL:

Akaishi Tectonic Line, ISTL: Itoigawa-Shizuoka Tectonic Line, TTL: Tanakura Tectonic Line, CSF: Central Sikhote-Alin fault. Compiled after GSJ (1982), Kiminami et al. (1986), Isozaki and Maruyama (1991), Hashimoto ed. (1991), Kojima et al. (2000), Yamakita and Otoh (2000, 2002).

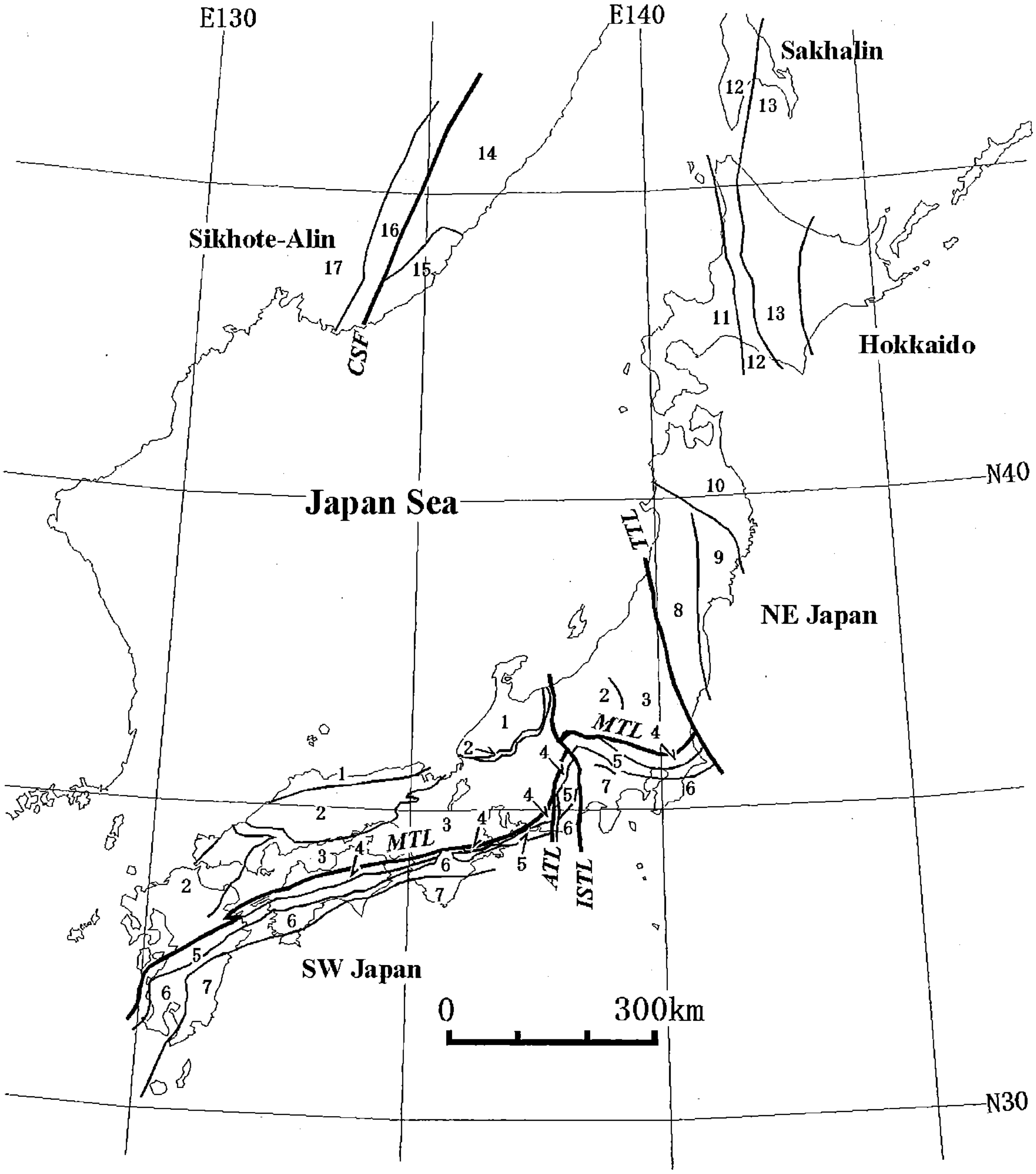
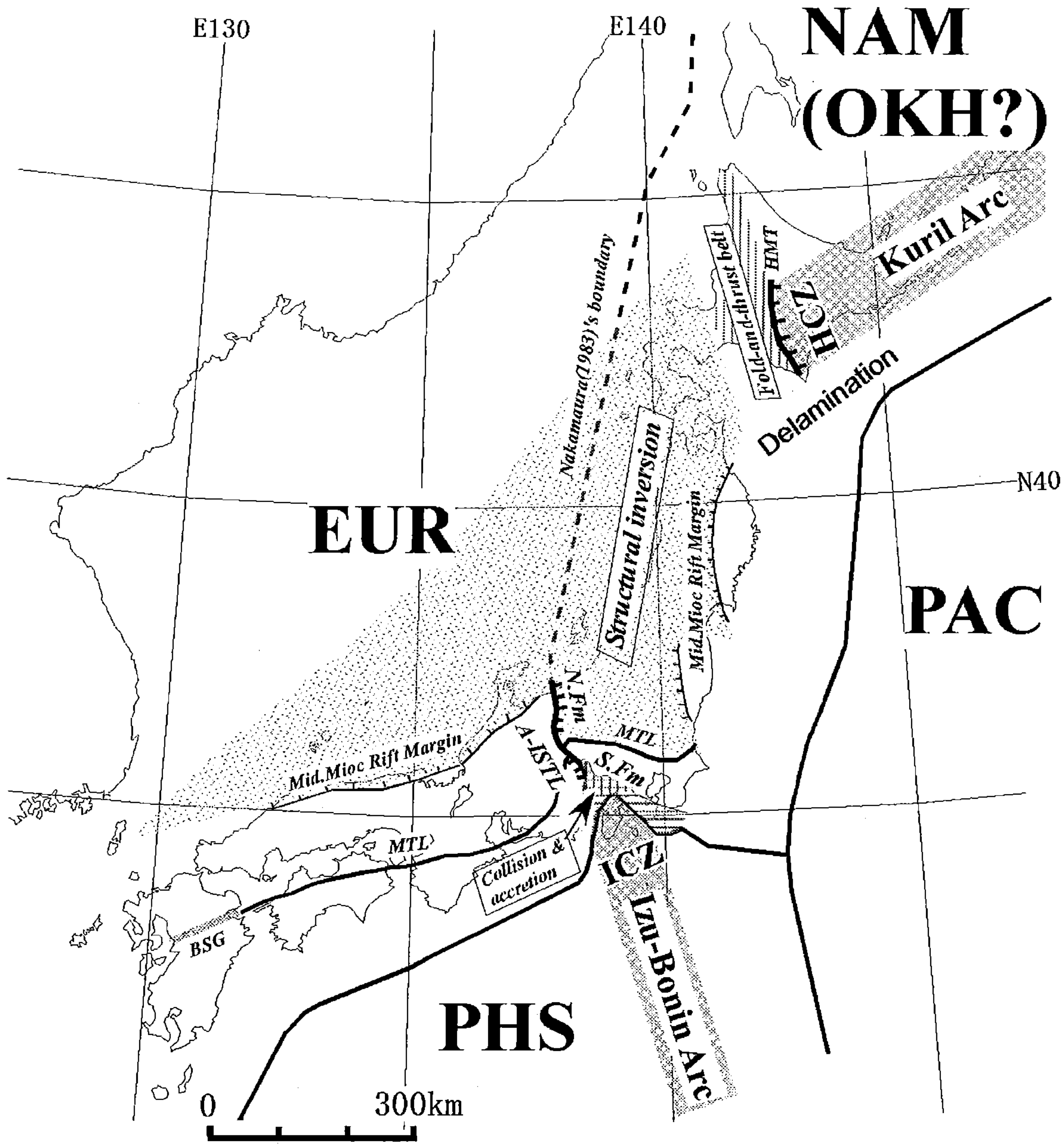


Fig.2: Middle Miocene to Recent tectonic map
HCZ: Hidaka collision zone, ICZ: Izu collision zone, MTL: Median Tectonic Line, A-ISTL: Active fault zone associated with Itoiga-Shizuoka Tectonic Line, N.Fm: Northern Fossa Magna, S.Fm: Southern Fossa Magna, BSG: Beppu-Shimabara graben, HMT: Hidaka Main Thrust, Nakamaura's (1983) boundary: Plate boundary between EUR and OKH proposed by Nakamaura (1983), Dotted area: Middle Miocene rifting area, PAC: Pacific plate, EUR: Eurasian plate, PHS: Philippine Sea plate, NAM: North American plate, OKH: Okhotsk plate.



Continental rifts and basins

10:50 CRB-O01

EXTENSIONAL HISTORY OF THE EASTERN BLACK SEA BASIN

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Although the Black Sea consists of one large depositional structure today, geophysical studies have revealed that the basin can be divided into two sub-basins, which have different tectonic histories. To provide constraints on the tectonic history of the eastern Black Sea Basin, a wide-angle seismic reflection-refraction survey was carried out in early 2005. We will present initial results from the data collected. To delineate basin structure, seismic tomography methods have been used to create 2D velocity models through the crust. A thick sedimentary package (8-10 km) is observed on all profiles. A low-velocity zone occurs near the base of the sedimentary section and is fairly continuous

throughout the basin. This zone is most likely caused by overpressured sediments, with anomalous velocities of 2.6-3.0 km/s and 3.4-3.6 km/s above and below. One profile extends across the basin from offshore Rize to the Mid Black Sea High, along the line the crust thins slowly from ~28 km at the eastern margin to ~8 km in the centre. This thickness indicates a stretching factor of 4.7 ±0.3 (assuming an initial thickness of 35 km). A second profile extends from the Turkish margin, across Sinop trough and Archangelsky Ridge, into the centre of the basin. A maximum thickness of ~32 km is detected beneath Archangelsky Ridge. Some crustal thinning is observed beneath Sinop trough; this thinning appears to be slightly offset from the deepest part of the overlying sedimentary basin. The crust thins abruptly from Archangelsky Ridge to ~8 km in the centre of the basin over a lateral distance of only ~30 km.

11:10 CRB-O02

WIDE ANGLE SEISMIC REFLECTION CONSTRAINTS ON THE LITHOSPHERE OF SW-IBERIA: IBERSEIS-WA

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Two wide angle seismic transects (A and B) have been acquired across the SW Iberian Peninsula. They run across three major tectonics terraces: South Portuguese Zone (SPZ), Ossa Morena Zone (OMZ), and Central Iberian Zone (CIZ), and his boundaries. The transect A coincides with the course of the IBERSEIS deep seismic reflection profile and the transect B was located to the south-east of the transect A. Both transects are approximately 300 Km long and feature a station spacing that ranges from 150-400 m. These unusually dense seismic wide-angle data provides velocity constraints on the Variscan lithosphere of SW-Iberia. This unique acquisition geometry, very dense trace spacing favored the lateral correlation of the seismic events. Careful processing of the shot records revealed high amplitude and relatively high frequency well defined arrivals within the upper, middle and, lower crust and upper mantle. Conventional forward model interpretation constraints an upper crust characterized by a gradient velocity from 5.2 km/s at the surface to 6.5 km/s at 13-15 km depth. Beneath this and up to 25 km depth velocities are relatively high within the range of 6.9-7.1 km/s. The lower crust, from 25-33 km depth velocities are within the range of 6.6-6.8 km/s. The velocity function is relatively high when compared with the standard average crustal velocity [Christensen and Mooney 1995]it approaches the average depth velocities for arcs scenarios. Taking into account the crustal thickness of the study area (approximately 32 km) the velocity depth profile are more consistent with velocity averages characteristic of rifts and/or extended crust, although mid-lower crustal velocities are higher in SW-Iberia. This suggests that crust has a relatively high content of mafic material when compared to the average composition. Thus, this favors that most probably mafic-ultramafic upper mantle material intruded the crust at some stage during the tectonic evolution.

11:30 CRB-O03

**REPROCESSING OF SEISMIC REFLECTION DATA WITH THE COMMON REFLECTION SURFACE STACK METHOD (CRS):
NEW INSIGHT INTO THE CRUSTAL STRUCTURE OF NORTHERN GERMANY**

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In this paper we present reprocessing results of seismic reflection data sets recently released by the industry. The aim of the reprocessing was to study the influence of deep rooted processes on formation and evolution of the North German Basin and their relation to neo-tectonic activities by interpretation of lower crustal seismic events. The new seismic images were obtained by application of the Common

Reflection Surface (CRS) stack method (Müller et al., 1998) to the data. In the reprocessed sections the image quality of the lower and middle crust and the visibility of the Moho could be significantly improved. The latter appears as a flat boundary lacking the typical features of basin formation and graben developments. The observed flat Moho is in conflict with the currently supported extension model of the Glückstadt Graben. However, the flat Moho topography would be in good agreement with other observations, e.g. DEKORP profiles (DEKORP-BASIN Research Group, 1999) or the Dniepr-Donets basin, Ukraine (Maystrenko et al., 2003). Also, recent gravity modeling by Bayer et al. (2005) shows consistent results. This real data example shows that the CRS stack method provides a promising tool for processing of not only subsurface structures, but also for imaging of crustal and subcrustal features.

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14:00 CRB-O04

SUB-SEISMIC STRUCTURE AND DEFORMATION QUANTIFICATION ON DIFFERENT SCALES FROM 3D REFLECTION SEISMICS IN THE NORTH GERMAN BASIN

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The evolution of a sedimentary basin is mostly affected by deformation. Large-scale, subsurface deformation is typically identified by seismic data, sub-seismic small-scale fractures by well data. Between these two methods, we lack a deeper understanding of how deformation scales. We analysed a 3D reflection seismic data set in the North German Basin (NGB), in order to determine the magnitude and distribution of deformation and its accumulation in space and time. A five-step approach is introduced for quantitative deformation and fracture prediction. An increased resolution of subtle tectonic lineaments is achieved by coherency processing, allowing to unravel the kinematics in the NGB from *structural interpretation*. Extensional events during basin initiation and later inversion are evident. *3D retro-deformation* shows major-strain magnitudes between 5-15% up to 1.5 km away from a fault trace, and variable deviations of associated extensional fractures. Good correlation of FMI data, strain distribution from retro-deformation and from *geostatistic tools* allows the *validation of the results* and makes the prediction of small-scale faults/fractures possible. The temporal component will be gained by *analogue models*. The suggested workflow is applicable to reflection seismic surveys and yields in great detail both the tectonic history of a region as well as predictions for hydrocarbon plays.

14:20 CRB-O05

CRUSTAL STRUCTURE AND EVOLUTION OF THE SOUTHERN RIO GRANDE RIFT, USA

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The crustal structure of the Rio Grande Rift is an important link to the understanding of mantle, crustal and surface processes associated with continental rift environments. We present a model for the crustal velocity structure of the rift derived from the analysis of seismic refraction/wide-angle reflection data acquired during the Potrillo Volcanic Field (PVF) experiment in May 2003. The 205 km long profile, consisting of 8 shots and 793 receivers across southern New Mexico and Far West Texas, was designed as a detailed seismic investigation of the structure and composition of the Southern Rio Grande Rift (SRGR) and the Potrillo Volcanic field, a very recent and well known xenolith locale.

Along the profile, the velocity structure of the upper 3-5 km reflects the basins and ranges of this recently extended area. Basin fill ranges in velocity from 2.5 to 4.5 km/s. In the ranges, velocities are 4.7 to 5.3 km/s and reflect uplifted Paleozoic sedimentary rock. A middle crust interface marks the transition from upper to middle crust at depths of 11-15 km. This layer steps up abruptly just to the west of the PVF and indicates a thickening of the middle crust associated with the PVF. Velocities range from 6.28 to 6.4 km/s below this transition to velocities of 6.7 to 7.1 km/s at the base of the crust. While near-vertical incidence records show a complicated reflectivity pattern at the Moho, velocity modeling does not suggest a pronounced lower crust transitional layer. Crustal thickness varies from 35 km at the western end of the profile to as little as ~30 km beneath the El Paso area. We Interpret the west to east thinning of crust and thickening of middle crust underlying the PVF as the manisfestation of the transition from southern Basin and Range province to the Rio Grande Rift proper. Upper mantle velocities range from 7.75 to 7.9 km/s, which is consistent with a warm upper mantle and high heat flow values of 75 to 125 mWm^2 associated with the SRGR.

14:40 CRB-O06

SEISMIC ANALYSIS AND MODELS FROM A RIFTED SUBMARINE PLATEAU OF CONTINENTAL ORIGIN: GREAT SOUTH BASIN AND BOUNTY TROUGH (NEW ZEALAND)

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The Campbell Plateau and Chatham Rise are large submarine plateaux of continental origin forming parts of the submarine New Zealand continent. Prior to the break-up of this part of Gondwana, New Zealand was situated at the proto-Pacific plate boundary of Gondwana, connected to Marie Byrd Land. It is expected that the development of the continental fragments forming Campbell Plateau and Chatham Rise played a key role in the development of Gondwana's plate boundary from a convergent margin to continental rifting. Our new crustal models of Bounty Trough and Great South Basin infer thinned crust beneath both basins. The crust beneath the Bounty Trough is extremely thinned up to nascent seafloor spreading. Seismic information implies that several extensional phases and styles (pure shear and simple shear) have occurred. Beneath the Great South Basin, the crust is less thinned and underplating can be observed in some areas. Our models as well as geologic information suggest, that an initial extension of the Campbell Plateau predates the Great South Basin opening in Cretaceous time. This information related to the magnitude and style of rifting along Bounty Trough and Great South Basin, influence models of the break-up process between New Zealand and Antarctica that will be presented here.

15:40 CRB-O07

THERMAL REFRACTION AND THE RHEOLOGICAL BASIS OF "COLD" INTRAPLATE DEFORMATION: SEISMICALLY AND GEOLOGICALLY CONSTRAINED NUMERICAL MODEL OF THE DONBAS FOLDBELT

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The Donbas Foldbelt is a mildly inverted (folded and faulted) segment of a Late Palaeozoic intracratonic rift basin (the Dniepr-Donets Basin, lying within the Archean-Paleoproterozoic East European Craton). Excellent deep seismic reflection data (with coincident crustal velocity structure from wide-angle/refraction data) image the entire basin, its flanks, and underlying crystalline crust. The sedimentary succession is about 20 km thick and the inversion is seen to have occurred primarily as a crustal scale pop-up, with a main, north-east vergent, thrust (shear) zone cutting the Moho and the basement-sediment horizon, coming to the surface within sediments near the northern margin of the rift. A slightly steeper, south-west vergent, back-thrust originating at the main thrust within crystalline basement rises through the basement-sediment interface emerging near the southern margin of the rift also within the sedimentary succession. Although there are several subsidiary, originally normal, faults within the sedimentary complex that have been slightly inverted, the crustal-scale main thrust and back-thrust appear to be new structures developed initially during the inversion stage. Shortening of the basin, based on palinspastic reconstructions of the seismic image, was about 12 kilometres (~10% strain) and occurred primarily at the end of the Cretaceous. This is about 300 Myr after rifting (Late Devonian-Early Carboniferous) and about 200 Myr after the youngest inferred (tectonic) extensional reactivation (Late Carboniferous-Early Permian) indicating that any thermal perturbation associated with these events was relaxed by the time of inversion. We have modelled the inversion using an elastic-viscous-plastic finite element code, simply by applying a 10% horizontal shortening strain, for a range of strain rates, on the pre-inversion crust-basin geometry as reconstructed from the seismic image. The results show that the accommodation of shortening occurs mainly on major, primary, bivergent structures that very closely mimic those imaged by the seismic data. The locations of these primary structures, beneath the flanks of the basin, are controlled by the thermal structure of the crust-basin model which, in turn, is dominated by a significant thermal refraction effect caused by the thick sedimentary basin succession itself. The presence of this effect in the actual crustal temperature structure can be seen in the observed surface heat flow pattern measured in the Donbas Foldbelt, which shows a relative low along the axis of the basin flanked by relative highs. A requisite feature of the model in replicating this is that the bulk thermal conductivity of the basin succession is less than that of the crystalline crust. We have carried out a parameter sensitivity analysis, using a Monte Carlo approach, and can conclude – for the crust-basin geometry being considered – that even a relatively small (grater than unity) contrast in crust-sedimentary basin thermal conductivity is sufficient to explain the style of inversion. The results are rather insensitive to variations in heat production in the basin and crustal units. That the main thrust zone has north-east vergence, with the secondary back-thrust being south-west vergent, is also predicted by the model and this is related to the presence of high velocity lower crustal "rift pillow" lying slightly offset to the north-east relative to the main basin depocentre.

16:00 CRB-O08

BAIKAL EXPLOSION SEISMIC TRANSECTS

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The Baikal Rift Zone is located in Siberia at the centre of the world's largest continental area. It provies a unique opportunity for studying the processes of ongoing continental rifting in an area with thick cratonic crust. The BEST project (Baikal Explosion Seismic Transects) aims at providing seismic velocity models of the crust and uppermost mantle across and along the strike of the Baikal Rift Zone. The project comprises two deep seismic profiles at the southern end of Lake Baikal: (1) a 360 km long, NS-trending profile across the rift zone from the Mongolian border to Cheremhovo, and (2) a 360 km long EW-trending profile along-strike of the rift zone at the northern shore of the lake into the Tunka depression to the Mongolian border. The seismic sources were 13 explosions in boreholes, airgun shots in the lake, and the supervibrator located at Babushkin near the cross point between the two profiles at the shore of the lake. The velocity models show a gently deepening Moho from the Siberian

Craton into the Palaeozoic fold belt to the SE of Lake Baikal without any sign of Moho uplift around the more than 10 km thick sedimentary graben structure. Strong seismic reflectivity slightly offset to the NE from the rift zone indicates the presence of pronounced magmatic intrusions in the lower crust, despite of the non-volcanic appearance of much of the rift zone. These intrusions may have compensated rifting associated lower crustal thinning. Further there is no sign of any reduction of the seismic Pn wave velocity around the rift zone. These features indicates that the existing models of continental rifting may not be adequate for describing the underlying processes in thick, cratonic lithosphere.

p 61

16:20 CRB-O09

CRUSTAL STRUCTURE OF MAINLAND CHINA FROM DEEP SEISMIC SOUNDING DATA

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We summarize the results of over 90 seismic refraction/wide angle reflection profiles from mainland China in the form of (1) a new contour map of crustal thickness, (2) 14 representative crustal seismic velocity-depth columns for various tectonic units, and, (3) a Pn velocity map. We found a north-south-trending belt with a strong lateral gradient in crustal thickness in central China. The region east of this belt has a crustal thickness of 30-45 km, while the region to the west has a thickness of 45-75 km. The crust in these two regions has experienced different evolutionary processes, and currently lies within distinct tectonic stress fields. Our compilation finds that there is a high-velocity (7.1 -7.4 km/s) layer in the lower crust of the stable Tarim basin and Ordos plateau. In orogenic belts, there usually is a low-velocity layer (LVL) in the crust, but in stable regions this layer seldom exists.

16:40 CRB-O10

CRUSTAL STRUCTURE OF THE SOUTHERN KOREAN PENINSULA FROM LARGE EXPLOSIONS

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In order to investigate the crustal structure of the southern Korean peninsula, seismic profiles were obtained along a 294-km WNW-ESE line and a 335-km NNW-SSE line. Seismic waves generated by detonating 500~1000 kg explosives in six drill holes at depths of 80~150 m were recorded by portable seismometers at nominal intervals of 1.5~1.7 km. Velocity tomograms of P- and S-wave first-arrival times were derived using a series expansion method. Reflection depth images were also produced through non-hyperbolic normal-moveout correction and finite-difference migration. Both the raypaths of tomographic velocity models and migrated reflection sections indicate several mid-crust interfaces including those at approximate depths of 2~3 and 15~17 km. The Moho discontinuity with refraction velocities of 7.8~8.4 km/s for P waves and 4.4~4.9 km/s for S waves has a maximum depth of 38 km under the southern central portion of the peninsula. The Moho becomes shallower as the Yellow Sea and the Korea Straight are approached on the west and east coasts of the peninsula, respectively. Average Vp/Vs ratios from P- and S-wave velocity tomograms are 1.71 in the upper crust, 1.74 in the lower crust, and 1.79 along the Moho interface. The velocity tomograms also show particular crustal structures including (1) the existence of low-velocity zone centered at 6~7 km depth under the Okchon fold belt and Ryeongnam massif, (2) existence of high-velocity materials under the Gyeongsang basin, and (3) the downward extension of the Yeongdon fault to depths greater than 10 km.

September 26th, Tuesday

8:30 CRB-O11

MELT INTRUSION IN THE CRUST AT RIFTED MARGINS AND BACK-ARC BASINS

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Deep penetration seismic reflection and wide-angle profiles across the North Atlantic volcanic continental margin image up to 5 km of extrusive basalts overlying a heavily intruded 15-20 km thick stretched continental crust. The intrusive section is generated by multiple lower crustal sill intrusions above the Moho in a relatively narrow region on the rifted margin. Seismic velocity measurements suggest that the lower crustal intrusions exhibit high velocities and densities, consistent with high-Mg basalts partially fractionated from mantle melts.
Similar lower-crustal intrusive processes are inferred in the Hikurangi back-arc basin in the North Island of New Zealand (the Taupo Volcanic Zone), and imaged from their effect on the P- and S-wave velocities. Although the pre-existing continental crust is stretched by a factor of ~2, the addition of large volumes of basaltic melt from the underlying mantle generates a 15 km thick lower crustal region of intruded melt which fractionates to form the explosive silicic eruptions such as those which generated the Taupo caldera. The ratio of P- to S-wave velocities shows that there is still likely to be molten rock present in the crust beneath Taupo.

Intra-continental collision and accretion

8:50 ICA-O01

THE AUSTRALIAN CRUST, ARCHAEAN TO PALAEOZOIC ARCHITECTURE: RESULTS FROM AUSTRALIA'S DEEP SEISMIC PROGRAM

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Australia's National Facility for Earth Sounding, ANSIR, has collected in excess of 30 regional deep seismic reflection surveys across different Australian geological regions; from crustal scale through detailed district to mine scale. Examples from these surveys will be presented showing images of the Australian Crust. Each survey has produced results that dispelled some 'sacred-cow' in geological understanding of that region. In particular, the seismic data are successfully imaged the major basement geological units and structures and therefore provided the depth constraints to construct 3D geological models. In addition, the seismic data is being used as a tool to predict and constrain mineral systems to help explorers to better target and assess the mineral potential of an area.

9:10 ICA-O02

DEEP CRUSTAL STRUCTURE, ORIGIN AND EVOLUTION OF THE PALAEOPROTERO-ZOIC LAPLAND-MIDRUSSIA-SOUTHBALTIA INTERCONTINENTAL COLLISION OROGEN, EAST-EUROPEAN CRATON

Mints, M.V.*(1), Suleimanov, A.K.(2), Philippova, I.B.(1), Zamozhniaya, N.G.(2), Stupak, V.M.(2), Babayants, P.S.(3), Blokh, Yu.I.(3) and Trusov, A.A.(3)
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The bow-shaped Palaeoproterozoic Lapland-Midrussia-Southbaltia intercontinental collision orogen outflanks the Neoarchaean Karelia craton and the Palaeoproterozoic Svecofennian accretionary orogen

from the northeast, east and south. Peripheral zones formed by the imbricated thrust and nappe ensembles of the Neoarchaean granite-greenstone and Palaeoproterozoic low-grade volcano-sedimentary assemblages frame the orogen. As it is seen from seismic CDP data (geotraverse 1-EU, EGGI-10, Kola-SD and 4B profiles), these structural ensembles sink mainly toward orogen axis. The Palaeoproterozoic granulite-gneisses thrusts and para-autochthonous amphibolite-gneiss assemblages of both the Palaeoproterozoic and Neoarchaean ages form the axial area. Structural links between granulitic rocks and low-crustal level cannot be established and are possibly lost as a whole as a result of the collision movements. Geodynamic evolution of the orogen includes some stages: Superplume related initial riftogenesis, origin of extended basins; high-grade metamorphism of the low crust and sedimentary-volcanic filling of those basins; final collision deformations.

9:30 ICA-O03

SEISMIC IMAGES OF THE SVECOFENNIAN OROGEN

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Recently the accretionary Svecofennian Orogen has been surveyed by EUROPROBE/ SVEKALAPKO tomographic network and by large scale reflection experiment FIRE in southern Finland. A new 3D-tomographic inversion supports the idea that the Svecofennian Orogen is a collage of microcontinents, arcs and intervening sedimentary basins. The older continental nuclei – micro continents and arcs – have slightly higher P wave velocity and Vp/Vs ratio than the sedimentary basins. The thick crust has been stabilized by high velocity high Vp/Vs ratio underplating material residing in the lower crust.
In seismic reflection sections, the older crustal fragments are imaged as poorly reflective units whereas the metasedimentary units display more variable reflectivity associated with layering and deformation. The lower crustal underplate is visualized by homogenous, rather featureless reflectivity gradually decreasing at the Moho boundary. The underplate and associated extensional deformation in the middle and upper crust are interpreted to image gravitational collapse of the orogen.

Seismic investigations related to mineral resources and volcano-plutonic system

10:30 SMV-O01

4DEEP SEISMIX: TIME LAPSE IMAGING OF MAGMA BENEATH MONTESERRAT- A FEASIBILITY STUDY

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4D imaging of reservoir fluids, as developed in oil exploration, offers a potentially transformative tool for investigating deep magmatic systems. Deep seismic reflection profiling with surface sources, as well as analysis of reflected phases from microearthquake sources and converted phases from teleseismic sources, have revealed a number of deep crustal "bright spots" which have been interpreted as fluid, usually magma. Most of these examples are associated with magmatic systems or rift zones where magmatism is expected. The prominent nature of such fluids suggests that they not only should be mappable in 3D using exploration-type surveys, but that temporal changes might be detectable with time-lapse surveys. We have explored the feasibility of such detection by calculating the synthetic reflection response for both shallow (ca 5 km) and deep (ca 12 km) magma chambers suspected to exist beneath the active Soufriere Hills volcano on Montserrat , British West Indies. The synthetics provide insight into the detectability of magma reservoirs of various shapes as well as variations in their shape due to inflation, deflation and cooling. Differencing synthetics (seismic interferometry) demonstrates that very subtle variations in magma chamber characteristics should be detectable if sufficient energy can be provided for illumination. This can be a challenge with high attenuation/scattering materials and difficult source/receiver coupling conditions. Montserrat offers a number of particularly favorable factors for detection/modeling of deep magma. Moreover, integration of controlled source seismic surveys, with natural source recording, can be used to minimize the costs of detection of temporal variations at depth. SEA-CALYPSO, an onshore/offshore experiment scheduled for late 2007 will provide a test of these methodologies.

10:50 SMV-O02

VARIABLE GROWTH OF CONTINENTAL CRUST IN THE IZU–BONIN INTRA-OCEANIC ARC REVEALED BY ACTIVE SORUCE SEISMIC STUDIES

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The processes that create continental crust in an intra-oceanic arc setting are a matter of debate. To address this issue we conducted active source wide-angle seismic studies to examine along-arc structural variations of the Izu-Bonin intra-oceanic arc. The data used were acquired along the volcanic front at the Izu-Bonin entire arc. The obtained structural model showed the existence of felsic to intermediate composition middle crust with a Vp of 6.0–6.5 km/s in its upper part and 6.5–6.8 km/s in its lower part. Those velocities well corresponds to compressional velocities measured from felsic to intermediate component tonalitic rocks corrected at the Izu collision zone. Average crustal velocities calculated from our model showed remarkable lateral variation, which correlated well with arc volcanism. Low average crustal seismic velocities (~6.7 km/s), due to thick middle crust, were obtained beneath basaltic volcanoes, while higher average velocities (~7.1 km/s) were obtained beneath rhyolitic volcanoes. Velocity-depth curves obtained at the basalt volcanoes are almost identical to those of typical continental crusts, except for a layer showing intermediate velocity between crust and mantle (~ 7.5 km/s). We concluded from these observations that continental crust grows predominantly beneath the basaltic volcanoes of the Izu arc, and that rhyolitic volcanism may be indicative of re-melting of continental crust.

11:10 SMV-O03

TECTONIC AND METALLOGENIC IMPLICATIONS OF REGIONAL SEISMIC PROFILES IN THE TIMMINS MINING CAMP, CENTRAL SUPERIOR CRATON OF CANADA

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Four regional Vibroseis reflection profiles totalling 153 line kilometres of 3-component data were acquired in 2004 near Timmins, northern Ontario, crossing the southern Abitibi greenstone belt of the Archean Superior carton. Five additional high-resolution lines using half the receiver and shot spacing targeted specific features such as the regional Porcupine-Destor deformation zone that is hypothesized to control gold mineralization. Interpretation of these profiles individually and in a composite north-south transect reveals a number of prominent bands of reflectors within the upper 15-km of the crust that define a series of folds or antiformal stacks of thrust nappes. Structures and greenstone belt stratigraphy mapped at the surface confirms structural culminations in these locations. At depths greater than 10 km the reflectors have generally shallower dips and lower amplitude folding is implied. World-class ore deposits such as those at the Hollinger, McIntyre and Dome mines are located on the northern, steeply dipping limbs of these antiformal stacks implying that the fold structures channelled mineralizing fluids within the upper crust and to the near-surface. The Porcupine-Destor deformation zone is revealed by the new seismic data to be a composite of early fold structures and late transpressive fault arrays. Processing of the inline horizontal component revealed reflections very similar, but distinct in detail, to the vertical component section if P-S conversion occurs near the source; a sharp transition from glacial till to Precambrian basement is the probable conversion point. Unusual, horizontal reflectors in the cores of anticlines have associated velocities that are less than those associated with the folded rocks.

Japan session

11:30 JPS-O03

JAPAN TRANSECT – OVERVIEW OF RECENT SEISMIC EXPEDITIONS IN JAPAN -

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The Japanese Islands are composed of several island arcs developed along subduction zones in the eastern margin of the Asian Continent. Their crustal evolutions have been dominated by complex tectonic processes including plate subduction, accretion, back arc spreading and arc-arc collision. Major islands of Hokkaido, Honshu, Shikoku and Kyushu are geologically divided into two arcs of NE Japan and SW Japan. The NE Japan Arc, which includes NE Japan and western Hokkaido, is overriding the subducting Pacific Plate. The SW Japan Arc consists of the western half of Honshu and Kyushu, beneath which the Philippine Sea Plate (PHS Plate) is subducted. During most of Mesozoic to early Miocene time, these arcs were situated along the subduction zone in the eastern margin of the Asian Continent, and rotated to their present locations by back arc opening of the Sea of Japan in 20-14Ma.

Crustal studies of the Japanese Islands using controlled seismic sources were started in the 1950's. Although expeditions in the early stage (1960's) elucidated large-scale crustal and upper-mantle structural variations across the Japanese Island, their detailed structures dominated by the tectonic processes were left enigmatic. In 1990's crustal und upper mantle studies in Japan progressed very much due to the introduction of near-vertical reflection method. In the session of "Japan Transect", important findings obtained from the recent research activities in Japan are presented for (a)Kuril Arc, (b)Hokkaido (arc-arc collision system), (c),(d)NE Japan (classic trench-arc-backarc system), (e)Izu Collision Zone (arc-arc collision system), (f) Izu-Bonin arc, (g)Central Japan, (h)Kii Peninsula, (i)SW Japan (subduction systems of the PHS Plate), (j)Kyushu (subduction and rift system) and (k)Ryukyu Arc (subduction system with ongoing backarc spreading). Locations of the profile lines are indicated in Fig. 1. In the following, our results are briefly summarized for Hokkaido, NE Japan and SW Japan.

(1) **Hokkaido (Arc-arc collision System)** Arc-arc collision between the Kuril Arc with the NE Japan Arc has been ongoing since Miocene, which is a controlling factor for crustal deformation in the central part of Hokkaido Island. Seismic reflection researches in 1994-1997 firstly delineated the crustal delamination of the Kuril Forearc associated with the collision. The subsequent seismic expeditions presented a detailed crustal model from the hinterland to the fold-and-thrust belt of the collision zone. The delamination of the Kuril Forearc is well imaged both from the reflection and refraction data. The structure of the fold-and-thrust belt is characterized by a very thick (5-8 km) sedimentary package including one or two velocity reversals of Paleogene sedimentary layers, probably formed by imbrication associated with the collision process. This package is situated on the eastward dipping crust of the NE Japan Arc.

(2) **NE Japan (Classic trench-arc-backarc system)** A 600-km wide-angle reflection profile, extending from the Japan Trench to the Sea of Japan via NE Japan, revealed a detailed crustal section for a typical trench-arc-backarc system. The crust in the forearc side is about 20 km in thickness under which the subducted Pacific Plate is well imaged down to 20-30 km. The crustal structure under NE Japan clearly recorded deformation under the extensional tectonics associated with the Miocene backarc spreading of the Sea of Japan. The eastern part of NE Japan, which remains a stable forearc block with a less deformed upper crust. Its western part, on the other hand, is characterized by the highly deformed Tertiary sedimentary layers and westward crustal thinning associated with backarc

spreading. Major fault systems created at the time of the backarc spreading are well imaged from the seismic reflection lines in the backbone range. The crustal thickness decreases to 16-17 km under the Sea of Japan (backarc basin). The Pn velocity under the arc is very low (7.5-7.6 km/s), but it increases to 8.0 km/s in the backarc side forming a rather narrow (20-30 km wide) transition zone.

(3) **Southwest Japan (Subduction system of the PHS plate)** A series of onshore-offshore seismic refraction/wide-angle reflection studies across the SW Japan Arc revealed the entire crustal and uppermantle section extending from the Nankai Trough to the backarc basin of the Sea of Japan crossing SW Japan Arc. The most important finding on the continental shelf, which is known as a source area of megathrust earthquake, is the subduction of a seamount colliding to the SW Japan Arc. This seamount is considered to have behaved as a barrier at the time of the last event (the 1944 Nankaido earthquake). On the SW Japan Arc, reflection from the top of the subducted PHS plate is well traced northward with a dip angle of about 12 degrees. Beneath Shikoku Island, northward dipping accretionary complexes of Cretaceous to Neogene are well imaged above the plate boundary. The island arc Moho is mapped at about 35 km deep with a gentle concave geometry. In the northern half of the SW Japan Arc, the original structure was lost by Cretaceous granitic intrusion and replaced with well developed reflectors at middle and lower crustal levels. A seismic profile line in the Sea of Japan elucidated crustal thinning from SW Japan Arc to the southwestern Yamato Basin associated with the Miocene back arc spreading. The crustal thickness beneath the southwestern Yamato Basin is approximately 13 km where thinning of the upper crust is prominent.

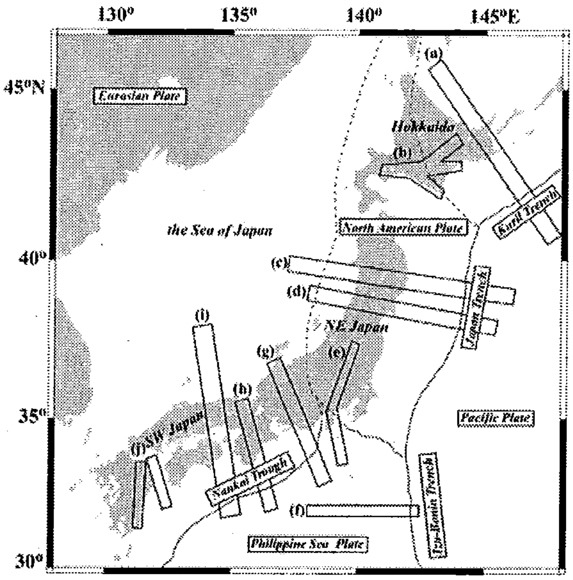

Fig.1-(a)

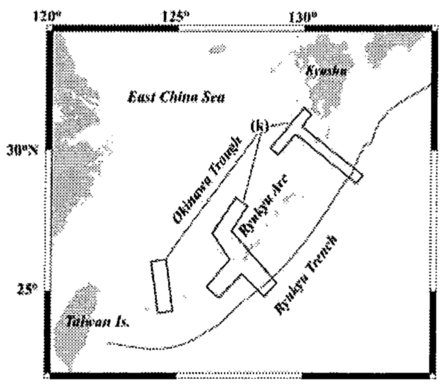

Fig.1-(b)

Fig.1 Location map of seismic profiles in and around Japan.

Active continental margins

14:00 ACM-O01

ACTIVE OBDUCTION OF OCEANIC LITHOSPHERE: THE UPPER CRUST OF THE ONTONG JAVA PLATEAU

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Many tectonic scenarios have been proposed for the emplacement of submarine mafic rocks, primary components of ophiolites, above sea level; most involve thrusting (obduction) of normal oceanic or arc-related crust onto land. However, thrusting of Ontong Java Plateau (OJP) large igneous province (LIP) rocks onto the Solomon Islands is the only active example of obduction known globally. Stratigraphic sections of basalt and overlying sediment from the islands of Malaita, Santa Isabel, and Ulawa are identical to those of the submarine OJP. Intrabasement reflections are common on the main OJP, especially on its crest. On multichannel seismic reflection (MCS) data, these intrabasement reflections are semi-continuous and sub-parallel to the top of igneous basement, and have an average frequency of ~20 Hz. Forward model synthetic seismograms using impedance contrasts between massive lava and pillow lava flows, obtained from downhole logs of Ocean Drilling Program (ODP) sites on the OJP, are able to produce intrabasement reflections similar to those observed in the MCS data. The intrabasement reflections therefore likely arise from alternating thin lava flows with low effusion rates and massive flows with high effusion rates, both originating from vents and fissures on the OJP, probably on its crest. A thrust décollement propagating seaward within the OJP is traceable laterally on MCS data from a seafloor fault propagation fold to greater than 6.7 km beneath the seafloor toward the Solomon Islands. Since 5 Ma, simultaneous obduction of the upper ~20% and subduction of the lower ~80% of OJP crust has been developing from ESE to WNW along the Solomon Islands convergent margin. We suggest that LIPs may be much more common as progenitors of ophiolites than is currently believed.

14:20 ACM-O02

SEISMIC SECTIONS ACROSS IZU-OGASAWARA (BONIN)-MARIANA ARC: FORMING CONTINENTAL CRUST IN OCEANIC ISLAND ARCS

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We have carried out seismic experiments using multichannel reflection system (MCS) and ocean bottom seismographs (OBSs) around the Izu-Ogasawara (Bonin)-Marina oceanic island arc since 2002. The specification of these surveys is common, and they are 12,000 cu.in. airgun array, 204 channel streamer and over 100 OBSs deployed with interval of 5 km. In consequence of these surveys, we understood seismic structural commonalities and differences within the arc crusts. The main characteristics are (1) a middle crust with 6 km/s velocity located within the arc regions, (2) strong heterogeneity within the lower crust and remarkable volume change of lower-velocity lower crust, (3) crust/mantle mixture zone beneath the continuous Moho with velocity contrast, (4) higher-velocity middle crust in Eocene arc (5) crustal thinning with normal faults beneath forearc regions, (6) high velocity layer with over 7 km/s beneath arc-backarc transition zone and (7) distribution of intrusive bodies and active faults developed on the arc-backarc transition zone. We discuss following scientific issues using above structural characteristics, (1) possible transformation of mafic crustal materials during crustal growth process beneath the arc regions, (2) tectonics of the arc-backarc transition zone with high velocity materials, which is accompanied with current active volcanics and faults, and (3) distributions of old Eocene and Oligocene arc crusts and normal faults developed beneath the forearc regions.

14:40 ACM-O03

IMAGING THE SUBDUCTION DECOLLEMENT, HIKURANGI SUBDUCTION ZONE, NEW ZEALAND

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Beneath the eastern coastline of North Island, New Zealand, the subducted Pacific plate dips at less than 3 degrees to the northwest and is at a depth of less than 15-km. This shallow geometry is optimum for detailed geophysical studies of the subduction decollement, using both active-source and passive-source experiments. The active-source NIGHT experiment carried out in 2001 has imaged the shallow dipping interface down to more than 6 s (twt) at which point it steepens landward, 120 km from the Hikurangi trench. The change in dip appears to be closely associated with the onset of seismogenesis in the subducted plate, which has been highlighted by the passive-source CNIPSE experiment. Velocity inversion of CNIPSE earthquake travel times reveals the forearc to be a relatively low Vp (< 5.5 km/s), high Vp/Vs (>1.85), high Poisson's ratio (>0.29) region overlying the 12-15 km thick subducted crust. In March-May 2005 a new industry-seismic survey, 05CM, was undertaken offshore of the east coast, primarily to identify hydrocarbon plays, but also to seismically image the subducted plate. Temporary seismometer stations placed along the coastline and permanent GeoNET stations recorded more than 278000 airgun shots out to offsets of more than 80 km. The new combined marine and offshore-onshore seismic data highlight changes in depth and reflectivity of the subduction decollement, the possible presence of subducted seamounts, and the presence of subducted sediments. Reflectivity and finite-difference modelling is currently focusing on the section of the subduction decollement close to the up-dip limit of seismogenesis.

15:40 ACM-O04

CRUSTAL STRUCTURE IN CHILE AND OCHOTSK SEA REGIONS

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In the region of Chile refraction and wide angle reflection migration, applied to CINCA seismic data, enable to reveal some new peculiarities of the crustal structure which does not agree with the classical model of the oceanic lithosphere subduction. Instead of the oceanic slab, a fault zone is imaged in the migration section. The fault separate the oceanic and continental crusts. A subhorizontal detachment and near vertical fault are also found in the continental crust.
In the Ochotsk Sea region reinterpretation of the old DSS data methods shows complicate systems of faults along the Kuril Islands and between the Sachalin Island and the South Kuril basin. The crustal type changes here and a strong reflecting boundary is sinking from the Moho to a depth of 70 km. The basin crust is of suboceanic type whereas in all other parts of the Ochotsk Sea it is of continental type. Low velocity zones are typical for the middle crust in the whole region. Along both sides of the Kuril Islands high velocity bodies are intruded in the crust showing the process of crustal basification.

16:00 ACM-O05

HETEROGENEOUS STRUCTURE AT NKTZ REVEALED BY THE RECEIVER FUNCTION AND SHEAR-WAVE SPLITTING ANALYSES WITH THE DATA OF THE JOINT SEISMIC OBSERVATIONS.

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The spatially dense network of GPS found a high strain-rate zone, which was named as the Niigata-Kobe Tectonic Zone (NKTZ). NKTZ will be important to the accumulation mechanism of the stress and strain in Japan. It is very important to know the seismic structure at the crust and upper mantle. Japanese university joint seismic observations are conducted at NKTZ. 73 seismic stations are operating in the area. Receiver function and splitting analyses were done using the data of the 73 seismic stations and Hi-net stations to know the structure in NKTZ. The receiver function analysis along the profile line extended in north–south direction to traverse the island arc of Japan obtained the configuration of the Moho boundary. The Moho boundary seems to be distorted at the area of NKTZ. The further analysis with many data will reveal fine structure of the area. The splitting analysis using deep earthquakes was also done to know the seismic structure beneath NKTZ. In this area, previous studies suggested that the anisotropic zone was located in the uppermost mantle. The anisotropy with large lateral heterogeneity is obtained in the uppermost mantle beneath NKTZ. The cause of the anisotropy has been explained by the heterogeneous structure with existence of magma. The heterogeneous uppermost mantle and distorted Moho boundaries should be related to the cause of NKTZ.

16:20 ACM-O06

COMPLEX GEOMETRY OF PHILIPPINE SEA SLAB BENEATH CENTRAL AND SOUTHWESTERN JAPAN AND THE RELATIONSHIP WITH LOCAL SEISMICITY

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We newly construct a detailed configuration of the oceanic Moho of the Philippine Sea slab (PHS) beneath the central and western part of Japan Islands, by using teleseismic receiver functions (RFs). In order to convert a time-domain receiver function to depth-domain, we adopt the local three-dimensional velocity model based on the travel time tomography analysis. The results show the clear velocity discontinuity descending from southeast to northwest. Since this discontinuity corresponds to the S wave velocity change from 4.3 km/s to 4.8 km/s, this indicates the oceanic Moho of the subducting PHS. Based on lots of radial RFs' profiles and polarity change of transverse RFs, we get the depth contour of the oceanic Moho with high accuracy. The Moho shows complicated feature with ridges and valleys, and it is coincident with the surface topography and hypocenter distribution of microearthquake. Ridges are located beneath Ise Bay and Kii Channel, where low frequency tremor activity along the slab is relatively low. The tremors occur along the 40 km depth contour line of the oceanic Moho. Since these tremors mainly occur 30 to 35 km in depth, the hypocenter of the tremors may be located at the uppermost of the subducting PHS. Although seismicity of microearthquakes along the PHS slab except northern Kyushu and southern Kii Peninsula is active shallower than 50 km in depth, we can clearly detect the existence of the slab to at least 70 km depth. The Moho becomes unclear beneath the eastern part of Shikoku, where spreading axis of Shikoku-Basin may subduct.

16:40 ACM-O07

RECEIVER FUNCTIONS FROM TRENCH-ZONE SCATTERING: RESULTS FROM 1D AND 3D FINITE-DIFFERENCE MODELLING

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For a teleseismc array targeting subducting crust in a zone of active subduction, scattering from the strong horizontal velocity heterogeneity beneath the trench zone itself and from surface topography of the coast ranges produce subhorizontally-propagating waves observed as coherent dipping events in the receiver functions (RF). Due to similar RF delay times and moveouts, these events could be difficult to distinguish from backscattered *P*- and *S*- wave modes from the subducting crust. To illustrate this observation, we performed: a) heuristic estimates using 1D modeling full-waveform, and

b) 3-D visco-elastic finite-difference modelling of teleseismic wave propagation within a simplified model of a subduction zone. The synthetics show strong scattering from the area of the trench, dominated by the mantle and crustal *P*-waves. These scattered waves occupy the same time and moveout intervals as the backscattered modes, and also have similar amplitudes. Although their amplitude decay characters are different, with the uncertainties in the velocity and density structure of the subduction zone, these modes could still hardly be unambiguously discriminated. Nevertheless, under minimal assumptions (in particular, without invoking slab dehydration), recent observations of receiver function amplitudes decreasing away from the trenches support the interpretation of (sub-) trench-zone scattering.

This modelling suggests that scattering from near-Moho crustal structures plays a key role in the formation of teleseismic wavefields. Recognition of scattered noise in teleseismic records could help to constrain major crustal structures, particularly those with strong expressions at near-Moho depths, such as crustal sutures, subduction fault zones, and mountain roots. Matching of the observed arrivals with wavefield synthetics could help constrain the locations and parameters of such structures and also help substantiate the interpretations.

September 27th, Wednesday

Passive continental margins

8:30 PCM-O01

SEISMIC EVIDENCES OF THE CONSUMPTION OF THE SOUTHERN MARGIN OF BAY OF BISCAY DURING THE ALPINE COMPRESSION.

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The MARCONI experiment took place in the eastern Bay of Biscay on board the Spanish RV Hespérides. The project aimed to elucidate, based on new geological and geophysical data, the structure and evolution of the southern Biscay margin and its relationship to the Pyrenean realm.

We present here the deep seismic reflection lines acquired during the experiment between the longitudes 6° and 2° W in a net of E-W (parallel to the strike of the main episode of deformation) and N-S (perpendicular to the convergence direction) profiles.

The seismic profiles show good images of the thick sedimentary sequence observed in the Bay, which includes three main packages separated by discordances corresponding to the pre, syn and post-orogenic episodes that shaped the margin, and show the lateral variations in the deformation front from west to east. Interpretation of the profiles indicate that the former rifted margin of the Bay has been completely consumed in the compression process that took place during the Tertiary. Compressional structures, accretionary features and discordances are well documented in the seismic data. The pre-stack depth migration indicates the depth and extent of the sequences providing good images of the submerged geology.

8:50 PCM-O02

CRUSTAL TRANSECT ACROSS THE NORTH ATLANTIC

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2D crustal models derived from four different Ocean Bottom Seismographic (OBS) surveys have been compiled to a 1580 km long transect across the entire North Atlantic, from the Norwegian Møre coast, across the extinct Aegir Ridge, the continental Jan Mayen Ridge, the presently active spreading ridge north of Iceland, the Kolbeinsey Ridge, into Scoresby Sund on East Greenland. Backstripping of the transect suggests that the continental breakup at c. 55 Ma occurred along a westward dipping detachment localized in the extreme western end of a c. 300 km wide basin. It is likely that an eastward dipping detachment near present day Liverpool Land Escarpment on East Greenland was active during the late stages of continental rifting. A lower crustal high-velocity layer (7.2-7.4 km/s) interpreted as mafic intrusions/underplating, was present beneath the entire basin. The observations are in agreement with the plume hypothesis, involving the Early Tertiary arrival of the Icelandic Plume beneath central Greenland and focused decompression melting beneath the thinnest portions of the lithosphere.

9:10 PCM-O03

CRUSTAL STRUCTURE OF THE FAROES NORTH ATLANTIC MARGIN FROM WIDE-ANGLE SEISMIC DATA

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This work reports results from a detailed 375km long wide-angle and normal incidence seismic survey of the Faroes rifted continental margin. The seismic dataset was acquired in 2002 as part of the iSIMM project. It comprises the densest and largest wide-angle survey conducted across a magmatic margin anywhere in the world. Combined with a deep seismic reflection profile acquired with a 12km streamer and a large airgun source, it affords one of the best opportunities to explore such a margin.

Careful modelling was performed using dense wide-angle arrivals recorded by 85 ocean bottom seismometers to constrain the oceanic crust, basalt flows of the Faroes shelf and the Faroe-Shetland basin. A low velocity zone caused by sediments under the Faroes shelf basalts was constrained and the results shed new light on its shape, particularly near the continent-ocean transition, where it dips downwards, consistent with subsidence caused by the thick seaward dipping reflectors (SDRs) above.

Good constraint is also achieved on the deep velocity structure, particularly near the continent-ocean transition, using deep turning rays and Moho reflections. Comparison with the reflection data allows estimation of the intrusion and underplating, crucial for understanding the conditions at continental breakup and influence of the Iceland hotspot. The continent-ocean transition is abrupt and accompanied by a highly layered narrow high velocity zone, interpreted as sill intrusion, beneath the SDRs. The Moho is seen under the entire profile, not possible with the streamer data alone.

9:30 PCM-O04

BASEMENT AND CRUST IN THE SW AUSTRALIA FROM ONSHORE/OFFSHORE SEISMIC EXPERIMENT: IMPLICATIONS FOR HYDROCARBON MATURATION

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A marine reflection survey of the SW Australian continental margin by Geoscience Australia in 2004 was supplemented by onshore/offshore and sonobuoy recording of refraction data, and led to reduced ambiguity of basement identification. A thick crustal root underneath Albany Fraser Orogen was interpreted and velocities in the basement of Mesozoic Bremer Sub-basin were found to be mostly in the 5.0-5.7 km/s range. Relevant part of the conjugate Antarctic margin also has low basement

velocities. Low grade metasediments is the preferred interpretation of these observations. Effects of significant variation in crustal thickness have been accounted for in advanced burial and thermal geo-history modelling. Basement controls on hydrocarbon maturation are significant: oil window can shift by up to 600 m as function of basement composition.

The continental mantle

10:30
TCM-O01
FINE SCALE HETEROGENEITY IN THE EARTH'S CRUST AND MANTLE
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New high-resolution seismic techniques provide evidence for pronounced fine scale heterogeneity in the Earth's crust and mantle. Whereas other depth intervals appear transparent in the frequency band of 0.5-15 Hz, fine scale heterogeneity has mainly been demonstrated in four distinct depth intervals:

(1) *The Mantle Low-Velocity Zone (LVZ)* below a depth of 100±20 km is globally observed from a pronounced seismic coda, which shows that the zone is highly heterogeneous at characteristic scale lengths of 5-15 by 2-6 km. We interpret that the rocks in the LVZ have a temperature close to the solidus or even may contain small fractions of partial melt.

(2) Significant scattering *from around the top of the Mantle Transition Zone* indicates the presence of pronounced heterogeneity at scale lengths of 8-20 by 3-8 km in the depth range of 320-450 km. This observation probably requires significant chemical heterogeneity.

(3) The deepest ever controlled-source seismic reflections from above the *Core-Mantle Boundary* image a heterogeneous zone, which we ascribe to a very high percentage of partial melts.

(4) Multiple underside reflections from *lower crustal heterogeneity* fully explain the enigmatic *Teleseismic Pn Wave,* which cannot be ascribed to the uppermost mantle as previously interpreted by other authors.

The scale lengths and velocity contrasts of the mantle heterogeneity are statistically represented in our 2D Finite Difference simulations of seismic wave propagation. This technique does not allow direct detection of structure, but the heterogeneous structure of zones in the mantle is now well demonstrated, probably caused by different petrologic and thermal processes.

10:50
TCM-O02
EVIDENCE FOR ACTIVE LOWER-CRUSTAL CONTINENTAL DELAMINATION IN THE VRANCEA SEISMOGENIC ZONE OF ROMANIA FROM PROJECT DRACULA
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The Vrancea Seismogenic Zone (VSZ) of Romania constitutes a volume (~30x70x130 km) of steeply NW-dipping, intermediate-depth seismicity beneath the southeastern Carpathians, traditionally interpreted as the result of subducted oceanic lithosphere. New deep seismic reflection data (DRACULA I) collected in 2004 as part of Project DRACULA (Deep Reflection Acquisition Constraining Unusual Lithospheric Activity) suggest that (1) Miocene shortening of the Eastern Carpathians can be restored to a position ~120 km W of the modern seismogenic zone, (2) Middle to Late Miocene volcanism in the Eastern Carpathians appears to be spatially unrelated to any recognizable subduction zone, and (3) changes in the depth extent of reflectivity across the profile imply a dramatic thinning of the continental crust (from ~45 to ~30 km) directly beneath the modern topographic edifice of the southeastern Carpathians. When combined with previous results from the

DACIA PLAN seismic reflection profile (Panea et al, 2005), the resulting ~310 km transect provides an image of a subhorizontal reflective fabric projecting continuously above the VSZ, from the stable orogenic foreland in the SE well into the hinterland to the NW. A large, relatively non-reflective region beneath this horizontally layered crust appears to represent a zone in which the crust is dramatically thinner than either the adjacent foreland or hinterland. Rotation of the VSZ about a NE-SW axis near the base of the crust provides a striking geometric match for this non-reflective region of inferred thinned crust. If these relationships are correct, the VSZ may be the result of active lower crustal and upper mantle delamination in the southeastern Carpathians, and as such, would constitute a potentially significant example of intermediate depth seismicity in the absence of oceanic subduction. The presence of relatively cold lower crust might explain the high seismic activity at mantle depths.

11:10
TCM-O03

COMPOSITIONAL VARIATIONS IN THE CONTINENTAL LITHOSPHERE CONSTRAINED BY SEISMIC TOMOGRAPHY DATA

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It is challenging to examine if global-scale compositional variations in the upper mantle constrained by geochemical studies of mantle-derived xenoliths are consistent with geophysical data. New 1 deg x 1 deg global thermal model for the continental lithosphere (Artemieva, 2006) provides an exceptional information on lithospheric properties as it permits to separate thermal and non-thermal effects in global geophysical models. Global Rayleigh wave tomography models are analyzed jointly with temperatures for the upper 200 km of the continental mantle and with experimental data on T-dependence of seismic parameters. The results show that (a) T-variations alone are sufficient to explain seismic velocities only in ca. 50% of continental regions; (b) global variations in lithospheric composition are well correlated with regional variations in lithospheric thickness and with crustal ages.

Classic transect

11:30 CTS-O01

IGCP PROJECT 474: IMAGES OF THE EARTH'S CRUST & UPPER MANTLE

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IGCP Project 474, "Images of the Earth's Crust and Upper Mantle" is jointly funded by UNESCO and IUGS. IGCP Project 474 has the primary objective of providing ready access to seismic images of the Earth's basement geology, deep crust and upper mantle. This is achieved through its website http://www.earthscrust.org/, where images are available of the interior of the Earth's crust and upper mantle across a variety of representative structural provinces from all parts of the globe. These images are available to a worldwide scientific, educational and public audience and therefore contribute to informed debate on tectonic processes, the natural environment, natural hazards and the sustainable use of natural resources. Project 474 is on the lookout for suitable images.

Japan session

11:50
JPS-O04

MEGATHRUST EARTHQUAKES AND SUBDUCTION STRUCTURES: LESSONS FROM THE NANKAI SEISMOGENIC ZONE

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Recent availability of a large number of ocean bottom seismographs (OBSs), a large volume of air-gun array and a long streamer cable for academics provide several new findings of lithospheric scale structures in subduction seismogenic zones. Japan Agency for Marine-Earth Science and Technology (JAMSTEC) has acquired long-offset seismic data using a super-densely deploy OBS (i.e. 1 – 5 km spacing OBSs along 100 – 500 km long profiles) in the Nankai seismogeinc zone, SW. Japan, since 1999. Long-offset multichannel seismic (MCS) data by a two-ship experiment, as well as conventional 2D MCS data, have been also acquired at a part of the profiles. Some of those profiles have been designed as combined onshore – offshore profiles for imaging a land-ocean transition zone. One of the most striking findings is an image of several scales of subducted seamounts/ridges in the Nankai trough seismogenic zone. We detected the subducted seamount/ridges, which are 50 – 100 km wide, distributing from near trough axis to ~ 40 km deep beneath the Japanese island. An important aspect, from a point of seismogenic process, those structures are strongly correlated with slip zones of magnitude (M) 8-class earthquakes, i.e.; subducted seamounts/ridge control the rupture propagations. Moreover, the most recent seismic study crossing the segmentation boundary between M=8 class earthquakes detected a high seismic velocity body forming a strongly coupled patch at the segmentation boundary. The numerical simulation incorporating all those structures explained the historic rupture patterns, and shows the occurrence of a giant earthquake along the entire Nankai trough, a distance of over 600 km long (Mw=8.7).

September 28th, Thursday

Subduction structures of megathrust zones

8:30 SSM-O01

REFLECTION SEISMIC IMAGING OF THE SUBDUCTION ZONE IN SOUTHERN CENTRAL CHILE

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We present the first results of the active seismic reflection survey of project TIPTEQ (from The Incoming Plate to mega-Thrust EarthQuake processes), which covers the subduction zone in southern central Chile in the area of the 1960 Valdivia earthquake hypocentre. The application of Kirchhoff prestack depth migration as well as two advanced imaging techniques (FVM, RIS) reveal a clear image of the subducted oceanic Nazca plate from the coast down to a depth of about 50 km below the Central Valley. The overriding continental crust is strongly structured showing horizontal, dipping and arching reflectors that indicate basal accretion. The reflectivity varies across the section and appears to be weak around the area of the 1960 earthquake hypocentre. Other specific features can be observed, like for instance a possible subduction channel at the top of the oceanic plate near the coast, a major crustal fault zone (LFZ) as well as a strong west dipping reflector perpendicular to the plate interface.

8:50 SSM-O02

3D IMAGES OF THE KUMANO BASIN REGION, JAPAN: NANTROSEIZE IODP SURVEY

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During April-May, 2006 we collected an ~570 km^2 3D seismic grid using the commercial vessel *Nordic Explorer* from PGS. We towed 4 x 4500m hydrophone cables and alternately fired two 3090 in^3 airgun arrays to yield 8 CMP lines per sail line. A "quick-look" 3D DMO stack and migration was produced by PGS shortly after the cruise. The 3D volume images the ocean crust to a depth of 8.5 sec (~11 km). A megasplay fault rises from the oceanic crust at ~10 km depth, cutting across the older part of the accretionary prism all the way to the seafloor in the frontal accretionary thrust region. This splay fault reflection exhibits areas of reverse-polarity, possibly reflecting fluid flow from the seismogenic zone to the surface. Approximately 2.5-3 km of sediment in the Kumano forearc basin are imaged. The seaward portion is progressively tilted landward due to repeated motion on the megasplay fault.

9:10 SSM-O03

VELOCITY STRUCTURES, REFLECTORS, SEISMICITY AND LOW-FREQUENCY TREMORS RELATING TO SUBDUCTION OF THE PHILIPPINE SEA PLATE IN THE KINKI DISTRICT, SOUTHWEST JAPAN

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A large seismic survey was conducted under the Special Project for Earthquake Disaster Mitigation in Urban Areas (DAIDAITOKU) in the Kinki district across Honshu Island from the Pacific (Kii Penisula) to the coast of the Sea of Japan in 2004. The line reveals the structure of the Philippine Sea plate (PSP) subducting northwesterly from the Nankai trough. Velocity structures and reflectors of the crust and upper mantle are derived from the survey using refraction and wide-angle reflection methods. In particular, the detailed configuration of the subducting PSP and deep reflectors in the upper and lower crusts are obtained from large off-set records. The resultant depth of reflectors and seismicity in the uppermost mantle are compared to reveal the internal structure of the down going slab. As a result, the reflectors relating to the subduction of PHP are very clearly determined at 20 km deep on the Pacific, increasing its depth to 60 km towards inland at about 100 km from the coast. At least two parallel reflectors dipping towards northwest were obtained and the lower one coincides with the upper boundary of the seismicity in the uppermost mantle. Therefore, the upper boundary is about 10 km shallower then the depth of the plate boundary determined from the earthquake distributions in the upper mantle. The lower reflector seems to be the oceanic Moho of the subducting PSP. Since the mechanisms of the earthquakes in the mantle are not thrust-type but strike-slip or normal fault-type, the earthquakes are intrarplate earthquakes, not interplate ones. This shows that the plate boundary is shallower than that determined from the seismicity by about 10km. Low-frequency earthquakes and tremors occur in the oceanic crust of the subducting PHP at depth of about 30-40 km where the continental Moho meet the subducting PSP. The Low-frequency earthquakes also occur at about the same depth in some areas in the inland areas. The lower crust is reflective but the Moho reflection is unclear.

9:30 SSM-O04

CRUSTAL STRUCTURE ASSOCIATED WITH THE SUBDUCTING PHILIPPINE SEA PLATE BENEATH THE SOUTHERN PART OF THE BOSO PENINSULA, JAPAN

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Great earthquakes of magnitude 8 class occurred in 1703(Genroku) and 1923(Taisho) beneath the Boso Peninsula, Kanto, Japan. These earthquakes are considered to be associated with the subduction of the Philippine Sea (PHS) plate (Matsuda, 1974; Shishikura, 2000). Since we have instrumental data of geodetic and geophysical observation for the Taisho earthquake, the location of its source fault was estimated. However that of Genroku earthquake remains unclear. To estimate the location of the source fault of Genroku earthquake, we conducted an integrated seismic reflection/refraction survey along the land/sea boundary zone in the southern part of the Boso Peninsula in 2005. In a seismic profile derived from this survey, we could find three reflection events, i.e. strong reflections seen at two way travel time(TWT) 3.0-3.5s (reflections A); weak reflections 2s below the reflections A (reflections B); and some intermitted reflections which are located at the shallower part above the reflections A (reflections C) beneath the southernmost part of the Boso peninsula. The reflections A have shallow dip and inclined toward the north or NNW direction. Its dip angle seems to increase around TWT 3.7 s. Through the compilation of the present results and the results of proceeding seismic profiles such as Boso 2002[Sato et al.(2002)], SK-78, and NIED1996 [Kimura(2005)], reflections A are interpreted as reflections associated with the upper boundary of the PHS plate. The reflections B show similar dip angle with that of the reflections A. This characteristic was observed in other regions such as Shikoku [Sato et al.(2006)]. The reflections B are interpreted as the moho of the subducting PHS plate. The reflections C return from the accretionary wedge and show a larger dip than that of reflections A. Such reflector was not pointed out in the previous studies. If this reflection corresponds to a high-angle thrust branching from the subducting PHS plate, it might play an important role at the generation of great earthquakes.

Numerical modeling of heterogeneity and anisotropy

10:30 NHA-O01

HETEROGENEITY AND SEISMIC SCATTERING IN EXPLORATION ENVIRONMENTS

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The amount and direction of seismic scattering is dependent on the scale of heterogeneity, which can be directly estimated by fitting petrophysical log data to a function that is characterized by a scale length inversely proportional to the degree of uniformity of the medium. Analysis of petrophysical logs, 2D and 3D seismic data from meteorite impact craters show, for example, that the brecciated impact rocks have small scale lengths, translating to near-transparent seismic sections. In contrast, post-impact intrusions into the footwall structures appear as bright scatterers in the data. In a mineral exploration setting, the scale of heterogeneity can have a direct influence on whether targets are detectable through seismic imaging. Models designed to simulate massive sulfide deposits embedded within heterogeneous media have shown that when scale lengths of background fluctuations are of the same order of magnitude as the orebody's size, it may not be possible to separate scattering events from the target from those of the background.

10:50 NHA-O02

PRIDE & PREJUDICE IN THE INVERSION OF LONG-OFFSET SEISMIC DATA

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Long-offset data are the work-horse for determining the gross crustal structure of the Earth. These data are necessary to provide a back-ground velocity model onto which we can map our more detailed reflection seismic images. The single final model is typically produced using a ray-tracing method after a considerable amount of optimisation. In this paper, we use a Bayesian based method called the Metropolis Algorithm (MA) to rigorously evaluate the use of ray tracing to determine the 'correct' single model. Unlike typical validation methods, MA repeatedly computes the response of the whole model to statistically derived random perturbations. We show that the velocity model is dependent on the frequency content of the data, uncertainty in the picks and identification of phases, as expected. However, the interplay between these factors becomes critical, and not always obvious, as the complexity of the model increases, particularly were the recorded energy is a superposition of several phases. For example, optimistic uncertainty estimates may drive the optimum model away from the true model. We conclude that there are major limitations to models derived using ray-tracing from long offset data which is then compounded by using these models to image the original data. Examples will be shown using synthetic data and real data from the Faroe-Shetland Trough, west of Britain.

11:10 NHA-O03

IMPRINT OF CRUSTAL SEISMIC ANISOTROPY ONTO MANTLE SHEAR-WAVE SPLITS: CALIBRATED NUMERICAL TESTS

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Numerous seismic field experiments over continental lithosphere are able to observe mantle shear wave splitting. In regions of large-scale mantle flow or intense lithospheric-scale deformation, shear wave splitting can be on the order of 2 or more seconds with large-scale regional alignment. Closer examination of individual station-event splitting often reveal local fluctuations, which can be attributed to local station conditions, installation sensor alignment, or analysis method uncertainties. The goal of our study is to quantify the amount of fluctuation which may be contributed by crustal anisotropy.

We constructed numerical simulations of crust-mantle seismic wave propagations wherein we control the cause of splitting by turning on and off the presence of anisotropy in either the mantle or in the upper crust. We also test the effects of changes in the thickness or intensity (%S) of anisotropic upper crust and of the effects of back-azimuth wave direction. For calibration, we ran two tests: isotropic crust and mantle, and isotropic crust with anisotropic mantle. In the first test, the seismograms exhibit no splitting and the splitting parameters are null. In the second test, uniform mantle splitting is produced. When crustal anisotropy is activated with an isotropic mantle, local splitting is produced of up to 0.6 sec (for our optimally oriented schist anisotropy). Splitting fast directions correlate with orientations of the crustal fabric. When both crust and mantle are anisotropic, the waveforms become altered and the splitting parameters show modification in delta-t and deflections in orientation. The crustal contribution produces second-order alteration to the mantle splitting values. While these might be confused with other explanations, coherence across a spatially high resolution array of stations may provide confidence that the results are due to crustal causes.

11:30 NHA-O04

CONSERVATION OF LITHOLOGY POWER LAW STRUCTURE IN SEISMIC REFLECTION DATA UNDER VARIOUS CIRCUMSTANCES

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The concept of a stochastic fabric of parts of the Earth's crust has become a generally accepted idea

through the years. The many observations of power law structure in lithology, through boreholes and geological surfacing/outcrops, as well as in broadband seismic reflection data contribute to this.

We present results of an investigation regarding the conservation of lateral power law structure in seismic reflection data, by examining as to how far a stochastic crustal structure will be retained in broadband seismic reflection data. The influence on Finite Difference modeled reflection data of horizontal / vertical heterogeneity scale length ratio, heterogeneity scale length / seismic bandwidth ratio, P-S conversion scattering and a possible power law regime shift will be discussed.

The results point towards the lateral power law structure being retained in several multiple scattering scenarios and heterogeneity geometries, in spite of the many complex wavefield interactions. Wave propagation scenarios, e.g. low-frequency source, very large impedance contrasts etc., under which the above mentioned conservation breaks down, will also be reported. The cases in which lateral lithological power law structure is conserved are promising for reconstruction of original crustal stochastic structure from broadband seismic reflection data.

Innovative seismic acquisition and processing techniques

14:00 IAP-O01

FINITE-FREQUENCY TRAVELTIME TOMOGRAPHY FOR ACTIVE-SOURCE SEISMIC DATA

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Infinite-frequency traveltime tomography/inversion is the most common approach for modeling active-source wide-angle data. This study-in-progress considers the advantages of using finite-frequency traveltime tomography for active-source data. In theory, finite-frequency methods should provide higher spatial resolution and more accurate recovery of anomaly magnitudes. For active-source data a nonlinear iterative gradient approach is necessary. The forward step solves the acoustic wave equation using a finite-difference scheme, and the first-arrival times are determined using a limited amount of manual picking to train an automatic picking algorithm. The inverse step uses Fresnel-zone sensitivity kernels. Conventional smoothing regularization is applied, although preliminary results suggest it acts to defeat the potential advantages of the finite-frequency approach. As a result, this study suggests that the precise form of regularization is the critical factor in determining the necessity of applying a finite-frequency approach.

14:20 IAP-O02

APPLYING FULL WAVEFORM INVERSION TO WIDE-ANGLE SEISMIC SURVEYS

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The frequency domain waveform inversion method of Pratt [1999] was applied to data from crustal refraction and wide-angle reflection seismic surveys across the plate-bounding San Andreas Fault (SAF), California, and the Chesapeake Bay Impact (CBI) structure, Virginia. This presentation discusses technical aspects and lessons learned for this relatively new application. Both long-offset (46 km and 30 km) surveys were acquired using similar parameters: sparse (0.2 – 1.5 km spaced) explosion seismic sources were recorded on a stationary receiver line at 50 m spacing. The CBI data were acquired in flat terrain with relatively homogenous sedimentary surface strata and show only minor static time shifts and amplitude variations. In contrast, the SAF data contain large time shifts due to rough topography and geology and huge variations in amplitude due to attenuation and surface scattering. Observed amplitudes of the CBI data were easily scaled to match synthetic 2D spreading.

For the SAF data, only the phases could be inverted. First-arrival traveltime tomography was used to create starting velocity models for waveform inversion. To account for noise in the SAF data, weighting factors were derived from the local coherence of the phases at each frequency in the dense receiver domain. For CBI, noisy data at longer offsets was simply not used, as they did not contribute greater depth penetration. The resulting velocity models show a marked improvement in resolution as compared to traveltime tomography models, justifying the application of the computationally expensive waveform inversion method.

14:40 IAP-O03

FRESNEL-VOLUME-MIGRATION OF DEEP SEISMIC REFLECTION DATA

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We present the principles and applications of a novel seismic imaging technique called Fresnel-Volume-Migration (FVM). In standard Kirchhoff-Prestack-Depth-Migration (KPSDM) the wavefield is smeared along two-way-traveltime isochrones. In the case of sparse sampling or limited aperture the result is often affected by significant migration noise. The basic idea of FVM is to restrict the smearing along the isochrones to the physically relevant part of the subsurface. This is performed by estimating the emergence angle at the receiver from the slowness/polarisation and by restricting the back-propagation to the vicinity of the reflected/diffracted ray using the corresponding Fresnel-Volume. Compared with KPSDM the results of FVM show significantly less migration noise, an increased image quality and resolution as well as beneficial properties with respect to imaging steeply dipping structures. We demonstrate these advantages with a summary of results obtained for different deep seismic data sets (NVR and wide-angle data from the Chilean subduction zone, the San-Andreas-Fault-System, etc.).

15:40 IAP-O04

PRESTACK IMAGING OF TELESEISMIC BODY WAVES: A COMPARISON OF RECEIVER FUNCTION ANALYSIS AND SEISMIC INTERFEROMETRY

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Over the past few years, the correlation-type reciprocity theorem for one-way wave fields has been extended to derive relations between the transmission and reflection responses of an arbitrary 3-D inhomogeneous medium (Wapenaar et al.(2004)). Based on this generalized relation, the interferometric seismic profiling (ISP) in the presence of passive seismic sources can be simulated by cross-correlating the transmission responses recorded at dense receiver array. The ISP approach inherently realizes symmetric pseudo-shot-receiver sampling, and prevents irregularities of offset distribution in CMP ensembles. We have investigated the possible application of ISP approach to teleseismic and regional earthquake data, which ensures the basic assumption of the correlation-type reciprocity theorem that the seismic source is located beneath the all reflectors to be reconstructed. Synthetic seismograms simulated by the elastic pseudospectral method for a simple 2-D crustal model are given to investigate the application of ISP approach to multi-component teleseismic data. The numerical modeling results demonstrate the potential imaging capabilities of ISP for crustal structure with a high spatial resolution rather than the depth-migrated receiver function image. We applied ISP method to the teleseismic and regional earthquake data acquired along the reflection survey line across the Itoigawa-Shizuoka Tectonic Line(ISTL), located in central Japan, and utilized prestack migration for receiver function and pseudo-reflection P-P records to investigate the lower-crustal structure beneath the northern Fossa Magna basin. The phase with positive polarity at the depth of 38-40km in both receiver-function and ISP method can be interpreted as that of Moho. We further discuss practical difficulties and evaluate potential for more general application of ISP.

16:00 IAP-O05

SOME IMPROVEMENTS ON SEISMIC IMAGING BY PRE-STACK DEPTH MIGRATION

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Depth migration schemes are powerful approaches to subsurface imaging using deep seismic reflection data. Nevertheless, some difficulties still exists that limit to some degree the power of depth migration algorithms. High velocity contrast seem to cause problems to ray tracing based, Kirchoff algorithms. This is mostly because the ray tracing schemes can not handle sharp ray bending. An approach based on a combination of travel time calculation through finite difference solution of the eikonal equation and least cost path algorithm can be a way to overcome these difficulties. The new approach has been successful in forward modelling seismic data in the presence of high velocity contrasts such as salt domes and basaltic layered intrusions. This new forward modelling scheme has been implemented in a prestack depth migration algorithm (PSDM), Kirchoff approach. Images obtained using this scheme in particularly challenging setting such as the case of subbasalt and/or subsalt structures have provided encouraging results. For example the migration images the base and features beneath the high velocity bodies. Furthermore, this scheme has been applied to prestack migration of dense wide-angle seismic reflection data acquired is SW-Iberia peninsula. The low fold PSDM image reveal the most relevant features of the crust and upper mantle, with a well defined crust-mantle transition at 32-34 km depth and high amplitude reflecting features within the upper crust. Additionally, the forward modelling scheme is in a sense a two point ray tracer, therefore, it assures a ray between a source and a receiver, that is that between a source and a receiver there is always a travel time. Because of this, such an algorithm can also be used in travel time inversion algorithms and should provide better constraint models as it would not miss any ray.

16:20 IAP-O06

IMAGING STEEP DIPS: EXAMPLES FROM AUSTRALIAN SEISMIC SURVEYS

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Steeply dipping reflectors have been recognised on regional stack data for the Lachlan Fold Belt (up to 60°) and the Tanami Province (up to 70°). This demonstrates that significant dip filtering by source and receiver arrays does not appear to occur during acquisition in these high velocity hard rock terrains. These events appear to be real reflections, not diffractions or reflected refractions, as verified by analysis of amplitude, frequency and moveout on shot records. In the Tanami case, the reflection is related to a small circular magnetic anomaly, possibly the expression of a granite stock. Dip moveout (DMO) correction is essential in processing to correctly image such features. Deregowski's method was used, following offset regularization of CDP gathers by trace interpolation based on dip coherency. Migration has proved problematical, as many migration algorithms could not simultaneously migrate the steep dips and remain artefact free in other parts of the section. The best results have been obtained with FK phase shift and time-space Kirchhoff algorithms, both of which produce comparable sections.

16:40 IAP-O07

HIGH-RESOLUTION SEISMIC CHARACTERIZATION IN A COMPLEX URBAN AREA

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A detailed characterization of the shallow subsurface including the two and three dimensional distribution of the physical properties and the reconstruction of the network of fractures (faults and dykes) was obtained by seismic imaging techniques. These aided horizontal drilling of tunnels for a new subway line in Barcelona (Spain). Seismic data acquisition in densely populated cities is very difficult. The street geometry determined the geometry of the seismic data acquisition experiments. The instrumentation (source and receivers) can not always be located on the surface projection of the tunnel trace, therefore, pseudo 3D acquisition is required deploying the instrumentation were it is possible. Furthermore, the shallow subsurface features extremely heterogeneous "weathered" layer of variable thickness (building fundations, sewage system, water supply conductions, etc), and the background noise is very high (car traffic, electricity lines, etc). Relatively old cities also lack a detailed geological control of the subsurface. The seismic data was acquired using as source a 8 s long Vibroseis sweep which provided relatively good S/N ratio. The shallow subsurface featured an extremely heterogeneous weathered layer characterized by very low seismic velocities (1000-1300 m/s) of variable thickness that made difficult to interpret the seismic reflection images at target depth. The first-arrival seismic tomography revealed as a key tool to clearly differentiate the different rock volumes characterized by different physical properties, especially the contact between the weathered layer and the more competent rock. Several high velocity anomalies (up to 5500 m/s) were observed at tunnel depth that were correlated with subvertical porphyric dykes. This were surrounded by low velocity anomalies that correspond to fault systems that cut and displace dykes. The tomographic velocity models also provide a new image of an important Miocene fault, quite different to the previous geological section derived from the core interpretation.

September 29th, Friday

Seismic investigations for disastrous earthquake areas

8:30 SDE-O01

REGIONAL CHARACTERIZATION OF THE CRUST IN THE TOKYO METROPOLITAN AREA, CENTRAL JAPAN

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Metropolitan Tokyo, located on the subduction mega-thrust of the upper surface of the Philippine Sea plate (PHS), has high risk of seismic hazards. Deep seismic reflection profiling, targeting the geometry of the down-going slab, was carried out along five seismic lines. All of them, we successfully obtained deep reflectors (<13 s TWT). Together with the results from earthquake tomography, the slab geometry of PHS was interpreted in the Tokyo metropolitan area including aseismic zone along the subducting slab northwest of the Izu peninsula. Obtained new geometry of the top of this plate (4 - 40 km), is much shallower than previous estimates based on the distribution of seismicity. This shallower plate geometry changes the location of maximum finite slip of the 1923 Kanto earthquake and its location corresponds to a zone of poor in reflection on the mega-thrust. Namely, a strong reflectivity zone along the mega-thrust is coincident with aseismic slip zone.

8:50 SDE-O02

HIGH RESOLUTION TOMOGRAPHY OF KANTO-IZU AND ITS IMPLICATIONS ON TECTONICS AND SESIMIC HAZARDS

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It is well known that the Philippine Sea plate subducts northwestward under central and southwest Honshu to enter into a wedge-shape space between the Eurasian plate on top and the west-dipping Pacific plate. Relatively high resolution tomography and relocated seismicity reveal the details of subduction and interaction of these two plates. Because the subduction are nearly at right angle to each other the subducted Philippine Sea plate encounters the Pacific plate at increasingly shallower depth as the apex of the wedge is approached. While well-defined subduction, in terms of both anomalously high P-wave velocity and seismicity, under western Kanto Plain barely comes into contact with the Pacific plate at 120 km depth under eastern Kanto plain, closer to the apex, the Philippine Sea plate encountered the Pacific plate at 50 km and appeared to be broken up upon collision. North of Izu Peninsula the absence of continuous velocity signatures or seismicity throws into question the behavior of subduction there. Under the Kanto Plain, the subduction of the Philippine Sea plate seems to be associated with a significant downward drag of lower crustal materials. An east-west striking deep trough of the 7.5 km/sec contour across the Kanto Plain, as a result of the drag, can be seen clearly. This transfer of materials into the upper mantle may lead to tectonic erosion under the Kanto Plain. The complex deformation of the Philippine Sea plate in the upper mantle under Kanto Plain introduces for Metropolitan Tokyo potential sources of M6-7 earthquakes in addition to the M~8 events associated with the megathrusts.

9:10 SDE-O03

SEISMIC REFLECTION PROFILING ACROSS THE ITOIGAWA-SHIZUOKA TECTONIC LINE, CENTRAL JAPAN: ACTIVE NAPPE WITH A HIGH SLIP RATE

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The Itoigawa-Shizuoka Tectonic Line (ISTL) in Central Japan is a fault zone with a very high slip rate in Pliocene-Quaternary time. The south-central segment of ISTL forms a ~10-km-wide fault zone with an active strand (the Shimotsuburai-Hakushu Fault) on its east. In 2005 we carried out (1) high-resolution seismic reflection profiling along a 12-km line across the southern part of ISTL, (2) wide-angle reflection and refraction seismic surveys along a 40-km line including the high resolution line and its east and west extensions, and (3) gravity survey along the high resolution line. Tentatively processed seismic and gravity data indicate (1) that the ISTL here is a west-dipping, low-angle (~15°) thrust, which separates horizontally-layered basin-fill sediments (total thickness ~1 km) on the east from highly deformed Miocene and older rocks on the west, and (2) that the hanging-wall side is likely to be thrust horizontally over the Quaternary basin fills for 1.2-1.3 km, forming an active nappe. Fault-bend folding is associated with the nappe formation. A fluvial terrace, which is tephro-chronologically dated at 50-60 ka, is involved in this deformation, yielding a slip rate as high as 7.5-10 mm/yr. West of the ISTL is the Akaishi Range, which has been uplifted and tilted westward at a very high rate in Quaternary time. Tentative balancing of topography and geologic structure suggests that the gently dipping ISTL extends down-dip below the whole width (40-50 km) of the Akaishi Range to a depth ~10 km, and then becomes nearly flat.

9:30 SDE-O04

SOUTHEASTERN CARPATHIAN FORELAND DEFORMATION IN RELATION TO THE VRANCEA SEISMOGENIC ZONE OF ROMANIA: RESULTS FROM PROJECT DRACULA

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DRACULA (Deep Reflection Acquisition Constraining Unusual Lithospheric Activity) II and III profiles, ~40 km each and recorded down to 60 s TWT, were designed to image crustal-scale structures of the Southeastern Carpathian foreland across what appears to be active foreland faults, in order to place constraints on the duration, timing, and scale of foreland deformation potentially genetically related to the Vrancea seismogenic zone (VSZ) of Romania. The DRACULA II profile shows a strong east to west dipping reflector in the upper 2-3 s TWT (approx. 5-7 km), interpreted to be the base of the Tertiary section. Although almost continuous, this reflector dims toward the west, coincident with the surface expression of the Siret fault mapped in the surface geology, but it does not show any considerable offsets. A layered package of reflectivity dominates the lower crust between ~10-15 s TWT (~30-45 km), and these reflections appear to be offset and deeper in the eastern half of the section. The DRACULA II section appears to indicate a lack of post-Tertiary deformation east of the VSZ, contrary to existing models that argue for significant reactivation of crustal-scale pre-Tertiary faults. In contrast, the DRACULA III profile shows a strikingly distinct change in the reflectivity pattern in the shallow section, within the top 2 s TWT (approx. top 3 km). This change in reflectivity occurs across the surface position of what we interpret to be a newly discovered fault, the Ialomita fault zone. The reflectivity pattern changes from flat-lying slightly north-eastward dipping reflections west of the fault, to a pronounced arcuate reflectivity east of the fault. The obscured reflectors below the surface location of the interpreted Ialomita fault suggest that this might behave as a fault zone at depth. Current results from the DRACULA II and III profiles appear to indicate (1) a lack of active crustal deformation in the foreland east of the VSZ, but (2) post-Tertiary movement south and south-west of the VSZ, alluding to mechanical coupling between the seismogenic body and the overlying crust toward this direction.

Integrated multidisciplinary case studies

10:30 IMC-O01

INTEGRATED MODELING OF A 3-D VELOCITY STRUCTURE FOR STRONG GROUND MOTION SIMULATION

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We carried out integrated modeling of 3-D velocity structures in the Tokyo metropolitan area (TMA) under the DaiDaiToku project in order to accurately simulate strong ground motions. Various kinds of geophysical exploration have already been conducted in TMA, so that we proposed to combine data from the refraction and gravity surveys and jointly inverted them assuming a relation between densities and seismic velocities. We then applied this method to the 3-D velocity structure in TMA, and improved the model by introducing new data from recent reflection surveys and the results of microtremor surveys. We further adjusted the velocity model by using records of 27 earthquakes. We calculated the spectral ratios of radial and vertical motions in the surface wave portions (R/V spectra). The structure model was adjusted in such a way that the theoretical R/V spectra got closer to the observed ones. We finally tuned up the adjusted model by carrying out inversions of observed waveforms from medium-size earthquakes for the 2-D structures along profiles between observation stations and hypocenters.

10:50 IMC-O02

STRUCTURE OF THE SAN ANDREAS FAULT AT THE SAFOD DEEP DRILL SITE

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A 46-km long seismic reflection and refraction survey across the San Andreas Fault near Parkfield provides a detailed characterization of fault structure at the EarthScope - San Andreas Fault Observatory at Depth (SAFOD) drilling project. Travel time tomography (P and S waves), frequencydomain waveform tomography, and steep-dip pre-stack depth migration were applied. The velocity model contains strong vertical and lateral velocity variations in P and S velocity. The Mesozoic Salinian arc complex west of the San Andreas Fault (SAF) has much higher velocity than the Mesozoic-Eocene Franciscan accretionary melange east of the fault. Salinian basement deepens from 0.8 km subsurface at the SAFOD site to ~2.5 km subsurface 20 km to the southwest. A ~2 km wide low-velocity wedge of late Cenozoic sedimentary rocks lies immediately southwest of the SAF and extends to the ~3 km depth of the shallowest earthquakes and M2 drilling target. The steep-dip migrated reflection image shows strong-amplitude vertical reflectors beneath the SAF and bounding the sedimentary wedge and active fault zone. A strong subvertical reflector ~9 km northeast of the SAF marks the boundary between the Franciscan terrane and the sedimentary Great Valley Sequence. A deep seismic section shows several reflectors in the Salinan crust. Subhorizontal mid-crustal reflectors correlate with patterns observed in SAF seismicity.

11:10 IMC-O03

FAULT ZONES FROM TOP TO BOTTOM: A GEOPHYSICAL PERSPECTIVE

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We review recent geophysical insights into the physical properties of fault zones at all depths in the crust and sub-crustal lithosphere. The fault damage zone, tens to hundreds of meters, exhibits a seismic velocity reduction (with respect to the neighboring country rock) as high as 20% to 50%, and then undergoes a slow healing process that appears to be related to fluid-rock interactions that leads to dissolution of grain contacts and re-crystallization. Deep seismic reflection profiles and teleseismic receiver functions provide excellent images of faults throughout the crust. Geo-electrical studies show that the fault can act as a fluid conduit, barrier, or combined conduit-barrier system depending on the physical properties of the fault core zone and damage zone. The geometry of active fault zones at depth is revealed by precise micro-earthquake hypocentral locations. A new discovery is slip-parallel, sub-horizontal streaks of seismicity that have been identified on some faults.

11:30 IMC-O04

HIGH RESOLUTION SEISMIC IMAGING OF THE IBERIAN LITHOSPHERE: THE TOPO-IBERIA RESEARCH INITIATIVE

TOPO-Iberia/PICASSO Working Group, (R. Carbonell(1), J. Gallart*(1), M. Fernandez(1), F.

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The scale of resolution is a key aspect in any research project, therefore any increase in the scale of resolution results in substantial new advances in science. EUROARRAY represents the willingness of the European Earth Sciences research community to achieve this objective. TOPO-Iberia is a multi-disciplinary initiative to explore the 3-dimensional structure and evolution of the Iberian Lithosphere. The first phase of this research initiative aims to the Betics-Alboran-Atlas System (South Iberia Peninsula, Northern Africa) in order to develop understanding of the lithospheric processes that resulted in the present day geodynamic scenario. This international research program will carry out a multi-scale, multi-seismic experiment in the area which includes: ATLAS, ALBORAN, and SOUTHERN IBERIA in order to develop innovative, frontier research on its topography and 4-D evolution (PICASSO). The evolution of the Iberian Peninsula has been dominated by the Late-Cretaceous onset of African-Europe convergence and the development of the Pyrenean and Betic-Balearic orogens along the northern and southeastern margins of Iberia respectively. According to stress field measurements, and topographic uplift and gravity Late-Neogene and Quaternary deformation is dominated by collisional coupling between Africa and Iberia and ridge—push from the Atlantic ridge. Northwestward movement of Africa at rates of 4–5 mm/yr is apparently compensated by crustal shortening in the seismically active Maghrebian, Betic and Pyrenean zones, as well as by deformation of cratonic Iberia. Yet the Alboran Sea in the midst of this collision zone developed by rapid and extensive lithospheric extension, which occurred within a period of less than 1 Myr about 20 Myr ago. The development of the Alboran Sea basin requires a major internal disturbance of lithosphere that had previously been thickened by continental collision. The most obvious way to achieve this is by convective destabilisation of the mantle lithosphere in the middle of this collision zone. Lithospheric delamination related to slab roll-back is also suggested as a means of producing the rapid extension observed in the Alboran Sea Basin. Changes in topography and its causes are of great social impact concerning the climate change and the evaluation of natural resources and hazards. The objective of this research initiative is to understand the processes and their implications from deep in the mantle up to the surface topography, by integrating multidisciplinary research which includes: geology, geophysics (seismics, potential fields), geodesy. PICASSO is intended to build up a comprehensive, multidisciplinary data base and results to tackle the key existing questions by developing novel interpretation strategies. A major aim of this programme is to significantly increase the high-quality information available, developing a multidisciplinary data acquisition grid of instruments of high resolution multisampling.

Poster session 1 September 25th, Monday - September 26th, Tuesday

Continental rifts and basins

CRB-P01

ESTRID-1: REFRACTION SEISMIC INVESTIGATIONS OF THE DANISH BASIN

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Project ESTRID-1 (Explosion Seismic Transects around a Rift In Denmark) aims at investigating the crustal velocity structure of the Danish Basin around the Silkeborg Gravity High. This gravity anomaly is proposed to be caused by a high density gabbroic intrusion in the middle to lower crust. The seismic experiment ESTRID-1 involved 6 shots of 300-500 kg of explosives and 240 seismometers with a total profile length of about 150 km. The seismic refraction/wide angle data are used to define the velocity field in the sediments and in the upper crust through 2D ray-inversion modelling. The results show the presence of high velocities: >6.8 km/s) at depths as shallow as 11-12 km below a sequence with typical velocities of sedimentary rocks. The vertical gradient is high such that the velocity is ca. 7.0 to 7.7 km/s at 16-30 km depth. The PmP is not clearly identified below the central part of intrusion, probably due to the low velocity contrast (from 7.6/7.7 to 7.9 km/s). Strong reflectivity from the lower crust and Moho at certain locations along the profile may be associated with magmatic underplating. We study this reflectivity by calculation of synthetic seismograms calculated with the reflectivity method and with a full waveform viscoelastic code. Unfortunately the initial length of the profile proved too short for identification of Pn waves, probably due to the anomalously high crustal velocities. The resulting models will be used for rheological modelling of the tectonic extension of the area and the subsequent cooling history, which may have been responsible for the development of the Danish basin.

CRB-P02

ESTRID-2: REFLECTION SEISMIC PROFILING IN THE DANISH BASIN

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The ESTRID project (Explosion Seismic Transects around a Rift In Denmark) aims at determining the origin of the Danish Basin. The reflection seismic profiling across the main gravity feature will determine the tectonic structure of the crust and possible internal layering of a proposed mafic batholith. The results will form the background for rheological and geodynamic modelling of the subsidence history of the Danish basin. The seismic experiment ESTRID-2 involved 94 shots of 20 kg of explosives and 780 seismometers distributed in three deployments along 100 km of the profile. Additionally 180 seismometers recorded the signals from all explosions at 1 km intervals along the whole of the 180 km long profile with the aim of detailed determination of the velocity structure. This model shows a layer of very high (>6.3 km/s) seismic velocity in the sedimentary sequence, interpreted as a volcanic layer related to the mafic crustal intrusion. It also shows a complicated structure of the surface of the high-velocity (>6.8 km/s at 10 km depth). The reflection seismic data has been acquired with the main purposes af determination of faults, with particular emphasis on a proposed transtensional fault which may have been active during the emplacement of the batholith, and of external and internal structure that may define the emplace history of the batholith. Both features are believed to have major importance for the subsidence history of the main basin in the area.

CRB-P03

SUB-SEISMIC STRUCTURE AND DEFORMATION QUANTIFICATION ON DIFFERENT SCALES FROM 3D REFLECTION SEISMICS IN THE NORTH GERMAN BASIN

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See abstract CRB-O04

CRB-P04

DEEP SEISMIC IMAGING AND CRUSTAL STRUCTURE IN THE ZONES OF MAJOR OIL FIELDS

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CDP deep seismic studies were commenced in Russia in 1993 to compare the structures of the Earth's crust in the regions of the largest oil fields and outside of them. Initial works were carried out in Tatarstan on two profiles intersecting the Romashkino giant field in the latitudinal and meridional directions. The first set of results most definitely indicated that the studied structures of the Earth's crust were different. Thick dynamic seismic reflectors have been found on the time section below a group of oil fields of the western slope of the South Tatarstan Arch. The time section also indicated another type of dynamic anomalies represented by subvertical and steep zones with the abnormally high seismic record intensity that narrow downwards. Their lowest parts reach the above-mentioned anomalous zones, and are probably portions of the disintegrated, fractured rocks that might be fluid migration paths, i.e. oil channels. The structure of the Earth's crust containing oil accumulations has been studied by the deep seismic survey through a regional profile crossing the Zhigulevsko-Pugachevsky Arch and its Zhigulevsky fault associated with a chain of oil fields. This major fault has been found to be an overthrust linked with the Moho boundary. The most impressive results have been produced by the deep seismic survey on the geotraverse *Tatseis-2003* crossing the Volga-Ural oil and gas province. It stands out in the time section by the structure of the Earth's crust and upper mantle. This could indicate the significant role played by deep zones in the formation of oil fields. Thus, CDP deep seismic studies can provide principally new geological information and facilitate the assessment of oil prospects in poorly studied areas and the location of major hydrocarbon fields.

CRB-P05

SEISMIC TOMOGRAPHY MODELLING OF THE EASTERN BLACK SEA BASIN.

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In spring 2005 we carried out a wide-angle seismic reflection-refraction survey in the eastern Black Sea with the aim to provide constraints on the tectonic history of the basin. Initial velocity modelling was carried out using a first arrival seismic tomography code (FAST), which produces a highly smoothed result. However a lot of information about the structure is lost as the secondary arrivals and reflections are not used in the model. Because we wish to delineate crustal type and basin structure, we have tested two other tomography codes that aim to optimise model resolution and reduce the velocity-depth trade-off by incorporating all arrivals. This presentation will concentrate on the results of this test using a section of data from a 570 km long profile running through the basin, perpendicular to the inferred direction of extension. The two tomography codes tested are JIVE and TOMO2D; JIVE performs simultaneous inversion of reflections and refractions from multiple layers, while TOMO2D

allows only one reflection to be incorporated. The quality of our data allows us to pick many different reflections, so we have to use TOMO2D with a layer-stripping approach. Both methods produce similar models that are a good fit to the data, however, there are significant advantages in simultaneously inverting for all layers as opposed to inverting for velocity structure in one layer at a time. For example, crustal reflections and refractions contain information on the velocity structure of the overlying sediments. In our test, the sediment velocity structure changes by up to 0.8 km/s between a JIVE model that includes the sediment arrivals and basement reflector only and a JIVE model that also incorporates the crustal arrivals and MOHO reflector. The extra constraints provided by simultaneous modelling of crustal and sediment arrivals suggest that JIVE will provide a better result for these data.

CRB-P06

BAIKAL EXPLOSION SEISMIC TRANSECTS

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See abstract CRB-O08

CRB-P07 Chun-Lu

TECTONIC SUBSIDENCE AND CRUSTAL STRUCTURE OF XIHU DEPRESSION, EAST CHINA SEA BASIN

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Beneath the flat East China Sea continental shelf lies the NE-trending Xihu Depression (XD), a deep Cenozoic continental margin rift with a maximum depth of deposition reaching up to 15km. In this paper we use deep seismic reflection, well logging, and gravity data to synthesize early rifting information of XD. To study the regional tectonic subsidence history we developed a program that performs backstripping and can simultaneously invert for stretching factor, lithospheric thickness and incipient age of thermal subsidence. Tectonic subsidence analyses of 40 industrial wells reveal uniform stretching at the center of the depression, supported by close crustal and lithospheric mantle stretching factors at about 2.5. To the western flank, the mantle stretching factors keep at about 2.5 but the crustal stretching factors are much smaller, at about 1.4. This implies that, for an assumed initial crustal thickness of 30km, the present-day MOHO depths along the depocenter are about 10km shallower than at the western depression margins. Subsidence analyses based on several wells near the western hinge line suggest prolonged, but of very small amount, initial subsidence, or even flank uplifts in the early rifting stage due possibly to flexural isostatic balance. The mechanical lithospheric thickness from subsidence inversion varies from about 90km at the depocenter to about 120km outside of the hinge line, suggesting that XD was developed initially on a region of relatively thin lithospheric thickness. A group of NW-SE trending seismic traverses (of 8 seconds in two way travel time) clearly reveals the deep basement structure of the depression, as well as the synrift and postrift sedimentary packages separated by a breakup unconformity. Preliminary gravity modeling indicates very thin crustal thickness beneath the depocenter of the XD, as also suggested from the large stretching factors.

CRB-P08

TOMOGRAPHIC IMAGES OF THE UPPER CRUST FROM THE YANYUAN BASIN TO THE DALIANG MOUNTAINS, SOUTHWEST SICHUAN PROVINCE: RESULTS FROM THE XICHANG REGION SEISMIC REFRACTION EXPERIMENT

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We apply seismic traveltime inversion method based on FD to first arriving P waves from explosive source seismic data collected along a profile of the Xichang region seismic refraction experiment , extending from Yanyuan, Xichang, northeastward to the Ma lake and crossing the Yanyuan basin, the Bailin mountains, the Yalongjiang valley, the Mopan mountains, the Xichang basin and the Daliang mountains, in order to determine a seismic model of the upper crust along the profile. According to P wave velocity distribution, The model may be divided into four blocks from west to east: the Yanyuan basin and the Bailin mountains block is located between model distances 120 and 180 km, the capping velocity of 3.6-5.7 km/s and the basement rock velocity of 5.8-6.1 km/s is obtained. Within the basement of the Bailin mountains a relative high-velocity region (~5.7 km/s) is present beginning at 1 km depth between model coordinates 160-180 km. The model indicate the surface velocity of 3.0-4.0 km/s and the structure of east or west dipping alternating high-lower-velocity zone beneath 1 km between model coordinates 180-240 km. Between model coordinates 180-300 km, the sedimentary velocity varies from 4.0 km/s at near surface to 5.7 km/s at 5 km depth. Easterly at model coordinate 300 km, the surface velocity is about 5.0 km/s. We interpret principal model features in terms of geology, including faulting. The maximum depth of low-velocity sedimentary and basement rocks in the Yanyuan basin is about 1.0 km , in the Bailin mountains varies from 3 km to 0.5 km, in the Yalongjiang valley is about 5.0 km, in the Xichang basin is 1.0-6.0 km, varies greatly and in the Daliang mountains is nearly exposed. A complex graben-like depression of basement rocks occurs between the Bailin mountains and the Daliang mountains. The west boundary of the Xichang basin is imaged as a moderately east dipping the velocity-gradient zone that projects to the surface at the easternmost trace of the Bailin mountains fault system. The Anninghe fault and the Zemuhe fault is imaged as a tabular, moderately east dipping the low-velocity zone. Tomography provides a definitive dip for the Mopan mountains fault, the Anninghe fault, the Zemuhe fault and the Daliang mountains fault.

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CRB-P09

SEISMIC REFLECTION AND GPS EVIDENCE FOR DISTRIBUTED CRUSTAL EXTENSION IN THE EASTERN BASIN AND RANGE, WESTERN USA

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In north-central Utah, USA, published geodetic measurements reveal east-west extensional deformation of about 3 mm/yr across a ~200-km-wide swath that spans the eastern Basin and Range and the Wasatch front (Friedrich et al., 2003; Niemi et al., 2004). The Wasatch fault has been considered the major, presently active tectonic structure accommodating this horizontal extension. However, GPS results show a horizontal displacement rate of 1.6 ± 0.4 mm/yr across the Wasatch fault (Chang et al., 2006), accounting for only ~50% of the crustal deformation. Seismic reflection data from the Great Salt Lake (GSL) suggest that other major normal faults are active west of the Wasatch fault that could be accommodating part of the remaining 50% of the northern Basin and Range extensional deformation. Palinspastic reconstruction of depth-converted seismic sections implies approximately 83% of Tertiary extension across the GSL, and high fault slip rates in the Pliocene (~1.1 mm/yr) and Quaternary (~0.7 mm/yr), along with lake-floor bathymetric scarps, imply that these faults remain tectonically active.

CRB-P10

METAMORPHIC CORE COMPLEX EMPLACEMENT AND BASIN FORMATION IN SOUTHEASTERN ARIZONA, USA

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The Basin and Range Province of western North America represents a broad zone of Cenozoic crustal extension characterized by various styles of extensional deformation and development of zones of extreme extension manifested as metamorphic core complexes. In southeastern Arizona, the Catalina-Rincon metamorphic core complex appears to have evolved in at least two distinct phases. The initial phase was characterized by isostatically driven core-complex emplacement into the middle-upper crust during low-angle detachment faulting and little net topography. After a significant tectonic hiatus, late-stage exhumation and uplift of the core complex was controlled by higher angle brittle faulting. Evidence for the timing and nature of the two-phase extension is present in the reflection geometries from the sedimentary and volcanic rock packages that fill adjacent half-graben basins. In the Catalina-Rincon metamorphic core complex, late-stage extension and core-complex exhumation appear to be directly coupled to subsidence in the adjacent Tucson Basin, a process that may include mid-crustal flow. However, new analyses of reflection data suggest that extension and core-complex uplift may have created a persistent underfilled basin, which could decrease estimates of lateral crustal flow rates and volumes in this area. Anastomosing zones of reflectivity, interpreted to be brittle-ductile shear zones, appear to couple range-to-range extensional deformation at mid-crustal levels.

CRB-P11

COMPLEXITIES OF THE WESTERN MARGIN OF THE TRANS-HUDSON OROGEN IN SASKATCHEWAN, CANADA

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A number of recent studies established significant differences in the nature of the western margin of the Trans-Hudson Orogen between 49^0 and 60^0 latitudes in SK. The margin from latitude 52^0 W to 59^0 W, is delineated by an 810 km long, orderly, curvi-linear, mainly positive magnetic anomalies. On the surface, this anomalous zone marks the boundary between the Archean Rae/Hearne craton and the Paleoproterozoic accreted terrane of the Reindeer Zone. Three widely separated, variable length regional deep sounding reflection surveys crossed this anomalous trend and determined a consistency along the strike of the crustal images of the western margin of the orogen. Several phases of tectonic development, including multi-stage subduction and continent-to-continent collision could be inferred from the seismic images. On all seismic sections, imbricate set of well-defined thrust sheets delineate the remnants of an orogenic wedge of a near complete convergence with its characteristic pro and retro-shear zones. South of the 52^0 W latitude the magnetic images are less controlled and deflected toward the southeast, narrowing the width of the orogenic belt from ~ 550 km in the north to ~ 200 km at latitude 49^0. A very prominent component of the southern segment is a region of intrinsic set of anomalies with an elliptical shaped delimitation. These recently obtained magnetic signatures outline the extension of the Wyoming craton in Southwestern SK. The complex regional magnetic images clearly indicate that the convergence of the Rae/Hearne and Superior cratons, in the south, was directly and intensively affected by the interference of the Wyoming craton. On going synthesis of deeper segments of exploration reflection data defined several prominent structural trends in the basement of the SK segment of the Williston basin.

CRB-P12

STRONG SEISMIC REFLECTIONS FROM THE UPPER MANTLE OF A CONTIENTAL BACK-ARC

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One of the unresolved aspects of subduction zones and back-arc rifts are the processes that allow magmas formed within the mantle wedge to be erupted at the surface. Active source seismic profiles across the Taupo Volcanic Zone (TVZ), in central North Island, New Zealand, provide new insights into magmatic processes in the upper mantle beneath a young back-arc rift . The NIGHT experiment (2000-2001) recorded unusually strong reflections (hereafter PmP2) from an interface at ~ 35 km depth, well below the inferred Moho at ~20 km depth (Stratford & Stern, 2004; 2006). We present results from a recently completed active source seismic experiment (MORC) that builds upon the NIGHT project by providing a high resolution dataset across the central TVZ. The distribution and amplitude of PmP2 arrivals recorded on the MORC array are dependent on shot offset and the shot position relative to the axis of TVZ rift. PmP2 are only observed over a narrow range of offsets; at near offsets for shots close to the rift axis and at progressively greater offsets for shots further from the rift. At near offsets PmP2 arrivals are typically weak, with an amplitude of < 0.1 relative to Pg. At offsets of 70-100 km the amplitude ratio of PmP2 to Pg is >10, and at least 2 - 10 times as strong as reflections from the top of an inferred Moho transition (Stratford & Stern, 2004; 2006). The new data constrain the PmP2 reflector to be an isolated body at 32-35 km depth directly beneath the eastern margin of the TVZ. The reflector has an maximum extent of ~25 km, but may be < 15 km once Fresnel-zone effects are allowed for. Its unusually high amplitude, limited lateral extent and position subjacent to the active geothermal fields, lead us to speculate that the reflector is body of partial melt.

Intra-continental collision and accretion

ICA-P01

3D STRUCTURE OF THE EASTERN ALPS FROM DEEP SEISMIC WIDE-ANGLE DATA

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The Eastern Alps of Europe were the target of Deep Seismic Sounding (DSS) surveys in 1998/99 (TRANSALP) and 2002 (ALP 2002). The reflection and refraction seismic TRANSALP transect provides high resolved 2D models at the Western end of the Tauern Window (12°E). ALP 2002 covers the greater East Alpine area, and consists of a network of 13 stationary lines with a total length of 4300 km recording 39 controlled sources. A variety of techniques from 2D forward modeling to 3D tomographic inversion and stacking was applied to take advantage of the spatially varying resolving power of the data. Older East Alpine DSS data from the 70'ies were included in the inversions to increase coverage and to obtain consistent models. This study focuses on a 3D velocity and Moho model for the Eastern Alps within a region of 300 km x 400 km from simultaneous traveltime inversion of refracted and reflected phases considering anisotropy. Observations of ALP 2002 shots on the TRANSALP line have shown that the first order p-wave velocity structure along TRANSALP is consistent with the ALP 2002 data within ~150 km towards the East when 10% anisotropy in the Tauern Window are taken into account. Results for the area between 12°-14°E indicate a south directed subduction of European below Adriatic crust, with the suture located south of the central mountain crest. The maximum Moho depth of 50-55 km in the central Eastern Alps decreases to less than 30 km in the Pannonian Basin at ~ 14.5°E. The apparently discontinuous nature of this change in crustal thickness indicates the existence of a separate Pannonian plate fragment.

ICA-P02

SEISMIC IMAGES OF THE SVECOFENNIAN OROGEN

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See abstract ICA-O03

ICA-P03

COMBINED CDP-DSS STUDIES ALONG PROFILE 1-EB (EAST-EUROPEAN CRATON)

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Detail CDP and DSS studies along the 1000 km long profile 1-EB cross several rift and collision zones of the Baltic Shield and the Russian Platform. Both studies were made with the same equipment and it enables en objective comparison of wave fields of vertical and wide angle reflections. The methods give different seismic images of the crust: CDP shows horizontal and inclined boundaries in the crust and the weak Moho. DSS traces Moho by strong reflections and refractions with velocities of 8.0-8.5 km/s . The crustal thickness varies from 40 to 50 km. Both methods reveal a block structure of the crust and the uppermost mantle which correlate with the tectonic domains. The blocks differ in seismic velocities, the number of seismic boundaries, their forms and crustal heterogeneity. They are divided by inclined faults. The largest fault which is traced into the mantle down to the depth of 70 km as a strong reflector, is observed in the Central rift/collision zone the East European Craton.

ICA-P04

MIDRUSSIA SEGMENT OF THE PALAEOPROTEROZOIC LAPLAND-MIDRUSSIA-SOUTHBALTIA INTERCONTINENTAL COLLISION OROGEN, EAST-EUROPEAN CRATON: INTEGRATION OF REGIONAL POTENTIAL FIELDS AND CDP DATA ALONG THE 1-EU GEOTRAVERSE

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The 1-EU Geotraverse crosses the Palaeoproterozoic Lapland-Midrussia-Southbaltia intercontinental collision orogen within central part of the East-European Platform. Geological-tectonic map of the Early Precambrian crust blanketed by the Phanerozoic sedimentary cover synthesizes a the data set that includes: maps of the distribution of effective meanings of the density and magnetization of the rocks outcropped on the basement surface beneath sediments; 3D density and magnetic models of the upper part of the crust and data from innumerous drill holes. On this basis and the results of geological interpretation of reflection seismic images of the crust along 1-EU Geotraverse, the model of the deep crustal structure of the Midrussia segment of the above mentioned orogen has been elaborated. Granulite-gneiss thrust and nappe ensembles in the upper crustal level are deformed and constitute linearly stretched synforms. Amphibolite facies metamorphic complexes of both the Neoarchaean and Palaeoproterozoic ages form para-autochthon. Mid and lower crust are formed by the successions of gently dipping tectonic slices flattening at crust-mantle discontinuity and sporadically demonstrating a submersion of the fragments of these slices into the mantle.

ICA-P05

FINE UPPER CRUSTAL STRUCTURE IN EASTERN KUNLUN ACTIVE FAULT BELT AND ITS ADJACENT AREA

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The Eastern Kunlun Active Fault Belt is one of the most important tectonic boundary of the northeastern edge of Qinghai-Tibet Plateau, which played a key role in Qinghai-Tibet Plateau rising. A 200km long high resolving seismic refraction profile, which nearly perpendicularly runs through the Eastern Kunlun Active Fault Belt and overlaps with the 600km long wide angle reflection/refraction profile completed at the same time, was carried out. 10 shots fired and 230 short period seismic

stations were deployed along the refraction profile. The fine upper crustal structures and the complex crystalline basement tectonic patterns along this profile were constructed by use of high quality Pg data. The results show that there are different structural features of the upper crust in the southern, middle and northern segments of this high resolving seismic refraction line and their boundaries take place at Xiaman and Langmusi. The southern segment is located in Ruoergai basin where the velocity of the upper crust changes smoothly, the middle segment situated in Animaqin suit zone where its velocity varies greatly, and the northern segment lies in the West Qinling fold zone where its velocity variation is moderate. The variation of the depths of crystalline basements among the three different segments is stronger than that of velocity distributions. The crystalline basement is deeper and its structure is comparatively complicated in Ruoergai basin. Its depth is about 3.5km and the basement velocity is about 5.65-5.80km/s. The strong deformations of the crystalline basement in Animaqing suit zone appear, and its structure is more complex than in the southern and northern segments. There are seemly double layer structure features in Animaqing suit zone, one of which is located at the depth of 3.0km or so and its basement velocity is about 5.65-5.80km/s, and the other lies at the depth of about 8.5km and its Pg velocity is about 6.2km/s. The basement structure in northern segment is relatively simple and its depth is about 2.2km, and the basement velocity is about 5.5km/s. The upper crust presents strong inhomogeneous and the structures in its lower part are more complex than in the top part. It possibly implies that the crystalline basement had been strong deformed under extrusion of Qiangtang-Changdu block in southwest, North China block in Northeast and Yangzi Block in southeast, and also implies that the neotectonic movement in the studied area was relatively weaker than in the adjacent regions, or the extruding from the deeper crust might be more strong than from the upper crust. In Animaqing suit zone, the crystalline basement had been destroyed by Kusehu-Maqing fault zone and it is characterized by a relatively large low velocity zone. The scales of Wudu-Diebu fault zone and Zhouqu-Liangdan fault zone are smaller than Kusehu-Maqing fault zone. The large low velocity zone in the upper crust near North Xiaman implies that Kusehu-Marqing fault goes there and possibly is the northern boundary between Ganzhi and Songpan blocks, and also implies that the Eastern Kunlun Active Fault Belt passes through Ruoergai basin and extends to western Qinling orogenic zone.

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ICA-P06

CRUSTAL STRUCTURE OF THE NORTHEASTERN MARGIN OF THE TIBETAN PLATEAU FROM THE SONGPAN-GANZI TERRANE TO THE ORDOS BASIN

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The 1000-km-long Darlag-Lanzhou-Jingbian seismic refraction profile is located in the NE margin of the Tibetan plateau. There are low velocity zones in the West-Qinling Shan and the Haiyuan arcuate tectonic region, which have low S-wave velocities and high Poisson's ratios, so it is possible partial melting has caused the formation of the low velocity zones. The results in the study show that the thickness of the lower crust increases from 22 km to 38 km as the crustal thickness increases from 42 km in the Ordos basin to 63 km in the Songpan-Ganzi terrane south of the Kunlun fault. Both the Conrad discontinuity and Moho in the West-Qinling Shan and in the Haiyuan arcuate tectonic region are laminated interfaces, implying intense tectonic activity. The arcuate faults and large earthquakes in the Haiyuan arcuate tectonic region are the result of interactivity between the Tibetan plateau and the Sino-Korean platform and Gobi Ala Shan platform.

ICA-P07

ACTIVE TECTONIC FEATURES IN THE NORTHERN PART OF THE IZU COLLISION ZONE, CENTRAL JAPAN

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The Izu collision zone has been formed by multiple collision of the Izu volcanic arc crust with the Honshu arc since the middle Miocene. To reveal the crustal architecture and strain distribution in late Quaternary, the seismic surveys were carried out across the northern part of the Izu collision zone. Along the northern end of the Izu collision zone, a WNW-ESE trending reverse active fault system, the Sone Hills fault system, is developed perpendicular to the motion of the Philippine Sea plate and bounds the southern margin of the Kofu basin. High-resolution seismic data were acquired across this fault system. Seismic reflection profiles reveal that the dip angle of the main fault is 30° and using the tectonic geomorphological data the net slip rate is estimated to be 1 mm/year. The deeper extension of this fault can be traced down to 10 - 15 km by dynamite shots of the Odawara-Yamanashi 2005 seismic survey. The main geologic structure of the Izu collision zone is marked by north-dipping thrust system, such as the Kozu-Matsuda fault along the northern tip of the Izu peninsula. The Sone Hills fault system is formed as back rim of the north-dipping fault system associated the uplift of collided Miocene volcanic arc crust (Tanzawa and Misaka Mountains).

ICA-P08

WOLLASTON LAKE REFLECTOR REVISITED: FLUIDS, MASSIVE FRACTURED DIABASE INTRUSION, OR SILICIFIED SHEAR ZONE?

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The nearly 160-km long Wollaston Lake Reflector (WLR) in northern Saskatchewan (Canada) is one of the most spectacular and well-recorded structures imaged within the crystalline crust. Based on modeling of its normal-incidence reflectivity, the reflector was originally interpreted as a series of subhorizontal, tabular diabase intrusions. Here, we revisit this its interpretation using the reprocessed Lithoprobe seismic reflection line with an emphasis on the Amplitude Variations with Offset (AVO) analysis. While recognizing the difficulty of establishing the reflection polarity of crustal reflections, we considered both positive- and negative-polarity interpretations. The measurements indicate high and positive AVO gradients and suggest two possible interpretations: 1) the reflector is caused by a massive mafic intrusion as suggested earlier, in which case the intruded rocks should have anomalous Poisson's ratios of □≥0.33, and 2) the WLR represents a silicified shear zone, with only moderate (e.g., ~ 5%) alteration of the host rock.

Although both of the above models may to some extent co-exist within the WLR, based on its brightness, sharpness, great lateral extent and smooth shape, we favour the second interpretation. In both models, a fractured, hydrothermal fluid zone within a major crustal detachment could play a key role in the formation of the WLR. The association of the reflector with laterally- and depth-migrating fluids is also supported by magneto-telluric measurements of crustal conductivity beneath the WLR, and also by its very long horizontal extent with only moderate depth variations. In addition, analogies from the studies of the Kola Superdeep Borehole in northern Russia suggest that free or metamorphic fluids could be present at the WLR depths.

ICA-P09

THE AUSTRALIAN CRUST, ARCHAEAN TO PALAEOZOIC ARCHITECTURE: RESULTS FROM AUSTRALIA'S DEEP SEISMIC PROGRAM

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See abstract ICA-O01

ICA-P10

REFLECTION IMAGING OF THE CRUST AND THE LITHOSPHERIC MANTLE IN THE LUTZOW-HOLM COMPLEX, EASTERN DRONNING MAUD LAND, ANTARCTICA, DERIVED FROM SEAL TRANSECT

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Deep structure and evolution of the crust and upper mantle viewed from East Antarctic Shield have sufficient significance involving continental growth in Earth's history. In this paper, we demonstrate lithospheric structure of the early-Paleozoic crust of the Lützow-Holm Complex (LHC), Eastern Dronning Maud Land, East Antarctica. LHC locates among the paleo-collision zones between East- and West- Gondwana super-continent. The "Structure and Evolution of the East Antarctic Lithosphere (SEAL)" project has been carried out since 1990' in a framework of the Japanese Antarctic Research Expedition (JARE). Several geophysical studies including deep seismic refraction / wide-angle reflections have been conducted at the LHC. In the austral summer in 2000, and 2002, deep seismic surveys were conducted on continental ice sheet in northern part of the Mizuho Plateau of the LHC. In both surveys, more than 170 plant-type 2 Hz geophones were planted on the plateau 190 km in length of transect lines. A total of 8,300kg dynamite charge at the fourteen sites on the Plateau gave information involving deep structure of a continental margin of East Antarctica.

Wide-angle travel-time analyses revealed the crust-mantle boundary takes values ranging from 38-42 km along the profiles, with velocities of the upper crust, the middle crust, the lower crust and the uppermost mantle, about 6.2, 6.4, 6.5 and 8.0 km/s, respectively. Deepening of the crust-mantle boundary less than 5 km in depth was identified in the profile of SEAL-2000, which almost perpendicular to the coastal line. The velocities in surface bedrock layer in the SEAL-2002 profile, in contrast, have variations in 5.9-6.2 km/s, which corresponds to the metamorphic grade of the surface geology from amphibolite to granulite facies. Additionally, clear reflection phases from the crust-mantle boundary, together with some inner crustal reflections were identified on the same record sections. Laminated layered structure around the crust-mantle boundary was clarified by the coherency enhancement processing after NMO correction applied to very far offset data. The CMP stacking was not so effective due to the following reasons,

A. The interval of receiver points is too sparce (1.0km)
B. Shot point interval is also very sparce (30km)
C. PmP reflection appears only on the very far offset data (more than 50km)

However, it was considered very promising for reflection data processing associated with refraction method, if shorter interval of receiver points, say less than 200m, is adopted in the future.

Relatively complicated crustal structure characterized by the reflection section in SEAL-2000 and 2002 indicates the influence of the compression stress in NE-SW direction during the Pan-African; which means the last stage of continent-continent collision between East- and West-Gondwana super-terrains.

Key Words: lithospheric structure, continental evolution, East Antarctic Shield, deep seismic surveys, Gondwana formation

Seismic investigations related to mineral resources and volcano-plutonic system

SMV-P01

CRUSTAL STRUCTURE OF THE KYUSHU-PALAU RIDGE, THE REMNANT OF THE PROTO IZU-BONIN-MARIANA ISLAND ARC

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The Kyushu-Palau Ridge (KPR) is considered as the remnant island arc separated from the proto Izu-Bonin Mariana arc by the backarc spreading of the Shikoku and Parece Vela Basin at the center of the Philippine Sea. The KPR is extending north-south direction in latitudes of 9-31 degrees N. We carried out 10 wide-angle and multi-channel seismic (MCS) profiles across the KPR to investigate variation in crustal structures along the ridge axis. A tuned airgun array with a total volume of 8,040 cubic inches was shot for a 480-channel MCS hydrophone streamer and ocean bottom seismographs deployed every 5 km. The results of the experiments show that the crusts beneath KPR are significantly thicker than those of a typical ocean in the most profiles and the crustal thickness varies largely between profiles. There is a rather thicker layer with Vp = 6.0-6.5 km/s to the north of 26 degrees N where the width of the KPR bathymetric high is relatively wide. However, the thick (> 5 km) middle crust with Vp= 6.0-6.3 km/s that characterizes the northern Izu-Bonin island arc crust does not exist so clearly in our profiles. The thicker crust beneath the KPR is mainly due to a fat lower crust with Vp = 7.0-7.2 km/s. The KPR upper mantle velocity of 7.6-7.8 km/s is similar to that beneath the Izu-Bonin-Mariana island arc.

SMV-P02

COMBINING DATA FROM DYNAMITE AND VIBROSEIS SOURCES: DEEP SEISMIC TRANSECT IN THE CURNAMONA PROVINCE, AUSTRALIA

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A new 460 km long transect combines 6-12 fold explosive and 60 fold vibroseis data, proving that it is possible to re-use old, low fold seismic data by utilizing new processing techniques. We demonstrate comparability in resolution of reprocessed dynamite and new vibroseis data. Reprocessing of the dynamite data using a vertical stacking technique that simulates DMO corrections, followed by detailed velocity analysis, has resulted in an improved seismic section that images dipping structures not detected in the original processing. Several deep penetrating shear zones in the Broken Hill block dip mostly to the SE, and link to a shallow thrust belt located further to the west. Because of the large depth of penetration, these shear zones may have conducted fluids from deeper levels, which has important implications for mineral exploration.

SMV-P03

TECTONIC AND METALLOGENIC IMPLICATIONS OF REGIONAL SEISMIC PROFILES IN THE TIMMINS MINING CAMP, CENTRAL SUPERIOR CRATON OF CANADA

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See abstract SMV-O03

Active continental margins

ACM-P01

WHOLE STRUCTURE OF THE MEDIAN TECTONIC LINE (MTL) FROM KYUSYU TO KANTO, JAPAN

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The Median Tectonic Line (MTL) is the most significant fault in Japan, which divides the Japanese islands into the two, the Inner and the Outer zones. Since Yoshikawa et al. (1987)'s pioneering seismic survey to the MTL, significant surveys have been made continuously to the MTL in various areas (Yusa et al. 1992, Ito et al., 1996, Kawamura et al., 2001, Tsutsumi et al., 2003, etc.) And the recent seismic survey across Shikoku and Chugoku in 2002 at last demonstrate clearly that the MTL is traceable down the Moho dipping at about 40 degrees northward, and that the MTL juxtaposes the two quite different crusts of the Inner and the Outer zones (Ito and Ikawa, 2005; Sato et al., 2006; Ito et al., 2006, this symposium). As the original structure of the MTL is considered to be preserved under less influence associated with the opening of the Japan Sea in middle Miocene, the results of the survey in 2002 provide essential information to analyze the growing histories (including its active tectonics) proper to its local segments. In Kyushu, the MTL has been changed into a listric normal fault with a right lateral motion and now growing a half-graben on its hanging wall (Yusa et al., 1992). In Shikoku and west Kii, the MTL is now branching into a low-angle thrust and vertical strike-slip faults due to the strain partitioning near the surface. During the opening of the Japan Sea, the MTL became nearly vertical in Central Japan by the bending of the Japanese islands, whereas it moved in Kanto as a normal fault corresponding to the southern border of the rifting area.

ACM-P02

ACTIVE TECTONICS IN AND AROUND THE BOSO PENINSULA, SOUTH KANTO, JAPAN, ANALYZED BY THE NETWORK OF SEISMIC REFLECTION PROFILES

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The area in and around Boso Peninsula is originally a part of the forearc basin called the Kazusa trough, originating from the subduction of the Philippine Sea plate between the Eurasia plate and the Pacific plate. With the help of the network of seismic reflection profiles, we reexamined the active tectonic history from the view point of the reducing trough and uplift processes. Based on the analysis, we present an new interpretation that the rapid northwest tilting moved the depocenter in the trough to the Tokyo Bay area during 400 to 130ka and that the replaced extensive uplifting has produced the 100 km wide Kanto plain after 130ka.

ACM-P03

CHALLENGING SEISMIC EXPLORATION TO THE COMPLICATED STRUCTURES AND OPERATIONAL DIFFICULTIES IN ACTIVE MARGIN OF JAPAN ISLANDS

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Japan Islands (4 major islands: Hokkaido, Honshu, Shikoku, Kyusyu) are located in the border of Eurasian Continents and Western Pacific Ocean and subducted by Pacific Plate, while the southwestern half is subducted by Philippine Sea Plate. Both of these two plates and Eurasian Plate have junction near the center of the mainland of Japan (Honshu). The active thrust is recognized in the southern part of Hidaka Mountains of Hokkaido, formed by the collision of Kuril Islands Arc to Japan Islands Arc, associated with the activity of North American Plate. These situations in Japan result in the high activities of volcanism, earthquakes and orogenesis and bring the complicated subsurface structures and rugged terrain. The modern seismic methods by digital recording/processing, non-explosive sources and other technologies were introduced for oil and gas exploration successively from 1968 to1990. In the later of these years, numbers of marine and land reflection survey for scientific purpose were tried but they were still limited to the shallower target due to the limitation of number of channels and cabling of seismic system. The first challenging deep sounding on land was carried out across Hidaka Mountain from 1994 to 1996, using newly developed digital telemetry system with several hundred channels. The resulting profile revealed the remarkable de-lamination wedge caused by the collision process and the underlain Moho reflection (Ito T. et al., 1998). The big Kobe earthquake occurred in January 1995 triggered further applications of reflection survey to clarify the source fault and to predict the strong motion of earthquake in big cities and Tokyo metropolitan area of Japan (Sato. H. et al., 1998, 2005). We discuss the modified and improved technologies applied to these surveys, that are combined reflection and refraction method by wide range distribution of receivers with short interval, combination of wired and wireless (GPS based) digital telemetry system with more than 2,000 channels, connection of land/transition and marine surveys, super stacking of Vibroseis data in noisy urban area and so on.

ACM-P04

HIGH SEISMIC ATTENUATION IN THE REFLECTIVE LAYERS OF THE PHILIPPINE SEA SUBDUCTION ZONE, JAPAN

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Intrinsic seismic attenuation gives additional constraints on the physical properties of deep medium. But in many cases it is masked by scattering loss. In this work the high-frequency *Q*-value; i.e., parameter of seismic attenuation, was studied in the Kii peninsula segment of the Philippine Sea subduction zone of Japan. The effect of geometrical spreading, which is necessary to remove before inversion for *Q*-value, is calculated numerically using a realistic 3D velocity model and ray approximation. Then *Q*-structure was estimated by the double-spectral ratio tomography. Generally, estimated "total" *Q*-values agree well with results of other studies and with common expectations based on the tectonic structure, except of one striking result: *Q*-values for the lower crust and the subducting oceanic crust become extremely low, $Q_{total} \sim 20\text{-}30f^{0.9}$. In order to interpret this result we compiled phenomena, related to attenuation, that were observed in the studied region. They are: (1) the seismogenic upper crust; (2) the aseismic lower crust; (3) the reflective lower crust; (4) the belt-like zone of the deep low-frequency tremor generation, that is parallel to the slab; (5) the low-frequency earthquakes; and (6) the reflective subducting oceanic crust. Analysis of the ray coverage shows that anomalously low *Q*-value in the reflective lower crust and subducting oceanic crust can be explained mostly by high scattering attenuation (i.e., low Q_{sc} value) in the reflective layers.

ACM-P05

HETEROGENEITY OF PHYSICAL CONDITIONS AND PROPERTIES ALONG THE UPPER SURFACE OF THE PHILIPPINE SEA PLATE OFF THE KANTO DISTRICT

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At the southern Kanto district, central Japan, the 1703 Genroku earthquake (magnitude M=8.0) and the 1923 Kanto earthquake (M=7.9) occurred on the subducting Philippine Sea plate (PHS). The offshore region is the place where various events including the largest aftershock of the Kanto earthquake (M=7.3), silent earthquake and repeating earthquakes occur. These zones are thought to have different physical conditions and properties. In order to reveal them, we conducted multi-channel seismic reflection survey. As a controlled source, air-gun array was fired and the digital streamer cable with a length of 3,525 m was used. In the obtained profile, upper surface of the PHS can be traced continuously, though reflection intensity changes greatly. The reflection intensity can be affected by physical conditions and properties at the discontinuity. Those along the upper surface of the PHS are implied to be quite heterogeneous off the Kanto district.

ACM-P06

A DETAILED TOMOGRAPHIC IMAGE OF THE PHILIPPINE SEA PLATE BENEATH THE KANTO DISTRICT, CENTRAL JAPAN, BY DENSE SEISMIC ARRAY OBSERVATION

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The Kanto region of central Japan, in which the Tokyo metropolitan area is located, is at the northernmost end of the Philippine Sea plate near the triple junction of the Pacific (PAC), the Philippine Sea (PHS), and Eurasian (EUR) plates. To understand a detailed geometry of these plates, internal structures, and deformation patterns associated plate interactions, we have conducted a series of active and passive seismic experiments. We deploy a dense linear array consisting of 30 3-componet 1-Hz seismometers in the Boso peninsular since 2003, which provides new data for a tomography study. We use 406 regional and local earthquakes, which occurred from February 2004 to January 2006, observed at 183 stations including the 30 temporal array stations and 96 permanent stations (NIED, JMA, ERI). We also use 12 explosions acquired at 57 receiver points. We employ the double-difference tomographic method by Zhang and Thurber (2003). We can clearly image the upper boundary of the PHS as a low velocity thin layer, which is generally consistent with the result of reflection surveys (Sato et al., 2005), with clearer picture at depth than previously obtained by either tomography or reflection methods. We also identify a low velocity zone in the PHS, which might be associated with an intra-slab earthquake.

ACM-P07

RELATIONSHIP BETWEEN SHALLOW SEISMICITY AND SEAFLOOR TOPOGRAPHY—ACCRETIONARY PRISM EARTHQUAKE AND OUTER-RISE EARTHQUAKE—

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The relationship between the seismicity at the shallow portion and the topography plays an important role in the understanding seismotectonics. In order to estimate the seismic potential of the occurrence of the offshore earthquake, it is important to determine the relation between the shallow seismicity and the seafloor topography because of the presence of a well-deformed accretionary prism along the Nankai Trough and the horst-graben structure on the seaward slope along the Izu-Bonin Trench. Here we show the relationship between the seafloor topography and the seismicities of a very-low-frequency (VLF) earthquake within the accretionary prism along the Nankai Trough, and a shallow outer-rise earthquake within the oceanic crust beneath the seaward slope of Izu-Bonin Trench. For VLF earthquake, we identify the limited distribution of the epicenters of VLF events between the deformation front and outer ridge. For outré-rise earthquakes, a majority of the earthquakes occurs beneath the seaward slope that bent downdip toward the trench. They are also distributed beneath the well-developed horst-graben structure zone.

ACM-P08

THREE-DIMENSIONAL VELOCITY STRUCTURE BENEATH THE JAPAN ISLANDS

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We estimated the 3-D P- and S-wave velocity structure beneath the whole Japan Islands using the data of the high-sensitivity seismograph network of Japan (Hi-net) of National Research Institute for Earth Science and Disaster Prevention (NIED). We used manually picked 2,780,965 P- and 2,077,243 S-wave arrival time data from 78,324 earthquakes for the seismic tomography with spatial correlation. Horizontal grid interval is 0.1° and resolution is 0.2° without assuming any velocity discontinuity.

Subducting PAC plate is clearly imaged to the depths around 180 km with high velocities (high-V) beneath the northeastern Japan arc. The heterogeneous structure in the PAC plate is also imaged such as the low-V hypocentral region of the 2003 Off Miyagi earthquake where earthquakes connect the double seismic zone. Beneath the central Japan, subducting high-V PAC plate is clearly imaged to the depths around 300 km and subducting high-V PHS plate is clearly imaged to the depths around 180 km. Thrust-type events occurred at depths around 70 km indicating the existence of the subductig PHS plate. The mega-thrust earthquake is expected to occur beneath the Tokai region. Thrust-type small repeating earthquakes occurred at depths around 25-30 km and are located in the low-V layer at the top of the PHS plate, indicating the the repeating events at the plate boundary between the EUR and PHS plates. Beneath the southwestern Japan, there are boundaries of high and low velocity at depths of 30-50 km and these are consistent with the iso-depth lines of the Moho discontinuity in the PHS plate derived from receiver function method (Shiomi et al. 2006). Beneath the Kyushu, steeply subducting PHS plate is clearly imaged to the depths around 250 km with high velocities.

ACM-P09

THREE-DIMENSIONAL ATTENUATION STRUCTURE BENEATH THE JAPAN ISLAND BY TOMOGRAPHIC METHOD

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The seismic attenuation is usually specified by a quality factor Q, and we carried out tomographic inversions for the three-dimensional attenuation structure beneath the Japanese islands with NIED Hi-net data. We select earthquakes between M2.5 and M5.5, and use the vertical component of ground velocity amplitudes data reported from April 2001 to May 2006. Horizontal grid interval is 0.1 degree without assuming discontinuity. We estimated the Qp and Qs by tomography, respectively, with 318,264 P-wave amplitudes and 318,491 S-wave amplitudes from 7,756 earthquakes.

There are four characteristic results. First of all, clear high attenuation (low-Q) zones can be found beneath the volcanic front in the northeastern Japan, and the distinct low attenuation (high-Q) is recovered in the east of the front. Low-Q zones appear only just below volcanoes in the upper and lower crust, while the low-Q area extends continuously along the volcanic front at a depth of 40km. In the mantle wedge, the low-Q zone is laid toward west. Secondly, a low-Q area is found at a depth of 40 km in the Kanto region, central Japan. In this area low-velocity materials with larger Poisson ratios was found, and considered the materials to be serpentine on the Philippine Sea slab. Thirdly, the high-Q area is clearly found along the upper boundary of the Philippine Sea slab from Kanto region to Kyushu region. And below the slab, we found a distinct mantle wedge low-Q zone. Fourthly, the hypocenter of the main shock of mid-Niigata earthquake is located in the part where both velocity structure and attenuation structure have large contrast.

ACM-P10

COMPLEX GEOMETRY OF PHILIPPINE SEA SLAB BENEATH CENTRAL AND SOUTHWESTERN JAPAN AND THE RELATIONSHIP WITH LOCAL SEISMICITY

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See abstract ACM-O06

ACM-P11

SEISMIC STRUCTURE OF THE NORTHERNMOST RYUKYU SUBDUCTION ZONE OFF THE SOUTHERN KYUSHU, JAPAN

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The ocean bottom seismographic (OBS) and multi-channel seismic (MCS) investigations were conducted in the northernmost Ryukyu (Nansei Shoto) Trench region where the Philippine Sea plate with several bathymetric highs is subducting beneath the Ryukyu island arc in the north-west direction. We shot a tuned airgun array with a volume of 8,040 cubic inches at an interval of 200 m for the wide-angle seismic profiles and at 50 m for the MCS (480 channels, 60 folds) profiles. The OBSs were deployed at an interval of 5 km, which provided us dense data of high quality. The OBS result shows the Amami Plateau, the one of the large bathymetric highs in this region has a thick (max. 16 km) island arc crust. Both the OBS and MCS records give clear images of very rough sea bottom configuration of the northern extension of the Amami Plateau beneath the landward slope of the Ryukyu Trench. Distinct reflections from the plate boundary can be traced on the MCS record to a depth of 15 km from sea surface at about 80 km landward from the trench axis. There are thick (> 12 km) and low velocity ($V_p < 5$km/s) materials above the clear reflector of the plate boundary. The strong undulations of the plate boundary may constrain the sizes and/or natures of the asperities in this region where the maximum magnitude of the earthquakes is at most around 7.

ACM-P12

CRUSTAL STRUCTURE OF THE MARIANA VOLCANIC ARC

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As part of the NSF-MARGINS Izu-Bonin-Mariana Subduction Factory project, a seismic refraction/wide-angle reflection survey was conducted over the Mariana arc in 2002 using R/V Ewing airguns and 52 ocean bottom seismographs (OBS) deployed in 3 arc-parallel lines along the active volcanic arc, the Eocene arc and forearc. Two-dimensional ray tracing models show the crust of the Eocene arc is thicker than that of the active arc crust. The sub-Moho velocity beneath the active arc is about 7.5 km/s, rather slower than that beneath the Eocene arc and we speculate this low-velocity region indicates partial melts or crust-mantle mixing. The forearc shows a robust change in basement thickness over a very narrow zone. The sub-Moho reflectors are found beneath each survey line. The Eocene arc and the active arc have a middle crust of 6.1-6.5km/s which is also represented in the Izu-Bonin arc. The crustal structure of the Eocene arc is similar to that of the northern Izu-Bonin arc.

ACM-P13

SEISMIC VELOCITY MEASUREMENTS ACROSS A HIGHLY OBLIQUE SUBDUCTION ZONE – THE FIORDLAND REGION, SOUTH ISLAND, NEW ZEALAND

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The plate boundary through the Fiordland region, southwestern South Island, New Zealand, corresponds to a young, highly oblique subduction zone. A 120 km long marine crustal seismic reflection profile was recorded across the offshore part of this subduction zone using a 139 l airgun array and 3000 m streamer. The shots from this reflection profile were recorded at two land stations and by four sonobuoys along the profile. These variable angle reflection and refraction data have been inverted to give a preliminary crustal velocity model for the subducting margin. This velocity model is consistent with extended continental crust being subducted at the margin, under crust largely of lower crustal velocities. The model is compared with a seismic tomographic model derived from a detailed passive seismology experiment.

ACM-P14

ECLOGITIC MOHO, CRATON STABILIZATION, AND THE SIGNATURE OF FOSSIL SUBDUCTION IN NORTHWESTERN CANADA

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The deployment of a dense array of 20 broadband, three-component seismic stations as part of the IRIS-PASSCAL CANOE experiment in Wopmay orogèn, Northwestern Canada, has allowed teleseismic study of a Proterozoic fossil subduction zone previously characterized by LITHOPROBE (SNORCLE) reflection/refraction surveys. We present radial- and transverse-component receiver function images of the subsurface beneath this region. Combined with synthetic modeling these images define the geometry of the subduction zone, provide compelling evidence for an eclogitic Moho, and afford an indication of the importance of shallow subduction processes in craton stabilization based on similarities between signature of dipping crustal material beneath Wopmay orogen and of lithospheric structure observed further east beneath Yellowknife.

ACM-P15

CRUSTAL STRUCTURE IN CHILE AND OCHOTSK SEA REGIONS

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See abstract ACM-O06

ACM-P16

FIRST DEEP IMAGES OF SEISMIC REFLECTION ALONG THE PROFILE IN NORTH-EASTERN VENEZUELA (64° W)

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Within the frame of the GEODINOS project, deep seismic reflection profiles were executed in northern Venezuela in December 2004, in order to obtain structural images along three north-south profiles crossing the strike-slip fault systems related to the interaction of the Caribbean and south American plates. Here we focus on the easternmost profile located along latitude 64° W in north-eastern Venezuela. From north to south, the profile covers: the Igneo-metamorphic Araya-Paria

complex, the El Pilar fault, the Interior Range fold and thrust belt into the Monagas foothills with a total length of 80 km. Previous seismic refraction studies conducted in 2004 in cooperation with the BOLIVAR project, allowed to obtain a preliminary map of the crustal thickness in northern Venezuela. The velocity structure obtained by the refraction studies, was used for the processing and interpretation of the seismic reflection profiles. The 64°W-profile consists of 30 shot-points, separated 3 km each, with 800 receivers spaced 50 m (deployed in three segments). The seismic data present good energy for the first 10 seconds TWT, and several reflection hyperbolas could be identified in the shot gathers. In spite of the good energy of the signals, the records were very noisy, mainly due to ground roll, air wave and refraction arrivals, which are identified in all shot gathers. Therefore, we designed several filters with different time windows (trapezoidal filter), aiming at preserving the predominant frequencies in the data, and to eliminate part of the coherent noise. One of the most important procedures was the generation of a predictive deconvolution in 3 time windows, which significantly improved the S/N ratio in the gathers. Due to the low fold in the sections (maximum of 20 with an average of 10), it was necessary to use the velocities from the deep seismic refraction for semblance analysis, in order to improve the velocity pickings to apply NMO. At a post-stack level, a f-k power filter was applied in order to increase the power amplitude. During the migration process, several tests were made, which included the Kirchhoff-migration, and finite difference migration method; the best results were obtained with the application of the finite difference migration method. The resulting seismic section has an approximate length of 60 km, and 2 important reflectors could be identified. The first, which is seen in the whole section, is located at 7 s TWT in the north and increase to 11 s in the south of the section, and could represent an important intracrustal interphase with an estimated depth of 30 km in average. The second reflector, which is located at 12 s in the north, tends to increase towards the south of the section, where it is observed about 16 s, which would result in a decrease of this reflector from 35 km in the north to 45 km in the south. This reflector will be interpreted as Moho, which would be in good agreement with observations from seismic wide angle data further south. Currently the implications of the structures observed in the sections are under discussion in the light of the tectonic context of the region. Contribution to the GEODINOS (FONACIT 2002000478) and PDVSA-INTEVEP 04-141 Projects.

ACM-P17

ISLAND ARC ACCRETION BY OBLIQUE COLLISION: THE RESULTS OF THE BOLIVAR PROJECT ALONG THE SE CARIBBEAN PLATE BOUNDARY

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We present the recent results of the ongoing NSF Continental Dynamics project BOLIVAR (Broadband Onshore-offshore Lithosphere Investigation of Venezuela and the Antilles arc Region). The project included the acquisition of ~6000 km of marine reflection data, OBS deployment along five transects, offshore-onshore refraction profiles and deployment of land and marine broadband seismographs. The imaged area spans from the Atlantic Ocean to the 71°W meridian, and from the Guyana Shield (60°N) into the eastern Caribbean basin (14°N).
Active source seismic data show the progressive underthrusting of the Caribbean plate beneath South America from west to east in response to the eastward migration of the Caribbean plate and the collision between the arc region and the South American continent. The velocity models obtained by the traveltime inversion of first arrivals and PmP show evidence for high velocity (> 6.5 km/s) bodies in the shallow to mid-crust coinciding with the major plate boundary strike-slip faults. It is noteworthy that the velocity anomalies are observed only in those portions of the strike-slip boundary which are presently under compression, suggesting that transpression along the boundary may play (or have played) a role in the exhumation of the HT/LP lower crustal and mantle rocks observed at the surface. Comparison between the 1-D velocity models of the Leeward Antilles arc and other island and

continental arcs shows that the Leeward Antilles arc has velocities lower than mafic oceanic island arcs (e.g. Aleutians, Tonga, Bonin arc) but higher than continental arcs (e.g. Sierra Nevada).
Receiver functions images of the Moho from the passive source seismic data document downward flexing of the South American lithosphere near the zone of active arc collision. Overall the crust of coastal Venezuela and the plate boundary shows a surprising degree of heterogeneity, with thickness varying from 10-15 km beneath the Caribbean LIP to 38-40 km beneath the Guyana Shield, and thicknesses as much as 50 km, and as little as 25 km beneath the coastal mountain belts.

Japan Transect

JPT-P01

CRUSTAL EVOLUTION OF THE SOUTHWESTERN KURIL ARC

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Combined analysis on onshore-offshore wide-angle seismic survey brought a 500km crustal transect across the Kuril arc-trench system. The obtained crustal image consists of the subducting oceanic crust, the Kuril island arc crust and the crust of the Sea of Okhotsk. The subducting oceanic crust can be imaged down to 40 km. The Kuril island arc crust consists of the upper crust of andesitic rocks (6.0-6.2km/s) and reflective middle to lower crust (6.5-7.3km/s), which may continue to the delamination structure of the Kuril island arc crust at the central Hokkaido collision zone. The structure in the backarc area shows thick accretionary complex formed by Paleogene accretion and collision, which may continue to Cretaceous accretionary complex observed in the Hidaka Belt on land obtained from the published seismic study. The existence of andesitic rocks and reflective middle to lower crust suggest that the southwestern Kuril arc is more mature oceanic island arc crust than that of the central Aleutian arc. Each volume of andesitic, basaltic and mafic layers estimated from the geochemical model is consistent with those obtained from the seismic velocity model. Crustal composition estimated from the geochemical model and major element chemistry of volcanic rocks of the Kuril Arc indicates that mechanical delamination is insufficient to evolve the oceanic island arc crust to the continental crust

JPT-P02

SEISMIC SECTIONS ACROSS HOKKAIDO - CRUSTAL DEFORMATION ASSOCIATED WITH ARC-ARC COLLISION -

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The crustal evolution of Hokkaido Island is characterized by a series of accretion and collision processes from the late Jurassic to the present. Particularly, ongoing arc-arc collision between the Kuril Arc (KA) with the Northeast Japan Arc (NJA) is a controlling factor for crustal deformation in the central part of this island (the Hidaka Collision Zone (HCZ)). The structure of HCZ was firstly provided by 1994-97 deep seismic reflection surveys undertaken in its southern part. The crustal section obtained show clear image of delamination of KA with a "crocodile geometry" at about 25-km depth. Subsequent seismic expeditions in 1998-2000 (Hokkaido Transect), crossing the middle part of HCZ with EW direction, succeeded in imaging the collision structure from its hinterland to the fold-and-thrust belt. The crustal delamination is also recognized as clear eastward dipping reflector sequences and flat or westward dipping events. The fold-and-thrust belt is characterized by a 5-8 km thick sedimentary package including one or two velocity reversals of Paleogene sedimentary layers, probably formed by imbrication in the collision process. Active growth folds in the frontal part of the

fold-and-thrust belt revealed by high resolution reflection surveys suggests the significant amount of horizontal convergence has been consumed in Central Hokkaido.

JPT-P03

SEISMIC SECTIONS ACROSS NORTHERN HONSHU, JAPAN: A CLASSIC TRENCH-ARC-BACK ARC SYSTEM

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Northern Honshu Japan is a classic example of a trench-arc-back arc system. The Pacific plate is being subducted beneath Northern Honshu volcanic arc. Northern Honshu has been rifted away from the Eurasian continent in the early Miocene. Associated with the opening of the back-arc basin, the crust of northern Honshu has been stretched. The Miocene extension is well preserved in the crustal structure, such as crustal thinning towards the back arc revealed by wide-angle reflection/refraction survey and development of half grabens by seismic reflection profiles. In the back-arc of northern-Honshu, two rift-systems has been developed, the Yamato Basin rift-system in the west and Northern Honshu rift-system in the east. Since the late Neogene, positive basin inversion has been prevailed under compressional stress regime. At the offshore of forearc the thickness of continental crust is thinner than in the onshore. Along the mega-thrust, tectonic erosion processes have been dominated associated with subsidence of fore arc since the late Neogene.

JPT-P04

SEISMIC SECTIONS ACROSS THE CENTRAL PART OF NORTHERN HONSHU, JAPAN: A TRANSECT ACROSS A CHAIN OF HAZARD EARTHQUAKES.

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Many hazard earthquakes occurred across the central part of northern Honshu: e.g. Miyagi-oki earthquakes (1978, 1936 and so on), Northern Miyagi earthquakes (2003, 1962 and 1900), Onikobe earthquake (1996), Syonai earthquake (1894), Sakata-oki earthquake (1833), and so on. To understand overall seismic structure, we collected many seismic sections which cover from the Japan Trench to the eastern margin of the Japan Sea. Refraction/reflection studies in fore-arc region show remarkable reflectors: shallow westward dipping events related to Northern Miyagi earthquakes, Conrad and Moho interfaces, subducting oceanic crust. Reflection studies in the back-arc region show the deformation features due to strong compression: low-angle Sakata thrust, fault system related to uplift of the Dewa hills, tectonic inversion structures, and so on.

JPT-P05

SEISMIC SECTIONS ACROSS THE IZU COLLISION ZONE, CENTRAL JAPAN: ON-GOING ARC-ARC COLLISION SYSTEM

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The Philippine Sea plate (PHS) subducts beneath the SW Japan arc with collision between Izu

volcanic arc and the central part of Honshu island. The crustal structure across the Izu collision zone has been investigated by seismic refraction and reflection. The crustal thickness of the Izu volcanic arc is ranging from 35 to 25 km. The forarc and back-arc of Izu-Bonin arc suggest normal subduction and thick volcanic arc crust has been collided since the middle Miocene with the Honshu arc. Due to the collision, the upper crust of the thick Izu volcanic arc has been underplated in the middle curst of Honshu arc, forming thrust sheets and/or wedge-thrust. This collision has been formed thick upper crust in the collision zone. NW-extension of subducted slab of PHS shows no seismicity related to slab. By recent seismic reflection profiling (Odawara-Yamanashi 2005 seismic survey), this aseismic slab was imaged at 30 to 40 km in depth.

JPT-P06

SEISMIC SECTIONS ACROSS THE TOKAI-CHUBU REGION, CENTRAL JAPAN: AN AREA OF FUTURE MEGATHRUST EARTHQUAKES

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The Tokai region is an active subduction zone where the Philippine Sea plate is subducting beneath the Japanese island-arc. In this area, large inter-plate earthquakes have occurred repeatedly. Knowledge of the configuration and physical property of the plate boundary is important to understand the mechanism of large inter-plate earthquakes. Onshore-offshore surveys have been conducted to know the seismic structure of the subducting Philippine Sea slab and characteristics of the plate boundary. Seismic velocity and reflectivity images show on going subduction of repeated ridges with the sizes of 10km-20km thick and 40km-60km wide. The large amplitude reflected wave at the upper boundary of the subducting Philippine Sea slab is observed. The reflection points are located at the depth of 20km-35km. The large amplitude variation with depth is obtained. The large amplitude wave can be explained by the reflected wave at the extremely low velocity layer which is located upper part of the slab. Several reflectors inside the crust are detected. Those reflectors are considered as the lithological boundaries. A profile line traverses island-arc Japan from south coat to north coast. The Niigata-Kobe Tectonic Zone (NKTZ), which is a high strain-rate zone, is located at the northern part of the profile line. The upper crust beneath NKTZ was characterized to low velocity. Seismic surveys with spatially high-dense seismic stations have revealed fine structure of the Tokai-Chubu area. The obtained structure will reveal the mechanism of mega thrust earthquakes and accumulation mechanism of the stress and strain in Japan.

JPT-P07

SEISMIC SECTIONS ACROSS THE KINKI DISTRICT: SUBDUCTING PHILIPPINE SEA PLATE FROM THE NANKAI TROUGH

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In the Kinki District, central Japan, the Philippine Sea plate (PSP) is subduction from the Nankai trough towards northeast, and great earthquakes occur in every 100 years. Besides, there exist many active faults in the northern part of the district, which cause large inland earthquakes. A seismic section is made across the Kinki district from the coast of the Sea of Japan to the Nankai trough from two big onshore and offshore seismic experiments conducted under the two projects promoted by MEXT. The seismic lines are 210 and 180 km for on shore and off shore experiments, respectively. The sections show clear subduction of PSP at an angle of about 20 degrees. The reflections from the plate boundary and the oceanic Moho of PSP show that the oceanic crust has a thickness of about 8-10km. Reflectors in the upper mantle at depth of 60-80 km seems to show aseismic slab relating to the subducting plate. Many reflectors are located in the lower crust, but the Moho is not clear in land area. Some reflectors were found in the upper mantle beneath the Moho in the oceanic area.

JPT-P08

SEISMIC SECTIONS ACROSS SHIKOKU-CHUGOKU DISTRICT, SOUTHWEST JAPAN: A TYPICAL CRUSTAL STRUCTURE OF THE JAPANESE ISLAND ARC

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The basement of the Japanese island arc is composed mostly of accretionary complexes of Late Paleozoic to Paleogene along the margin of the Eurasian continent. The basement is divided by the Median Tectonic Line into the two, the Inner and Outer zones. The Inner zone is characterized by a nappe structure composed of Late Paleozoic to Jurassic accretionary complexes and their related strata, whereas the Outer zone by a seaward younging zonal arrangement of Jurassic to Paleogene accretionary complexes. Although these characteristics are typically observed in the surface geology of Shikoku and Chugoku (Kobayashi, 1941), the whole crustal structure has remained unknown for a long time. The integrated seismic surveys were made in 1999 and 2002 from the Nankai trough through Shikoku and Chugoku to the Japan Sea, transecting overall the typical Japanese island arc. In combination with the results of previous seismic surveys, the surveys in 1999 and 2002 clearly indicate that the Inner and the Outer zones are quite different in crustal structure as follows: (1) The upper crust of the Inner zone exhibits the horizontal structure, whereas that of the Outer does the seaward verging structure. (2) The lower crust of the Inner zone has been completed with the thick olivine cumulate on the bottom, whereas that of the Outer has not yet.

JPT-P09

SEISMIC SECTIONS IN AND AROUND THE KYUSYU ISLAND: ACCRETION PROCESSES AT THE WESTERN EDGE OF THE NANKAI TROUGH

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Seismic images along inland and marine profiles at the western part of the Kyusyu island, SW Japan, provide us a complete accretion section since Cretaceous due to subduction of the Philippine Sea Plate.

In this study, we compiled seismic data acquired from a toe of the present day accretion prism at the Nankai trough to the north of the Median Tectonic Line (MTL) which is boundary between low-P/T and high-P/T metamorphic rocks derived from a Cretaceous accretionary complex. Several tectonic domains are observed from the toe of the accretionary prism toward the land; e.g., imbricate thrust zone which is composed by recent accretionary package, large out-of-sequence thrust zone which probably consists of Mio-Pleistocene accretionary package. At the landward end of those packages, the MTL is clearly imaged as the northward dipping reflector (~40 degrees) at surface. The dip is abruptly changed to subhorizontal at severl km deep. The present motion of the MTL is a listric normal faulting with a right-lateral slip. Thus the MTL has been growing a longitudinal half graben. Along the eastern part of the Kyusyu island, a very thick (more than 10 km) accretionary complexes and strong midcrustal reflectors at depths of 15-25 km are imaged. The Moho is not well constrained but situated at a deeper depth of 35-40 km. Seismic profiling in the middle part of Kyushu showed the normal fault structure probably related with the process of crustal extension.

JPT-P10

SEISMIC SECTIONS IN AND AROUND RYUKYU ISLAND ARC – SUBDUCTION SYSTEM WITH ONGOING BACKARC SPREADING -

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The Rykyu trench, Rykyu Islands and Okinawa Trough form a trench-arc-backarc system associated with the Philippine Sea plate developed along the eastern margin of the East China Sea. The Okinawa Trough is knows as an ongoing backarc spreading area. In this region, several marine seismic experiments were carried out. In the northern part of the Ryukyu trench-arc system, the subduction structure is characterized by undulated Philippine Sea Plate at the trench area and very thick (more than 12 km) accretionary wedge beneath on the continental slope, beneath which the plate is subducted with an angle of 11°. The forearc part has a rather low velocity (5.4-5.8 km/s) upper crust. The backarc basin behind this section shows a thinned continental crust. The total crustal thickness decreases southwestward from 27-30 to 23-24 km. The middle part of the Ryukyu trench-arc system shows significant structural difference from that in the northern part. The Philippine Sea plate in this region is subducted with a gentle angle of 6° as compared with the case in the northern part, and the accretionary wedge is less developed. In the southern part of the Okinawa trough, the crust is reduced in thickness to about 15 km remaining continental structure. Probably, oceanization associated with the spreading does not occur in the Okinawa Trough or is limited in its southernmost part.

JPT-P11

SEISMIC SECTIONS ALONG THE IZU-BONIN ARC: VARIABLE GROWTH OF CONTINETAL CRUST IN AN INTRA OCEANIC ARC

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An accretion of island arc crust containing felsic to intermediate composition has been proposed to be the most effective process for growth of continental crust. In order to examine whether felsic to intermediate component continental crust is formed within a crust of intra-oceanic subduction zones, we examine structural variation along the Izu-Bonin arc by means of active source seismic imaging. The wide-angle seismic data used were acquired in 2004 and 2005 along the entire Izu-Bonin arc, over 1100 km long, on the volcanic front. Seismic image obtained shows remarkable along arc structural variations, which are clearly correlated with the arc volcanism; i.e., low average crustal seismic velocities (~6.7 km/s) of the crust due to well developed felsic to intermediate component middle crust at the basaltic volcanoes, while high average velocity (~7.1 km/s) at the rhyolite volcanoes. Toward the Bonin sector of the arc, crustal structure is dramatically changed. Total crustal thickness becomes

less than one third of the Izu arc. Although the volume of felsic to intermediate component crust (Vp = 6.0 – 6.8 km/s) is remarkable smaller than that of the Izu arc, we still observe decreasing the average crustal velocity beneath volcanoes. We propose from those observations that the continental crust predominantly growths beneath the basalt volcanoes in the Izu arc, while a juvenile stage of continental growth may take place in the Bonin arc.

JPT-P12

SEISMIC SECTIONS ACROSS IZU-OGASAWARA (BONIN)-MARIANA ARC: FORMING CONTINENTAL CRUST IN OCEANIC ISLAND ARCS

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See abstract ACM-O02

Classic transect

CTS-P01

IGCP PROJECT 474: IMAGES OF THE EARTH'S CRUST & UPPER MANTLE

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IGCP Project 474, "Images of the Earth's Crust and Upper Mantle" is jointly funded by UNESCO and IUGS. IGCP Project 474 has the primary objective of providing ready access to seismic images of the Earth's basement geology, deep crust and upper mantle. This is achieved through its website http://www.earthscrust.org/, where images are available of the interior of the Earth's crust and upper mantle across a variety of representative structural provinces from all parts of the globe. These images are available to a worldwide scientific, educational and public audience and therefore contribute to informed debate on tectonic processes, the natural environment, natural hazards and the sustainable use of natural resources. Project 474 is on the lookout for suitable images.

CTS-P02

PROTEROZOIC INTRA-CONTINENTAL COLLISIONS – ARUNTA-TANAMI AND THE GAWLER-CURNAMONA

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The wedge shape reflectivity pattern within the Gawler Craton crust suggests the presents of a boundary either between two different crustal blocks or between a stable crustal block to the south and the reworked crust of a mobile belt to the north. The latter hypothesis is preferred, but the former cannot rule out with these data. Regional extrapolation of this collision into the adjacent Curnamona Province suggests the presence of Gawler basement beneath an upper crustal decollement that is interpreted as the juxtaposition of two different crustal blocks. A pronounced crustal thickening and similar wedge shape reflectivity at the inferred Tanami –Arunta boundary suggests major collision prior to deposition of the Tanami Group. The Tanami Group completely overlies the Proterozoic-Archaean basement, attaining thicknesses up to about 10 km.

CTS-P03

CLASSIC TRANSECT: INDEPTH PROFILE ACROSS THE HIMALAYA-TIBET PLATEAU

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Project INDEPTH is a multinational, multidisciplinary initiative that has now collected an extensive suite of geophysical data extending from the high Himalayas to the central portion of the Tibetan plateau. INDEPTH I detailed the geometry of the Main Himalayan detachment beneath which Indian continental crust is subducting beneath the deforming leading edge of Asia, providing an important new constraint on the amount of plate convergence that could be attributed to crustal shortening in the Himalaya. INDEPTH II seismic and magnetotelluric indications of partial melt in southern Tibet have lent support to tectonic models involving warm, weak crust and attendant material flow at depth. INDEPTH III results that are consistent with such flow beneath the central plateau include a highly conductive crust, restriction of local seismicity to the uppermost crust, reflective lamination in the lower crust, and coherent crustal anisotropy. Mantle tomography of INDEPTH III teleseismic recordings indicate a steeply dipping zone of anomalously fast (cold?) material in the mantle beneath central Tibet that likely marks subducted Indian lithosphere, an interpretation consistent with the gravity field over Tibet. Receiver functions computed beneath INDEPTH stations indicate a segmentation of the Moho that may reflect post-collisional reactivation of older accreted terranes.

CTS-P04

FINE CRUST STRUCTURE IN NORTHERN MARGIN AREA OF TIANSHAN MOUNTAINS REVEALED BY DEEP SEISMIC REFLECTION PROFILING

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The investigation results of active tectonics indicate that the typical active tectonic features of intra-Continental collision orogenic belt are presented in northern margin of the Tianshan Mountains. It behaves as multiple-row anticlines and thrusts parallel to each other. In order to investigate the fine crustal structure, the geometry of these active faults and the relationship between the shallow and deep structures, a deep seismic reflection profile with 75km long, which runs in SN direction, was carried out in 2004. This profile is located at the joint region of basins and mountains to the west of Urumchi. The stacked and migrated deep seismic reflection section shows a clear image of the crustal structure. The crust is divided into the upper crust, about 26~28 km thick, and the lower crust, about 23~25 km thick, by a reflective zone at 8.8 - 9.5 s TWT. According to the reflective features of the reflective section, the upper crust is finely subdivided into the upper and lower parts. Up to 5 s TWT, the section is dominated by many reflection events showing clear structural forms and different structural features in laterally. There are a series of nearly EW -strike anticlines arranged in NS direction and a series of thrusts spread in nearly SN direction to the south of the joint region between the basin and mountains. A set of steeply north-dipping reflections and some interformational sliding faults can be identified. The typical sediment imaging is presented in the northern part of the profile. The maximum depth of the basin is about 10-12 Km. The lower part of the upper crust along the profile is characterized by "reflectivity transparency", in which there being a few discontinuous and weak reflection events between 6 and 9 s TWT. In the upper part of the lower crust, between 10 and 14 s TWT, there is no any obvious reflection. The strong reflections from the Moho transition zone begin at 14 s TWT, and terminated at about 17 s TWT, corresponding to a thickness of 9~10 km. The Moho deepens from the north part to the south part of the section. The depth of the Moho in Zhungeer basin is about 49-50 Km and it is about 51-52 Km near Tianshan Mountains. In the joint region between Tianshan Mountains and Zhungeer basin, in the middle part of the profile, the reflections from the boundary between upper and lower crust and from the Moho transition zone become blurring and some upheavals and folds are shown in the shallow formation. It may result from compression action between Tianshan Mountains and Zhungeer basin.

The research was supported and funded by China Earthquake Administration.

CTS-P05

THE AGULHAS-KAROO GEOSCIENCE TRANSECT: UNRAVELLING A BILLION YEAR HISTORY OF CONTINENTAL ACCRETION AND SEPARATION IN SOUTHERN AFRICA

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Southern Africa and its southern continental margin offer an unrivalled region, where continental accretion processes over a period of more than 3.5 billion years can be studied. Along a geoscientific transect from the offshore Agulhas Plateau across the Agulhas Fracture, the Outeniqua Basin, the Cape Fold Belt, the Namaqua-Natal Belt into the Karoo Province, geophysical and geological data and samples have been collected in order to build a model of the evolution and crustal accretion as well as the continental break-up of this region. With this transect, which is a component of the German - South African project "*Inkaba ye Africa*", objectives are addressed such as the Mesoproterozoic accretion processes along the southern margin of the Kaapvaal Craton, the extent of Pan-African inliers in the Cape Fold Belt, the formation of the Cape Fold Belt, the sources for the Beattie Magnetic Anomaly and the Southern Cape Conductivity Belt, the continental/oceanic origin of the Agulhas Plateau, the formation of the Agulhas Fracture Zone and its consequences for basin formation and uplift processes. A combined land-sea deep crustal seismic reflection and refraction survey as well as a magnetotelluric survey along the transect provides detailed structures and constraints for physical parameters from the upper crust to the upper mantle which will be integrated with geological, petrological and geochemical analysis on rock composition, age and alteration history to form an overarching geodynamic model for the evolution of the region and its tectonic units.

Poster session 2 — September 27th, Wednesday - September 29th Friday

Passive continental margins

PCM-P01

SEISMIC PROFILING ACROSS THE ARCTIC: DISTINGUISHING CONTINENTAL AND OCEANIC CRUST

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The deep troughs and ridges of the Arctic Basin are some of the least known features of the Earth's crust. Some of the ridges, e.g. Chukchi and Northwind, are connected directly to the continental shelves and are certainly submarine promontories of the latter. Others are separated from the shelves by shallow troughs, but are inferred, mostly on the basis of seismic data, to also be continental fragments. Thus, the character of the Lomonosov Ridge as a narrow slice of continental crust that separated from the Eurasian margin in the early Cenozoic (by opening of the Eurasian Basin), is not in doubt. Recent drilling (ACEX) and piston coring have confirmed this interpretation. However, there are other ridges and some of the troughs that are of uncertain origin. Long, wide-angle profiles have shown that the crust beneath most of these features is anomalously thick and has a velocity structure that allows (even, in some cases, favors) the presence of highly attenuated continental crust. Combining near-vertical reflection and wide-angle data is helping to solve this problem. Reflection

profiling is providing evidence of the character and thickness of the sedimentary cover (mostly Cenozoic and late Mesozoic), both on the ridges and beneath the troughs. Some of the ridges (e.g. Marvin Spur) appear to be fragments of continental crust rifted off the Lomonosov Ridge (with a similar, unconformable Cenozoic cover); however, they gently plunge into and beneath troughs (e.g. Makarov Basin). Only the Eurasian Basin is unambiguously oceanic in seismic, magnetic and gravity signatures. This poster illustrates the seismic data and possible interpretations.

PCM-P02

DEEP SEISMIC INVESTIGATIONS IN THE BARENTS AND KARA SEAS

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DSS and CDP seismic studies were carried out along the 2-AP profile from the center of the Barents Sea through Novaya Zemlya and Kara Sea. A dense system of observations with intervals between bottom stations of 10 km enables to compare the possibilities of CDP and DSS surveys and of different methods of the data interpretation: 1D solutions, tomographic modeling, the Moho wave imaging, ray-tracing ets. In the region the studies shows the continental crust with average thickness of 35-37 km. In the deep basins filled with 7-15 km thick sediments, the crystalline crust is reduced to 15-20 km with the Moho rising to 30 km. The crustal structure is complicated by a series of blocks divided by fault zones. The block structure shows different tectonic regimes in various parts of the region. The largest fault of listric form crosses the whole crust between the Novaja Zemlya and the South Kara basin. Several rift grabens and faults are revealed in the basin basement. This confirms the idea that the continental basin formation is started from narrow rift grabens. Beneath the Moho inclined boundaries are traced down depths of 60 km.

PCM-P03

SEISMIC EVIDENCE OF THE CONSUMPTION OF THE SOUTHERN MARGIN OF BAY OF BISCAY DURING THE ALPINE COMPRESSION.

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See abstract PCM-O01

PCM-P04

DEEP CRUSTAL STRUCTURE OF THE SHEARED SOUTH AFRICAN CONTINENTAL MARGIN

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The southern margin of South Africa offers an unrivalled possibility to enhance our understanding of the structure and processes involved in the formation of sheared continental margins. During the *RV Sonne* cruise SO-182 in 2005, the *AWI* acquired marine seismic reflection and refraction/wide-angle reflection data along two sub-parallel profiles (part of the Agulhas-Karoo Geoscience Transect) across the continental margin. A velocity depth-model was created using a forward modelling and an inversion approach. The observed crustal thickness along the western profile thins from 30 km on the inner continental shelf to 6 km in the Agulhas Passage (AP). A transition from continental to oceanic crust occurs at the Agulhas-Falkland fracture zone. A layer of unconsolidated sediments with P-wave velocities between 1.7 and 3.0 km/s and a thickness of about 2 km can be observed from the continental shelf to the Outeniqua Basin (OB). South of the OB, this layer becomes thinner and

disappears in the AP. A layer with velocities between 3.5 and 5.0 km/s can be found along the entire profile. The seismic reflection data suggests that this layer may consist of alternating layers of volcanic flows and sediments. Metasediments may also play a role in the composition of this layer. Beneath the stratified sedimentary sequences of the OB, a 6 km thick zone with relatively low velocities of 5 – 6 km/s exists, suggesting pre-break-up metasediments which were altered by magmatic and tectonic processes. The top of the crystalline basement is marked by a sharp P-wave velocity increase from 5.7 to 6.6 km/s. Average velocities between 6.4 and 6.9 km/s were measured for the middle to lower crust. Uppermost mantle velocities of 7.8 to 8.0 km/s are observed from clear Pn phases.

The continental mantle

TCM-P01

EVIDENCE FOR ACTIVE LOWER-CRUSTAL CONTINENTAL DELAMINATION IN THE VRANCEA SEISMOGENIC ZONE OF ROMANIA FROM PROJECT DRACULA

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See abstract TCM-O02

TCM-P02

DEEP EUROPE TODAY: GEOPHYSICAL SYNTHESIS OF THE UPPER MANTLE STRUCTURE AND LITHOSPHERIC PROCESSES OVER 3.5 GA

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We present a summary of geophysical models of the subcrustal lithosphere for the entire Europe. This includes the results from seismic (reflection and refraction profiles, P- and S-wave tomography, mantle anisotropy), gravity, thermal, electromagnetic, elastic, and petrologic studies of the lithospheric mantle. Three profiles (two N-S and one E-W), constrained by all available geophysical data, illustrate major tectonic processes as reflected in the lithospheric structure of Europe ranging from Precambrian terrane accretion and subduction to Phanerozoic rifting, subduction and continent-continent collision. We propose an integrated model of physical properties of the European subcrustal lithosphere, with emphasis on the depth intervals around 150 and 250 km. At these depths, seismic velocity models, constrained by body- and surface-wave continent-scale tomography, are compared with mantle temperatures and mantle gravity anomalies. (Artemieva et al., *Geol. Soc. London*, v. 32, 2006).

TCM-P03

CAN TEMPERATURE VARIATIONS ALONE EXPLAIN LARGE-SCALE Vs AND Qs VARIATIONS IN THE CONTINENTAL LITHOSPHERE?

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Global elastic and anelastic seismic tomography models based on Rayleigh waves at periods between 40 and 150 sec (Billien et al., 2001) show a weak correlation of attenuation of seismic shear waves, Qs^-1, and seismic velocity, Vs, with temperatures in the upper 150 km of the continental mantle (Artemieva et al., *Geophys. J. Int.*, 2004). A quantitative comparison of theoretical Vs(T) and Qs(T), calculated from experimental data on T-dependence of seismic parameters and mantle temperatures (Artemieva &

Mooney, 2001), with global Rayleigh waves elastic and anelastic tomography models shows that more than 1/2 of amplitude of Vs and Qs anomalies in the continental lithosphere should be attributed to non-thermal mechanisms. Compositional anomalies due to Fe-depletion can explain the misfit between seismic and theoretical Vs in the cratonic lithosphere. In regions of active tectonics, partial melts and/or fluids are likely to affect seismic parameters. The effects of scattering on Qs are not included into the analysis.

TCM-P04

COMPOSITIONAL VARIATIONS IN THE CONTINENTAL LITHOSPHERE CONSTRAINED BY SEISMIC TOMOGRAPHY DATA

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See abstract TCM-O03

TCM-P05

FINE SCALE HETEROGENEITY IN THE EARTH'S CRUST AND MANTLE

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See abstract TCM-O01

TCM-P06

DIFFERENCES IN DEPTH OF UPPER MANTLE DISCONTINUITIES BENEATH THE ALPS AND THE VARISCIDES FROM WAVEFORM ANALYSIS OF SELECTED EARTHQUAKES

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The subject of this study is the upper mantle velocity structure beneath the Alpine and Variscan orogens in Central Europe. The crustal structure beneath these regions has been extensively studied by controlled and natural source seismology but relatively little information exists on the structure of the lithosphere/asthenosphere system.
We interpret recordings in Europe of waves from natural earthquakes with epicenters in Europe and in north Africa (Algeria) in order to determine the depth to prominent upper mantle discontinuities, such as 8 and 20-degree discontinuities.
The seismic ray coverage of the upper mantle structures is selected for the Alpine area. The data include both regional and global traveltimes and waveforms.
In the case of Algerian earthquakes, the high density of stations in Germany (GRSN and GRF networks) and in the UK is particularly suitable for our study because the epicentral distance range of 1600-2400 km provides ray coverage at depths of 250-450 km. We have compared the P-coda waveforms for recordings from two azimuthal intervals (referring to the stations in the UK and in Germany) at different offset ranges (1600-1800 km and 1800-2400 km). The UK recordings at distances between 1600- and 1800 km corresponding to rays crossing the tectonically 'cold' Variscan region, are characterized by distinctive refraction from beneath the 410-km discontinuity.
The models obtained for different azimuths suggest that a high velocity discontinuity at a depth of about 300 km is a characteristic of the mantle below the Alps. It produces a strong refraction clearly distinguishable on the relevant travel time curves. No similar discontinuity is identified in the upper mantle beneath the adjacent Variscan area.

TCM-P07

CHARACTERISTIC DIFFERENCES IN TRAVELTIME CURVES FOR 'COLD' AND 'HOT' MODELS OF THE UPPER MANTLE FROM SELECTED EARTHQUAKES FROM THE NORTH AMERICA AND EUROPE

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In order to compare the upper mantle structure beneath 'cold', tectonically stable regions with 'hot', tectonically active regions, we have checked the differences between earthquake traveltimes for ray paths passing through both domains. We find a clear distinction between 'cold' and 'hot' upper mantle in North America and Central Europe.
We have focused on traveltimes in the offset range between about 700 km and 3000 km. There is a significant delay for phases sampling the upper mantle low velocity zone (LVZ) below a depth of about 100 km. The delay depends on the thickness and velocity drop of the LVZ and appears to correlate with the tectonic state of the region. For 'hot' regions there is a large delay for phases that have crossed the LVZ, which corresponds to a thick LVZ; whereas the delay is smaller for phases that have propagated in 'cold' regions. For three events from Texas we identify some delay from the LVZ for recordings in the eastern US and a much larger delay for recordings in the western US in the offset range of 800-1600 km. The difference between these delays amounts to 3-5 s. A similar difference has been observed for two events in northern Algeria for recordings in Europe between ray paths that traverse the 'hot' Alpine region and outside. For all five events the situation is reversed at offsets beyond ~1600 km where phases from around the mantle transition zone are observed. At these large offsets seismic phases with velocities that are typical to those observed below the '410-km' discontinuity are recorded 2-3 seconds earlier for 'hot' regions as compared to 'cold' regions. It suggests that the '410-km' discontinuity is located at a significantly shallower depth (ca. 300-350 km?) below 'hot' than 'cold' tectonic domains. We cannot rule out the possibility that it may represent so-called X-discontinuity, however the observed high apparent velocity of this phase is typical rather for 410's.

TCM-P08

UPPER MANTLE STRUCTURE OF NORTHERN EURASIA FROM PEACE NUCLEAR EXPLOSION DATA

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9 long-range seismic profiles, carried out in Russia with 25 Peace Nuclear Explosions (PNE) were used to compile a 3-D upper mantle velocity model. As a result four basic boundaries were traced over the area on study: N1 boundary (boundary velocity V= 8.3 km/s, depths D = 70-120 km), N2 (V=8.4 km/s, D = 100-150 km), L (V=8.5 km/s, D = 200-250 km), H (V=8.6 km/s, D = 300-330 km). All boundaries are not simple discontinueties, they are heterogeneous (thin layering) zones which generate multiphase reflections. The most horizontal inhomogeneity is observed in the uppermost mantle: the velocities change from the normal 8.0-8.2 km/s to 8.3-8.5 km/s in some blocks of the Siberian Craton and of the Urals. At a depth of 100-150 km two large anomalies are observed: the old and cold cratons have higher velocities than the young West-Siberian Plate with higher heat flow. This velocity difference is observed down to 200-250 km. No indication is observed on asthenosphere, predicted at depths of 200-250 km from the heat flow data. Low velocity layers, however, are revealed at depths of 80-120 km.

TCM-P09

THE STRUCTURE OF MOHO BOUNDARY FOR RUSSIA, ADJOINING REGIONS & SEAS

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The schema of Moho interface for Russia, the adjoining regions and seas was formed using the result of seismic reflection and refraction methods on more than 250 liens and another geophysical date. The integration of this schema and geological data shows the common regularity of Moho for the major geological structures. For the most part, the tectonic areas are characterized by nearly homogeneous normal distributed earth crust thickness. The average for the continental part is nearly 42 km, for shelf -32 km and for ocean zones - 18 km. Maximum thickness is marked in the areas of Uralide-Mongolian orogen (more than 50 km) on the one hand, and the shields of the ancient platform (56-66 km) on another. For the ancient platform overall average thickness of the crust is 36-44 km, for the West Siberian basin it is only 32-36 km, in the modern shelf regions it decreased to 24-32 km/and in the ocean part it changes from 25 to 15 km. To discuss the detail of Moho interface structure in the continental part of Russia we used the schema of velocity on this level and the mordent data. The transect cross the East-European Platform, the south part of Siberian platform and the North-West of Russia.

Subduction structures of megathrust zones

SSM-P01

DEVELOPMENT OF HORST–GRABEN STRUCTURE AT THE IZU-BONIN (OGASAWARA) TRENCH

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Horst–graben structure is the most important factor to cause subduction erosion. In and around the Izu–Bonin (Ogasawara) trench (IBT), the detailed development system of horst–graben structure has not been well-resolved yet. The purpose of this study is to obtain a clear seismic depth section across the IBT by re-analyzing multi-channel seismic data, and consequently reveal a development system of the horst–graben structure. The depth section obtained could provide an ever unavailable image of a whole horst–graben structure on the Pacific plate behind and beyond the IBT. The section shows that normal faulting begins about 70km eastward of the IBT, and makes a high relief between horst and graben. The oceanic sediments lying on horst terrain become thin as approaching to the IBT, because they progressively fall into the adjacent graben. Beyond the IBT, horst–graben structure on the subducting plate can be still traced. Although it is ambiguous whether or not relief of the horst–graben develops, the full graben fills seem to be compacted due to increasing lithostatic pressure. Appearance of space in the graben due to the compaction presumably facilitates subduction erosion to remove material from base of the upper plate. In addition, development of accretionary prism cannot be identified distinctly. These suggest that subduction erosion is more predominant than accretion at the IBT.

SSM-P02

CRUSTAL STRUCTURE BENEATH THE SOURCE REGION OF M7-CLASS EARTHQUAKES OFF IBARAKI PREFECTURE

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A region off Ibaraki Prefecture, an eastern part of Japan, is one of the high seismicity regions along the Japan Trench where the Pacific Plate is subducting at a rate of 8-9 cm/yr. It has been known that M7-class earthquakes occurred in the region with a fairly constant recurrence period of 20 years. The last event of such earthquakes occurred on July 23, 1982. It has been proposed by observing the

seafloor topography that subducting seamounts may work as an asperity. We conducted an active-source seismic survey using ocean bottom seismometers to reveal correlations between the crustal structure and the size and location of the source region that has been estimated for the 1982 event. The resultant crustal structure delineates subduction of the Pacific plates, and shows along-trench heterogeneity that may be ascribed to subduction of seamounts.

SSM-P03

QUASI-3D IMAGE OF THE ASEISMIC SLAB OF THE PHILIPPINE SEA PLATE BENEATH THE NORTHWEST OF IZU-TANZAWA COLLISION ZONE

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It is well known that an aseismic region is widely distributed between 20 and 70 km in depth in the northwestern part of the Izu-Tanzawa Collision Zone (Kasahara, 1985; Ishida, 1992). Does the subducting slab of the Philippine Sea plate really exist in the aseismic region? If it exists, why is the slab aseismic? These problems have been controversial for a long time. Two seismic surveys were carried out in the northwestern part of the Izu-Tanzawa collision zone: The Special Project for Earthquake Disaster Mitigation in Urban Areas (Daidaitoku 2005) with the 88-km-long survey line passing through the aseismic region from southeast to northwest, and the Seismic Survey across the Itoigawa-Shizuoka Tectonic Line (Itoshizu 2005) with the 40-km-long line through the northern part of the region. Daidaitoku 2005 presents firstly the prominent image of the slab subducting down to 40km in depth and gives at last a clear solution that the subducting slab really exists although it is aseismic (Sato et al., 2006; this symposium). Since all strong shots of Daidaitoku 2005 were recorded along the line of Itoshizu 2005 almost perpendicular to that of Daidaitoku 2005, CMP were distributed widely between the two lines covering the northern part of the aseismic region. Thus the quai-3D image of the aseismic slab is obtained, which gently dips northward or northwestward down to about 50 km deep. The image must provide new essential information to discuss the Izu-Tanzawa collision zone.

SSM-P04

TIPTEQ 2005 NVR – ATTEMPT OF DATA-DRIVEN TRUE-AMPLITUDE PROCESSING

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The amplitudes of a seismic wave are influenced by numerous different factors on its way from the source to the receiver, such like e.g.: source strength and coupling, spherical divergence, reflectivity and transmissivity, reflector geometry, scattering, absorption, interferences, multiples, recording configuration and parameters, geophone sensitivity and coupling, superimposed noise, etc. When carrying out the seismic processing most of these factors are in general quantitatively more or less unknown. Moreover, they superimpose each other making it difficult to separate their effects and correct for them appropriately.
Therefore, during conventional reflection processing in most cases a very robust scaling process called AGC (automatic gain control) is routinely applied before stacking to enhance low amplitudes and to level down high amplitudes – the advantage is, that all amplitudes become equally weighted delivering a well-balanced image, but the disadvantage is also, that noise can be drastically increased, and that the true reflectivity of the structures, which might contain valuable information for the interpretation, gets lost.

We will present a method that allows to correct for amplitude changes with time and distance by separating them into two portions, one representing the systematic, constant or slowly varying background model (including spherical divergence, absorption, shot and geophone parameters, transmission loss, etc.), the other one representing the more randomly and strongly varying amplitude changes (assumed to consist mainly of the local reflectivity which is impressed on the background model). The method is fully data-driven on a trace-individual base and corrects each trace in such a way, that it gets equivalent to its stacking partners without the disadvantage of an AGC (loss of dynamics, shadow zones around strong reflectors, ...).
The explosive near-vertical seismic reflection survey TIPTEQ 2005 investigates the subduction zone below southern Chile. These data offer an exceptionally strong reflectivity along the entire profile and at all depth ranges. In comparison with the AGC-processed section the True-Amplitude version shows a much higher amplitude dynamics and may allow estimations of relative reflection coefficients for different reflectors.

SSM-P05

REFLECTION SEISMIC SURVEY ACROSS THE SEISMOGENIC COUPLING ZONE IN SOUTHERN CENTRAL CHILE AT 38° S (PROJECT TIPTEQ)

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A 110 km long seismic line was shot in southern central Chile within the project TIPTEQ (from The Incoming Plate to mega-Thrust EarthQuake processes) at 38.2° S. The profile spans from the coast over the down-dip end of the seismogenic coupling zone and crosses the hypocenter of the 1960 Valdivia earthquake. We present a structural image and an interpretation of the subduction zone in the survey area. A first-break tomographic velocity model helps to improve the existing wide-angle velocity model at this latitude (SPOC 2001 experiment) for an advanced migration image. The subducting Nazca plate can be traced from a depth of 25 km below the coast down to a depth of 50 km at the eastern end of the profile. A subduction channel may be interpreted directly above the plate interface with a varying thickness of up to 5 km. The continental crust exhibits highly reflective bands with an average thickness of 2-3 km, dipping at various angles. Broad arching structures argue for basal accretion and subsequent uplift of material, dated by isotope tectonochronology and simulated in analogue sandbox experiments. Between depths of 5 to 25 km several bright reflectivity spots can be seen in the upper plate, which may suggest fluid traps in the accretionary wedge. The tomographic velocity model covers max. 15 km in z direction and can, therefore, extend surface geology studies within project TIPTEQ towards depth. The sediment thickness of the sedimentary basins in the Central Valley reaches approx. 3km, and we see prominent fault systems like the Lanalhue fault zone also in the tomographic model.

SSM-P06

REFLECTION SEISMIC IMAGING OF THE SUBDUCTION ZONE IN SOUTHERN CENTRAL CHILE

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See abstract SSM-O01

SSM-P07

A MCS-OBS SURVEY OF THE GREAT 1906 ECUADOR-COLOMBIA EARTHQUAKE

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Multichannel seismic reflection (MCS) and wide angle seismic data (OBS) were collected across the rupture zones of the 1906, 1958 and 1979 Ecuador-Colombia subduction earthquakes to investigate the nature of the seismic barrier seaward and between the 1958 and 1979 earthquake rupture zones, and examine causes for the 1979 earthquake seismic asperity. MCS and bathymetric data show evidences for the margin wedge to be segmented by inherited transverse crustal faults that correlate with the limits of co-seismic slip zones. The Manglares fault cuts transversally through the margin and correlates with the limit between the 1958 and 1979 rupture zones. The fault, which is considered as a weak mechanical barrier to elastic strain release, allows local, high-stress concentration on the plate interface during the earthquake cycle. A mega-thrust splay fault that cuts through the fore-arc basement and passes laterally to a steeply dipping reverse fault is proposed to have controlled the seaward rupture of the 1958 earthquake. Wide-angle data were collected along OBS dip and a strike lines cutting through the area of the 1979 earthquake seismic asperity. Arrival times of refracted and reflected waves were 2D-modeled to construct a velocity model for each line. At the intersection of the two lines, wide angle data show evidence for intra-margin basement reflections, and exhibit higher P-wave velocities than further seaward and southward along the margin. These observations were modeled as a ~10-km-thick basement body with a 6-6.5 km/s P-wave velocity, bounded by velocity discontinuities at its base and top. The body coincides with extensive crustal shortening, outlined by thrust faulting and folding supporting a relatively strong interplate coupling.. The high-velocity body, which coincides with the 1979 seismic asperity, may relate to crustal heterogeneity inherited from the pre-subduction history of the oceanic terranes that form the Ecuador-Colombia margin.

SSM-P08

THERMAL VARIATION, TECTONIC SEGMENTATION AND SEISMIC RUPTURE ZONES ALONG THE N ECUADOR – S COLOMBIAN MARGIN.

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Along the N. Ecuador – S. Columbian margin (1-4°N), we conducted seismic and thermal experiments to investigate the relationships between seismogenesis and thermal structure along the plate boundary. The margin is divided in morphotectonic segments with different tectonic and structural patterns. The dip of the Nazca subducting plate is 40% higher beneath the deformation front of the central segment than the others segments. Three megathrust events occurred in 1942, 1958 and 1979 with rupture zones abutting one another and bounded by barriers that also limit the morphotectonic segments. The seismogenic zone, defined by the thrust seismicity, reaches the trench beneath the central segment whereas it is restricted ~20 km landward beneath the other. Numerous heat flow measurements and estimations from BSR show that each morphotectonic segment has a specific thermal regime. The heat flow is anomalously low in the central morphotectonic segment. Finite-element thermal models carried out for each segment show that: (1) The along-strike heat flow variations are mainly due to the variations in the incoming Nazca plate dip and the related sediment thickness in the trench: a steeper dip beneath the central segment cause downward heat loss by advection and thus a lower heat flow. (2) The updip limit of the seismogenic zone corresponds to isotherms 60-70°C in every segments. The variations in the distance between the updip limit of the seismogenic zone and the trench, from a segment to another, is mainly due to the variation in the underthrusting plate dip. Thus the along-strike variations in the downgoing plate dip is a key parameter to explain the thermal segmentation of the margin and the related variation of the seaward extension of the seismogenic zone.

SSM-P09

SEISMIC REFLECTION IMAGING OF THE SUBDUCTION DECOLLEMENT, HIKURANGI SUBDUCTION ZONE, NEW ZEALAND

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Beneath the eastern coastline of North Island, New Zealand, the subducted Pacific plate dips at less than 3 degrees to the northwest and is at a depth of less than 15-km. This shallow geometry is

optimum for detailed geophysical studies of the subduction decollement, using both active-source and passive-source experiments. In March-May 2005 a new industry-seismic survey, 05CM, was undertaken offshore of the east coast, primarily to identify hydrocarbon plays, but also to seismically image the subducted plate. Over 2800 km of data were recorded along the margin. The original specification for the survey called for a 12km streamer length and 12 second record, so that the subduction decollement could be imaged. As the survey progressed, repeated and violent attacks by sharks caused considerable damage to the survey equipment. However, the grid of reflection data is sufficient to reveal first order structural features along the Hikurangi margin, marking the transition from a coupled plate interface in the south to decoupled in the north.

SSM-P10

SUBDUCTION STRUCTURE OF THE NANKAI TROUGH SUBDUCTION SEISMOGENIC ZONE, RELATED TO INTRASLAB EARTHQUAKES

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The Nankai Trough is a unique subduction zone because the recurrence intervals of M8 class earthquakes and the segmentation of rupture zones are well documented on the basis of geophysical, geological and historic data. In 2004, large intraslab earthquake (Mw7.5) occurred southeast off the Kii Peninsula. To understand the genesis of such intraslab earthquakes and its relation to large interplate earthquakes as well as to obtain an entire structural image of Nankai Trough subduction seismogenic zone, a wide-angle reflection/refraction survey across the coseismic rupture zone of the Tonankai earthquake was conducted in 2004. This research is part of 'Structure research on plate dynamics of the presumed rupture zone of the Tonankai-Nankai Earthquakes' funded by Ministry of Education, Culture, Sports, Science and Technology. The result of structural image shows a bit thicker oceanic crust (>8km) subducting landward, and the existence of oceanic sub-Moho reflectors in the uppermost mantle. The aftershocks are distributed within the oceanic crust and the uppermantle, which is not consistent with the estimated fault plane of main shock. Comparing the structural image with this aftershock distribution, the depth of the oceanic sub-Moho reflectors and the aftershocks within the uppermantle are both distributed around 20km. The uppermantle seismicity at the similar depth in this region is also revealed by our offshore observation of microseismicity. We consider that such sub-Moho reflectors may become a seismic fault of intraslab earthquakes.

SSM-P11

REGIONAL VARIATION OF THE VELOCITY STRUCTURE IN THE NORTHERN JAPAN TRENCH SUBDUCTION ZONE

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In the northern Japan trench subduction zone, many destructive earthquakes as well as microearthquakes have occurred owing to the subduction of the Pacific plate beneath the northeastern Japan island arc. Although the distribution of interplate earthquakes shows strong regional variations, the eastern limit of large interplate earthquakes is located approximately 70~80km west of the Japan trench.

In this region, we have conducted several seismic refraction experiments using OBSs (Ocean Bottom Seismometers) and airguns during the last decade. P-wave velocity structure models obtained by the traveltime inversion show regional variations, and some features such as the thickness of shallow sediment layers correlate with the regional variations of the distribution of the large interplate earthquakes. In addition, we found bending points of the subducting Pacific plate in all the three east-west lines that are almost perpendicular to the trench axis by applying the traveltime mapping method. These bending points are located around 143.5E and we can define a bending axis by connecting bending points. The bending axis is roughly parallel to the trench axis and approximately coincides with the updip limit of the rupture zones of large interplate earthquakes. P-wave velocities

of the upper plate vary across the bending axis, implying that the position of the bending axis is closely related to physical properties of the upper plate and to seismic activities.

Numerical modeling of heterogeneity and anisotropy

NHA-P01

SEISMIC IMAGING OF CONTINENTAL LOWER CRUST – ASPECTS, INSIGHTS, POSSIBILITIES

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Near-offset reflection profiling has revealed a complex structure for the mature continental lower crust. A stochastic parameterisation has been shown to be appropriate for such a medium - both from geological and simulation exercises. Seismic imaging of lower crust is still mostly done under the assumption of single scattering. Possible artefacts resulting from wave-propagation in complex media are therefore interesting and merit careful investigation.

We present results from a series of visco-elastic simulations of wave-propagation in a bi-modal "lower crust" obtained from an original 2-D von Karman medium. The "observed" source-gathers thus include effects due to wave-type conversion, attenuation and multiple-scattering. The simulations are later repeated with noise added. Near-offset traces from such simulations are then used for "imaging" the complex medium with industry standard migration algorithms.

The result - somewhat surprising - shows that conventional seismic imaging is robust, even without accurate velocity information. Pre-stack migrations using both Kirchhoff- and finite-difference techniques yield comparably good results. The same applies also to the recovery of the stochastic papameters associated with the medium. Application of the latter include possible characterisation of the lower crust into separate units, each with its distinct evolutionary history.

NHA-P02

THERMOBARIC SEISMIC STRATIFICATION OF THE LITHOSPHERE

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Experimental studies of the elastic and density parameters of a broad spectrum of rocks and minerals at high P and T have established complex relations of their changes with depth. The thermobaric parameters in the experiments change according to their values in the Earth's crust of the specific regions. On the V_p,V_s=f(PT)=f(H) curves zones of their inversion are detected and low-velocity zones are distinguished. The data of a petrophysical modeling based on the comparison of the experimental relations V_p,V_s=f(PT)=f(H) and explosion seismology materials suggest seismic anomalies of thermobaric nature at depths of 10-20 km in the Earth's crust. More actively the seismic thermobaric stratification of the lithosphere is manifested for acidic and intermediate rocks. The anomalous horizons of the lithosphere are featured by low Young's and shear moduli, high brittleness, high compressibility. X-ray and electron-microscopic studies of rock samples exposed to P and T corresponding with depths of anomaly zones indicate the violation of the intergranular boundaries in the rock, the dislocation density of the rock-forming minerals increases, other structural disturbances of the rock favouring its discompaction are marked. The further "plunge" of the rock to greater depths, i.e. the PT-parameter increase in experiments leads to structural perfection of the mineral medium and forms seismic reflection after the discompaction zone. We think that these zones of abnormally low elasticity are a domain of most active tectonic disturbances and crustal earthquake foci.

NHA-P03

2-D INVERSION FOR CRUSTAL ANISOTROPY IN THE TRANS-EUROPEAN SUTURE ZONE, SE POLAND, BASED ON SEISMIC DATA FROM CELEBRATION 2000 EXPERIMENT

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Analysis of data from CELEBRATION'2000 experiment in SE Poland reveals azimuthal variation of the crustal Vp velocity, unlikely to be explained by a common model with a local velocity anomaly. This phenomenon is explained by seismic anisotropy of the upper crustal rocks in the Małopolska and Łysogóry units. The azimuthal dependence of the traveltimes of the Pg phase was analysed in order to prove this hypothesis. Assuming TI approximation, an inversion of available traveltimes was performed in order to determine the amount of anisotropy, using 1-D and 2-D delay-time method. Obtained results indicate that the Vp anisotropy amounts to about 10%, with fast axis trending at azimuth of approx.110 deg. The result is consistent with the geological data from the area, where tightly folded (dip 40-80 deg) metapelites of Neoproterozoic and younger age were reported at depths of few km and deeper. Fast axis direction coincides very well with azimuth of outcropping folds axes and other deformational structures. Therefore anisotropy is interpreted as the effect of collisional deformations at the EEC margin. In order to assess the credibility of obtained anisotropy parameters, synthetic tests have been performed. The tests consisted of generating synthetic traveltimes for several variants of isotropic and anisotropic models and subsequent inversion using anisotropic delay-time method to check if artificial anisotropy can be obtained by inverting data generated by isotropic medium. The tests indicate that realistic velocity inhomogeneities can account only for small part of observed azimuthal traveltime variations. Therefore, the modelled anisotropy cannot be an artifact resulting from inhomogeneous upper crust.

NHA-P04

STRUCTURE BENEATH SUDETES MOUNTAINS FROM ACTIVE SEISMIC EXPERIMENTS - 2D AND 3D CRUSTAL MODELS AND THEIR UNCERTAINTIES

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During the last decade four large seismic refraction and wide angle reflection experiments (POLONAISE'97, CELEBRATION 2000, ALP 2002 & SUDETES 2003) has been performed in Central Europe. These experiments cover the area of different types of the crust, from East European precambrian craton in the north, trough Trans-European Suture zone and Paleozoic platform to Alpine and Carpathian orogens in the south. We present detailed analysis of selected profiles across Sudetes Mountains obtained with 2D ray-tracing technique and travel times tomography of first arrivals and joint refracted and reflected waves. Prepared profiles show the structure and tectonic interpretation of the crust and uppermost mantle. For the area with dense net of profiles the 3D travel times inversion were performed. In the latest 3D interpretation for the area of Sudetes Mountains and Bohemian Massif we used inversion package JIVE3D which use travel times of both refracted and reflected waves. Beside of multilayer 3D model of the structure we present detailed uncertainty analysis for both depth of boundaries and velocity field. It is interesting, that obtained uncertainties strongly depends on inversion path (order of phases used in inversion).

Innovative seismic acquisition and processing techniques

IAP-P01

HOW TO MAKE TURNING RAY TOMOGRAPHY INVERSION?

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The Middle Urals region has been widely studied with geophysical methods over the past decades. An integrated program is in progress to summarize this knowledge including modern reprocessing of controlled source seismic data. We have access to a number of reflection seismic lines as well as to the wide-angle DSS data. The purpose of reprocessing wide-angle (refracted wave) data with turning ray tomography methods are: (1) – to confirm previously recovered velocity models, (2) – to investigate if the tomography approach gives some new information and (3) – to obtain mean velocities to be used in reflection seismic data processing.
Sources and receivers in most wide-angle experiments were followed latitudinal line and the profiles could be roughly assumed to be straight lines. Since the results from tomographic inversion have to be compared with previous velocity sections along the profile it was of interest to perform the inversion in 2D, as well as in 3D, and compare the results. We obtained different velocity structures for depending upon whether the inversion was done in 2D or 3D. For 2D inversion we obtained higher amplitude and deeper anomalies than for 3D. Reasons for this difference (wrong projection technique or forward/inverse algorithm problems) are currently under investigation. Although artifacts resulting from processing along crooked lines are common knowledge and discussed elsewhere, 2D algorithms are still extensively used due to their availability and fidelity. In particular, straight lines are assumed in marine seismics with streamer deviations and OBS generally not accounted for. The studies presented here may aid in properly handling tomographic inversion of this type of data.

IAP-P02

FINITE-FREQUENCY TRAVELTIME TOMOGRAPHY FOR ACTIVE-SOURCE SEISMIC DATA

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See abstract IAP-O01

IAP-P03

FRESNEL-VOLUME-MIGRATION OF DEEP SEISMIC REFLECTION DATA

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IAP-P04

PRESTACK IMAGING OF TELESEISMIC BODY WAVES: A COMPARISON OF RECEIVER FUNCTION ANALYSIS AND SEISMIC INTERFEROMETRY

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See abstract IAP-O04

IAP-P05

WIDE-ANGLE SEISMIC ACQUISITION WITH DIGITAL ACCELEROMETERS FOR THE IMAGING OF SEISMOGENIC AND ACTIVE-FAULT SYSTEMS

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The deep geometry of active faults and the mid-crustal detachment at the base of seismogenic layer is important for understanding active tectonic process and accessing the risk of destructive earthquakes. To investigate the deeper extension of active faults within the seismogenic layer, we conducted a seismic reflection profiling experiment across the western marginal faults of Kitakami lowland, northeast Japan. The combination of telemetry and independent recording system has provided the deployment of wide-angle survey line with dense seismic array. The simultaneous data acquisition of regional refraction, low-fold wide-angle reflection and dense reflection survey has been optimized by the integration of vibrator source focused on effective low-frequency bandwidth of sweep signal and the three-component digital sensors with broader frequency responses. The seismic profile demonstrates the potential capabilities of wide-angle acquisition scheme with three-component digital sensors for deep seismic imaging of crustal structure. The images of the deeper extension of active faults estimated through CMP stacked profiles using digital sensors and conventional 4.5Hz/10Hz geophones will be compared.

IAP-P06

MULTICHANNEL SEISMIC IMAGING OF THE MEDITERRANEAN OUTFLOW WATER PATTERNS IN THE GULF OF CADIZ

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Multiseismic imaging is becoming a new tool for oceanographic research. Relatively recent investigations show that conventional Multichannel Seismic (MCS) profiling enables producing high-lateral resolution images (~10 m) of the internal oceanic structure. Coincident seismic and hydrographic data indicate that seismic reflectivity is sensitive to abrupt temperature (and salinity) contrasts of less than ~0.05° C (0.01 psu) with a vertical resolution of ~10 m, therefore providing a well-suited tool to image the oceanic fine-structure in great detail. The Mediterranean Undercurrent (MU) salt tongue is a well-known, prominent hydrographic feature that originates in the Mediterranean Sea, overflows the Strait of Gibraltar, flows westwards following the continental slope of the Iberian margin, and equilibrates at 800-1200 m deep. Warm and salty lenses separate from the MU as clockwise rotating eddies (Meddies), typically with 50-100 km diameters and salinity and temperature anomalies reaching 1 psu and 4° C respectively. Specific seismic processing flows have been developed to image the MU. This include: tau-P and frequency filtering, wavelet deconvolution, NMO correction, stacking and post-stack depth-migration. The quasi- 3D geometry of the MU in the Gulf of Cadiz has been followed using four MCS transect acquired in September 1993 within the IAM project. Sequences of prominent, seaward dipping reflectors stuck to the Iberian continental slope depict the top, bottom and internal stratification of the MU. A set of finely stratified (layer thickness of ~10 m), concentric reflectors forming a ~60 km-wide and ~1 km thick elliptical lens, that we associate to the presence of a Meddy, may also be observed. Additionally, a number of out-of-sequence, steeply dipping reflectors that might correspond to the propagation of internal waves is also imaged.

IAP-P07

IMAGING STEEP DIPS: EXAMPLES FROM AUSTRALIAN SEISMIC SURVEYS

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See abstract IAP-O06

IAP-P08

ADVANCES IN PROCESSING: 2005 TANAMI SEISMIC SURVEY, AUSTRALIA

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The 2005 Tanami Seismic Survey consisted of 720 km of deep crustal seismic reflection data acquired along 4 lines, and represented an improvement in hard rock seismic data processing in Australia. The processing sequence was aimed at obtaining a high quality image of the crust from Moho to surface, with particular emphasis on imaging shallow features and steeply dipping reflectors. The key processing steps included refraction and automatic residual statics, spectral equalisation, detailed velocity analysis pre- and post-DMO, and omega-x post-stack time migration. Near surface features, including base of regolith, were better imaged using a floating datum technique, separating the total shot and receiver refraction static for each trace in a CDP gather into a mean CDP static and a residual CDP static. Only the residual CDP refraction static was applied prior to velocity analysis and automatic statics calculation, while the mean CDP refraction static was removed following coherency enhancement after migration. Crooked-line 60-fold acquisition necessitated offset regularization of CDP gathers pre-DMO. The regularization technique employed trace interpolation based on dip coherency which had the dual advantage of improving signal to noise, and normalizing amplitudes in low-fold areas, thus reducing migration smiles.

IAP-P09

METHODOLOGY OF OFF- AND ONSHORE JOINT SEISMIC PROFILING: AN EXAMPLE OF BOSO 2005 EXPERIMENT CONDUCTED IN THE SOUTHERN PART OF THE BOSO PENINSULA, JAPAN

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There are severe difficulties in the conventional seismic reflection method in order to obtain deep seismic images along coastal zones where sandy beaches are developed. The first difficulty is that the onshore source energy is apt to be considerably attenuated by thick sand layers. The second is that only short hydrophone cables are permitted to be used offshore because of coastal fishery activities. As the Boso 2005 Experiment (Tsumura et al., 2006; this symposium) had the same difficulties as mentioned above, the following off- and onshore joint seismic profiling technique was applied; air-guns were shot at 50-m intervals along the 60-km-long shot line about 1 to 2 km offshore nearly parallel to the coast, and off-line recorders with 50-m interval 6 geophones were set up at about 300-m intervals along the 50-km-long onshore receiver line. This off- and onshore joint seismic profiling technique made it possible to transport effectively the source energy to the deep and to prepare the long seismic line. However this technique inevitably made CMPs distribute widely compared with the conventional reflection method, due to the configuration of shot and receiver lines. Furthermore the two lines do not run across the structural trend at high angle. These conditions suggest that the conventional processing method may produce obscure or no images of the deep structures. Thus the azimuth move out (AMO) method is tried to be applied in the southern part of the experiment. The trials make original reflectors of the conventional method emerged clearly at TWT 3.0 to 5.5 sec and

above it. The AMO method must make clear the overall structure of the subducting Philippine Sea plate (PHS), as well as that of the thrusts branching from the upper surface of PHS.

IAP-P10

ENGINEERING APPLICATIONS OF HIGH-RESOLUTION SEISMIC TECHNIQUES: TUNNEL DRILLING

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Seismic methologies has been succesfuly used in different civil engineering applications. Underground construction projects (subways, tunnels, etc), require detailed characterization of the rock massif, including information of the structural and physical properties for an optimal planning and execution. Seimic reflection and/or tomographic images provide detailed 2D or even 3D information of the subsurface that can not be obtained with conventional geotechnical methods used in these kind of projects (for instance, core interpretation o borehole geophysics). These seismic techniques, including 2D seismic reflection profiles and 3D first-arrival seismic tomography were used for tunnel design in two different areas. Two seismic data acquisition experiments have been carried out to test if these seismic methods could be used as a prediction tool for horizontal drilling. High-resolution seismic techniques were applied to the investigation of the subsurface structure along the trace of a tunnel for the projected high-speed train. The tunnel crosses a complex region of Variscan deformation in northern León (Spain). The area is underlined by Paleozoic rocks deformed within two thrust sheets corresponding to the thrust systems of the southern Cantabrian Zone. In addition, the area includes several, brittle, high angle fractures and a thick cover of fluvioglaciar deposits across a rugged topography. The high resolution study included borehole geophysics and a 2.12 km long seismic profile. The results indicated that a 3 m thick layer of weathered rocks at the surface, together with the large variability of the topography caused a great dispersion of the seismic energy. And the images were not well resolved. Nevertheless, the convined results revealed that at tunnel projected depth a 150 m long carbonate layer (Láncara Fn) would be encountered. A seismic tomography study was carried out in the city of Barcelona (Spain), in order to image the subsurface for the construction of a new subway line. The city is densely populated and good quality seismic data is very difficult to acquire in this environment, due to the existence of background noise (car traffic, electricity, etc), and the complex shallow subsurface (buiding fundations, sewage systems, watter supply, etc). The tomographic images were abe to resolve subvertical structures, faults and porphyric dykes, that control the geometry of the weathered surface layer characterized by a variable thickness and a very low seismic velocity.

IAP-P11

INTEGRATED SEISMIC IMAGE USING CONVENTIONAL MCS AND WIDE-ANGLE REFLECTION OBS DATA

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Multichannel seismic reflection method (MCS) using airgun and hydrophone streamer is able to image the shallow structure towards sediments and acoustic basements, whereas there are some weak points: offset distance of recording signal is limited by the streamer length and recording signal is influenced by the sea conditions because streamer locates sea surface. On the other hand, structural surveys using ocean bottom seismometers (OBS) have conducted frequently and used to reveal the velocity model based on traveltime information. There are some merits of OBS survey: the recording condition is

better than MCS because of sea bottom, the long offset distance and wide-angle recording survey is possible, and OBS records vertical and horizontal components. Integrated seismic image using airgun-OBS and MCS data is expected to be a powerful method to reveal the physical properties at the plate boundary of seismogenic zone and at the deep interfaces related with the arc growth model. To utilize the integrated image, we have developed the software to clear the different recording situations. Moreover, we have examined the pre-processing of input data. In this presentation, we will present the outline of the integrated seismic image using OBS and MCS data in the Japan Trench subduction zone.

IAP-P12

TOWARDS INTEGRATED OPEN-SOURCE COMMUNITY GEOPHYSICAL SOFTWARE FOR CRUSTAL STUDIES

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With wide spreading of modern object-oriented programming techniques, integration of the key geophysical software in a broadly acceptable framework becomes feasible. As it is proven by the success of the Linux development model, modular design and the use of common programming frameworks such as OpenGL and Qt allow easy collaboration of hundreds of developers, leading to abundance of reliable, high-quality software with 3D graphics and intuitive graphical user interfaces.

Although all researchers in crustal geophysics cannot adhere to a fixed code development style, it appears that several most broadly used packages could also benefit from integration into a common processing framework. Examples of such key packages include: 1) data acquisition; 2) travel time picking, ray tracing, and tomography; 3) seismic waveform modeling and inversion, 4) post- and pre-stack migration, 5) potential-field processing and inversion, and 6) publication-quality graphics. The advantages of such integration would include: streamlined data handling, input/output, access to basic seismic processing, common parameterization, graphical user interfaces, 3D visualization, web and online documentation, uniform and automated software distribution and maintenance.

I suggest that with a limited yet focused effort (e.g., sponsored by IRIS) a powerful and flexible geophysical software package could be created to satisfy many of the software needs of the crustal research community. To illustrate the potential benefits of such an effort, we have ported the popular 2-D ray tracing program *rayinvr* by C. Zelt, adding true interactive operation and 3-D visualization performed in the spherical-Earth geometry. The display uses coastline and other geographic data directly obtained from GMT databases and could also include gravity inversion, travel-time tomography, results of finite-difference waveform modeling, as well as any other information specified by the user.

IAP-P13

EFFECTS ON CONVENTIONAL AVO ANALYSIS OF WOLLASTON LAKE REFLECTOR, TRANS HUDSON OROGEN

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The amplitude-versus-offset (AVO) analysis of seismic reflection data has been widely used in predicting oil and gas reservoir in industry (Hilterman,2001). It can also help to reveal the nature of a reflector a powerful tool in the analysis of deep crustal bright spot (Juhlin, 1990; Makovsky and Klemperer, 1999; Ma and Morozov, 2004). Conventional AVO analysis is based on plane wave assumption and utilizes full Zoeppritize equation or linear approximation of Zoeppritize equation. However,the cylindrical wave modeling results fit the observed seismic data better than does plane wave modeling (Winterstein and Hanten,1985). Spherical wave AVO response is not considered in conventional AVO analysis. The observed vertical component of seismic wave reflection is regarded as full P-wave reflection in conventional AVO analysis as well. In order to study how the spherical wave AVO response and vertical component affect conventional AVO analysis in Wollaston Lake Reflector (WLR) bright spot reflectors, we utilize reflectivity method (Fuchs, 1968; Fuchs and Miiller, 1971) and full Zoeppritize equation to compute spherical wave and plane wave AVO response. Elastic parameters of geological model and data examples come from WLR (Mandler and Clowes, 1997;Ma and Morozov,2004). Different surface layer models such as high and low velocity models are selected in our reflectivity models to simulate different surface conditions. Thin and interbed of WLR reflectors in different depths are included in our reflectivity models. Then, AVO analysis is done on true amplitude processed synthetic seismogram using full Zoeppritize equation and linear approximation of Zoeppritize equation. Furthermore, AVO tuning and anisotropy AVO problems are analyzed in our study.

Seismic investigations for disastrous earthquake areas

SDE-P01

DEEP SEISMIC REFLECTION PROFILING ACROSS THE KINKI TRIANGLE ZONE, SW JAPAN: DEEP GEOMETRY OF DENSELY DISTRIBUTED ACTIVE REVERSE FAULTS

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The deep geometry of active-source fault system is significant for better estimation of earthquakes and strong ground motions. The Kinki triangle zone of SW Japan is marked by dense distribution of active faults. The deep seismic reflection profiling was undertaken from Osaka to Suzuka along a-120 km-long seismic line. The major target is to obtain deep geometry of active fault and a velocity structure. The main seismic source was four vibroseis trucks and dynamite shots. The upper surface of pre-Neogene is well detected beneath the Osaka plain on the west and Ise plain on the east, including reverse faults in the sedimentary basins with growth strata. Beneath the mountain range between these sedimentary basins, horizontal coherent reflectors at 16 km and 26 km in depth are recognized. The mid-crustal reflectors at 16 km in depth correspond to the base of the seismogenic zone. In the seismogenic zone, dipping reflectors, which correspond to possible deeper extension of active faults, are recognized. The dipping reflectors do not extend beneath the base of seismogenic layer and merge to the mid-crustal horizontal reflectors corresponding to the bottom of the seismigenic layer.

SDE-P02

DEEP STRUCTURE AND SEISMICITY IN THE KINKI DISTRICT, NORTHWEST JAPAN, AS REVEALED BY SEISMIC REFRACTION AND WIDE-ANGLE REFLECTION SURVEYS

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In order to elucidate the relations among crustal structures, seismic activities, active faults, and geologic structures, we analyzed three seismic refraction and wide-angle reflection survey records conducted in the Kinki district by using reflection and refraction analyses. The survey lines are (1) the 1989 Fujihashi-Kamigori profile line, (2) the 1995 Keihoku-Seidan profile line passing through the source region of the 1995 Kobe Earthquake (Mw6.8), (3) the 2004 Shingu-Maizuru profile line. To determine the depth of the Moho, we also use the travel-time data of (4) the 1963~1964 Kurayoshi-Hanabusa profile line. As these profile lines cross almost same area, we can obtain a 3-dimentional crustal structure of wide area uniquely. From the analyses of reflections, we can obtain detailed reflection images from the surface down to the upper mantle. For example, we can find the horizontal subducted Philippine Sea Plate at depth of 60-70km under the Japanese Islands.

Furthermore we find obvious reflectors at about 17km of depth, which is the lower cut off depth of the seismogenic layer in the crust and some north-dipping reflectors in the upper crust. From refraction analyses, we find the followings: (i) The P-wave velocities of the seismogenic layer is 6.0~6.4 km/s. (ii) Depth of the Moho under the Kinki district is about 35km and the oceanic Moho of the subducting Philippine Sea Plate is determined to be 7~10km under the plate boundary. (iii) Velocity variations in the surface layer seem to be well coincident with geological structures. (iv) The low frequency earthquakes occur near the intersection of the Moho and the top of the Philippine Sea Plate.

SDE-P03

SEISMIC REFLECTION PROFILING ACROSS THE ITOIGAWA-SHIZUOKA TECTONIC LINE, CENTRAL JAPAN: ACTIVE NAPPE WITH A HIGH SLIP RATE

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See abstract SDE-O03

SDE-P04

SEGMENTATIONS OF THE ITOIGAWA–SHIZUOKA TECTONIC LINE ACTIVE FAULT SYSTEM, CENTRAL JAPAN, INFERRED FROM SEISMIC TOMOGRAPHY

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The Itoigawa–Shizuoka Tectonic Line (ISTL) is a major geological boundary dividing NE and SW Japan. A large active fault system exists in subparallel with the ISTL, and has a potential of catastrophic disaster. Surface geology and seismic surveys suggest that the active fault system is divided into three regions, each of which shows a different dominant fault type of east-dipping reverse fault (north), left-lateral transverse fault (middle) and west-dipping reverse fault (south), respectively. To study a whole structure of the ISTL active fault system, we analyzed traveltime data combining microearthqake observations and refraction surveys using a seismic tomography method. The velocity structure obtained shows a supportive evidence for segmentations into three regions. Shallow parts in the north and the south regions show remarkable low velocity, while that of the middle region doesn't, except for some specific volcanoes. Moreover, the north low velocity locates eastward from the ISTL, while the south low velocity locates west-downward from the ISTL. Such different characters suggest that the segmentations would depend on different tectonic history in each region.

SDE-P05

SEISMICITY AND CRUSTAL STRUCTURE ALONG THE SOUTHERN JAPANESE ALPS SEGMENT OF THE ITOIGAWA-SHIZUOKA TECTONIC LINE

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The wide area along the Itoigawa-Sizuoka Tectonic Line (ISTL) is considered to be with one of the highest probability of a major event occurrence in the near future. In order to understand the active

tectonics that control the earthquake genesis mechanisms, it is essential to investigate the microseismic activity near the faults, the deep layout of active faults and the seismic velocity structure of the earth crust in the surrounding area. To reveal seismic activity, which may be related to the ISTL activities, we deployed 60 offline stations in the south-central part of the ISTL from 15 Sep. 2005 to 23 Dec. 2005. We manually repicked 348 M > 0.5 events published by the Japan Meteorological Agency (JMA) and reprocessed them using the Double Difference tomography method (Zhang and Thurber, 2003). The relocated events have lined up on a low / high Vp boundary between 5 to 20 km depth. The deeper extension of the ISTL in Southern Alps region seems to be the boundary between these low Vp and high Vp zones, which can be identified as the accretionary prism units and the Izu-Bonin arc sequences. The ISTL forms a thrust fault that dips approximately 45^0~55^0 towards the west. The seismicity in the area may occur on the deeper extension of the ISTL; and if so, this could be evidence that the deeper part of the geological ISTL is connected to the active fault at depth.

SDE-P06

INTEGRATED RESEARCH PROJECT FOR ACTIVE FAULT SYSTEM ALONG ITOIGAWA-SHIZUOKA TECTONIC LINE

Research Group for Active Fault System along Itoigawa-Shizioka Tectonic Line
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The 250-km long Itoigawa-Shizuoka Tectonic Line (ISTL), running with NS direction in Central Japan, is a major tectonic boundary between NE and SW Japan. The northern segment of the ISTL has been under a compressive stress regime since the late Neogene to form an active fault system with the largest slip rates (4-9 mm/yr), which is recognized as an earthquake fault with the highest risk. Multidisciplinary project on active fault systems along ISTL starting in 2006 is aimed to improve estimation on source properties of the forthcoming earthquake (occurrence time, magnitude etc.) and strong motions in populated areas. Together with these objectives, this project intends to reveal detailed crustal activities along ISTL. Several geophysical and geological researches have been undertaken, including seismic reflection survey, earthquake observation, magnetotelluric survey, GPS measurement, tectonic geomorphological survey, paleoseismological research and strong motion study. The most important finding so far obtained is the regional structural difference between northern and southern parts of ISTL. Namely, the active fault in the northern part shows a gentle eastward dip while a westward dip in the southern part, indicating the existence of clear segment boundary around the Suwa Lake. Such a result provides important constraint on the magnitude estimation for the forthcoming earthquake.

SDE-P07

DATA ACQUISITION FOR DEEP SEISMIC PROFILING IN MUNICIPAL AREAS - SUBSURFACE STRUCTURE SURVEY IN TOKYO METROPOLIS -

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Underground investigations of major sedimentary basins in Japan have been carried out by local governments for the purpose of earthquake disaster prevention. As part of this project, Tokyo metropolitan government has conducted reflection and refraction surveys in Tokyo area (Kanto basin) for three years. As difficulties of field data acquisition over densely populated areas, the reflection survey for a deep basin part in Tokyo has been considered to be impractical so far. By developing the data acquisition method, such as mid-night (concentrated) operation of Vibroseis, a large-scale

deployment of receiver array, use of wireless recorders, we could delineate a seismic basement deeper than 4,000m. The technique and some problems about the field data acquisition for deep seismic profiling in municipal areas will be discussed.

SDE-P08

REGIONAL CHARACTERIZATION OF THE CRUST IN THE TOKYO METROPOLITAN AREA, CENTRAL JAPAN

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SDE-P09

GEOMETRY OF ASEISMIC SLAB OF THE PHILIPPINE SEA PLATE AND CRUSTAL STRUCTURE OF THE IZU COLLISION ZONE, CENTRAL JAPAN

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Philippine Sea plate (PHS) is being subducted beneath Honshu island, Japan, associated with the collision of Izu volcanic arc. To identify the geometry of the mega-thrust on the upper surface of PHS is crucial to understanding the occurrence of earthquakes and estimate strong ground motions. Due to the lack of seismic activity along the slab of PHS in the northwestern part of Izu collision zone, presence of subducting slab is poorly understood. Deep seismic reflection profiling was carried out across the northwestern part of Izu collision zone for a 88-lm-long seismic line. Along the seismic line, high energy shots (explosives for 100 – 300 kg; 100 sweeps bay four vibroseis trucks) were recorded by 1752 channels deployed at 50 m interval. The outstanding feature of the stacked time section is north-dipping reflectors at 9 to 13 sec (TWT; 30 - 40 km in depth) in the northwestern part of the seismic line. These north-dipping reflectors appear down dip extension of north-dipping hypocentral zone ranging from 15 to 25 km in depth. These north-dipping reflections are interpreted as aseimic slab of PHS and probably corresponds to the lower crust of the Izu volcanic arc.

SDE-P10

HETEROGENEITY OF PHYSICAL CONDITIONS AND PROPERTIES ALONG THE UPPER SURFACE OF THE PHILIPPINE SEA PLATE OFF THE KANTO DISTRICT

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At the southern Kanto district, central Japan, the 1703 Genroku earthquake (magnitude M=8.2) and the 1923 Kanto earthquake (M=7.9) occurred on the subducting Philippine Sea plate (PHS). The offshore region is the place where various events including the largest aftershock of the Kanto earthquake (M=7.3), slow slip events, and repeating earthquakes occur. The analysis of crustal

deformation observed by dense GPS network shows large backslips off the Boso Peninsula, which indicates that the plate interfaces are locked now. We expect that these zones have different physical conditions and properties. In order to reveal them, we conducted multi-channel seismic reflection survey. In the obtained profile, upper surface of the PHS can be traced continuously, though reflection intensity changes greatly. The reflection intensity is strong at the basement of the sedimentary basin, weak at deeper portion with depths of 10 to 13 km, and moderately strong at depths of 13 km or more. The weak reflection zone is included in the area with large backslips and moderately strong zone overlaps with the slip area of slow slip events. The reflection intensity can be affected by physical conditions and properties at the discontinuity. The above observations suggest that those along the upper surface of the PHS are quite heterogeneous off the Kanto district. In comparison with some recent studies, the weak reflection zone might be an asperity of large earthquakes.

SDE-P11

CORRELATION BETWEEN GEOLOGIC STRUCTURE AND SOURCE FAULT OF THE 2004 MID-NIIGATA PREFECTURE EARTHQUAKE, CENTRAL JAPAN, REVEALED BY SEISMIC REFLECTION PROFILING

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To correlate the source fault and surface ruptures with individual geologic structures is crucial to improving seismic hazard assessments in areas of active folding. The 2004 Mid-Niigata Prefecture Earthquake (M 6.8) occurred in a folded zone of central Japan, provided exceptional opportunity to study the relationship between geologic structure and source faults. CMP-reflection profiling using four vibroseis trucks across the focal area and high-resolution shallow seismic surveys across the surface ruptures and active faults were carried. The seismic reflection profile portrays an asymmetric anticlinorium with a steeply dipping eastern flank. According to the aftershock distribution, high-angle west-dipping reverse fault is located beneath the main anticline. The shallow seismic reflection profile suggests that the surface ruptures in the eastern margin of the anticlinorium occurred along the pre-existing emergent thrust. The formation of the main geologic structure is well explained by high-angle reverse faulting beneath the main anticline and low-angle thrusting in the shallower part. Seismic reflection sections across the south of the focal area show a west-dipping homoclinal structure produced by west-dipping reverse active fault at the eastern edge of the uplifted zone. The extent of rupture associated with the 2004 Mid-Niigata Prefecture Earthquake was strongly controlled by the pre-existing geologic structure.

CDE-P12

SEISMIC STRUCTURES AROUND FAULT ZONES OF TWO NORTHERN MIYAGI EARTHQUAKES IN 1962(M6.5) AND 2003(M6.4), NORTHEASTERN JAPAN

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Northern Miyagi prefecture was often struck by hazard earthquakes. We compare seismic structures around fault zones of the 1962 (M6.5) and 2003 (M6.4) events of Northern Miyagi earthquakes. Both sections show westward dipping reflectors which are located at respective fault zones traced by aftershock distribution. Geologically, this region was subjected to rapid EW extension in middle Miocene and then to EW compression after early Pliocene due to tectonic inversion. The inverted structure is clear in the section of the 2003 event area, however is not clear in that of the 1962 event area because of poor resolution in the shallower part. As for deeper part, the 1962 event area show clear reflective lower crust. Although data acquisition parameters in both areas were quite different and thus obtained seismic sections were different in resolution and penetration, essential geological features are very similar in both sections.

SDE-P13

SEISMIC REFLECTED WAVE FROM THE FAULT PLANE OF THE 2003 MIYAGIKEN-HOKUBU EARTHQUAKE

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We are interested in the relationship between distribution of coseismic slip or aftershocks and heterogeneity on a fault plane. The coseismic slip can be estimated by source process analysis, and aftershock distribution can be estimated from arrival times of seismic waves. However, it is not easy to estimate the heterogeneity on a fault plane. In September 2005, we executed a seismic reflection survey at Nango (currently Misato) in the north of the source region of the 2003 Miyagiken-Hokubu Earthquake. From the combination of the shots along NS-Line and the receivers on EW-Line, we might identify spatial distribution of strong reflection. As a result, reflected waves from the north end shot of the NS-Line are most clearly recorded on the EW-Line. In future, we are going to investigate the more detailed spatial distribution reflection.

SEP-P14

SOUTHESTERN CARPATHIAN FORELAND DEFORMATION IN RELATION TO THE VRANCEA SEISMOGENIC ZONE OF ROMANIA: RESULTS FROM PROJECT DRACULA

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See abstract SDE-O04

SDE-P15

SEISMIC EVIDENCE OF A THICKENED CRUST UNDERNEATH THE 2001 KUTCH (BHUJ) EPICENTRAL REGION, WESTERN INDIA

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Three short (20-35 km) seismic reflection profiles are presented from the immediate region of the 2001 Mw 7.7 Bhuj (western India) earthquake. These profiles image a 35-45 km thick crust that is highly reflective with strong, near horizontal reflections at all depths. The crust thickens by 10 km over a distance of about 50 km from the northern margin of the Gulf of Kutch to the epicentral zone of the earthquake. Whereas the Kutch tectonic framework dates to Mesozoic rifting associated with the break-up of Gondwanaland, the existence of a thick and high reflective crust (~45 km) at the epicentral zone may indicate crustal thickening due to the compressive regime of the past 40 Ma. Alternatively, a part of the crustal thickening might have happened due to rift-related mafic underplating during the earlier Mesozoic extensional regime, as evidenced by the presence of a high velocity (>7 km/s) lower crust in the epicentral region.

SDE-P16

ACTIVE AND PASSIVE SEISMIC IMAGING OF THE SAN-ANDREAS-FAULT-SYSTEM

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Recently high-quality active and passive seismic data have been acquired in the vicinity of the San-Andreas-Fault-System within the EarthScope project SAFOD. We have processed parts of the available data sets using newly developed techniques in order to derive a high-resolution image of the

subsurface in the vicinity of the fault system. On one hand we applied Fresnel-Volume-Migration to the SAFOD2003 reflection/refraction seismic data set and obtained a structural image of the region around the fault system from the surface down to about 10 km depth. The major feature is a bunch of steeply dipping reflectors in the vicinity of the surface fault trace. On the other hand we applied a migration-type location algorithm to passive seismic data recorded with the 3C receiver array in the SAFOD pilot hole.
These local earthquake hypocenters as well as the image from the active seismic survey are combined and together provide a basis for a combined interpretation of the seismic structure and the earthquake dynamics of this mega-shear zone.

Integrated multidisciplinary case studies

IMC-P01
JOINT INVERSION: THE PROPER WAY TO COMBINE DIVERSE GEOPHYSICAL AND GEOLOGICAL INFORMATION

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Conventional controlled-source seismic techniques does not provide a complete geophysical description of the subsurface. Missing information may be derived from gravity and magnetotelluric (MT) measurements. Unfortunately, both gravity and MT methods are characterized by a large degree of non-uniqueness such that it is impossible to derive an unambiguous model, if the different data sets are processed and inverted separately. To obtain a robust result, we chose to develop an approach in which we jointly invert seismic tomography, MT and gravity data. A key element in the inversion is determining the relationships between the different rock properties (velocity, resistivity and density) using prior experimental data. We tested our joint inversion technique on a challenging 2-D model, which was developed within the framework of the EC project "SIMBA", to represent a typical geological situation of a basalt structure on the European margin. We show that we can recover the original model including lateral changes in basalt and sub-basalt sediment thickness, that is not possible with the individual inversions of the data sets. The result is robust and shows that the combination of non-unique data can provide strong constraint. The application to real data is also successful and we demonstrate that boundaries in the inverted model coincide with isolated bright reflections observed on the seismic reflection data.

IMC-P02
HIGH-RESOLUTION SEISMIC REFLECTION PROFILING ALONG THE RIKUU EARTHQUAKE FAULT, NORTHEAST JAPAN

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The Rikuu earthquake of 1986 was generated by the Senya fault system. This is new created reverse fault under strong east-west compression since the late Pliocene, and is exemplified as front migration of thrusting. It is difficult to define the segment and the segment linkage of it because of the irregular geometry. We investigated the relationship between the geometry of faulting and the geomorphic features, based on a data from several disciplines including high-resolution seismic reflection profiling.

Furthermore, we discussed the process and the timing by the restoring the balanced cross sections. The seismic sections revealed faulting geometries. The Senya fault system is recognized two major tectonic zones. One is range-bounding fault that is inactive and occasionally be a fold. Another is frontal active fault that consists at least of four segments based on their continuity or direction of fault trace. These are divides the eastern margin of the basin and foothills. Each of segments is characterized by a distinct structural style in the hangingwall of front thrust. Similarly, the trace curvatures of faults were interpreted as expression of thrust migration. Through the thrust system, the shortening was commonly estimated at about 3km in total. We inferred that the first motion of thrusting began at the time of about 2.5 million age (Ma) and the fault migration to the basin occurred after 1.0Ma.

IMC-P03

DOBRE-2: INTEGRATED GEOPHYSICAL STUDIES OF THE CRUST AND UPPER MANTLE ON THE SOUTHERN MARGIN OF THE EAST EUROPEAN CRATON (AZOV SEA-CRIMEA-BLACK SEA AREA)

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The southern part of the eastern European continental landmass consists mainly of a thick platform of Vendian and younger sediments overlying Precambrian basement, part of the East European Platform (EEP). The Scythian Platform (SP) lies between the EEP and the (mainly Alpine) deformed belt running from Dobrogea (Romania) to Crimea (Ukraine) and the Greater Caucasus (Russia), along the northern margin of the Black Sea. Hard constraints on the Palaeozoic history on the SP are very sparse and little is known of its crustal structure in this area. The poster presents new results and plans for the coming year of a new multidisciplinary project that will fill some of this gap. The new project is called DOBRE-2 (as it forms a prolongation of the successful DOBRE project executed in 1999-2001). The main objectives of DOBRE-2 are to elucidate the deep-seated structure of the lithosphere and geodynamic setting of the shelf zones of the Azov and Black seas and the Crimean peninsula and to study the deep controls on the structure of basement and sedimentary cover. DOBRE-2 traverses a number of major faults and suture zones separating the EEP from the SP, the Crimean Mountains, and the Black Sea depression. Significant hydrocarbon reserves occur in the basins traversed by DOBRE-2. Deep seismic reflection profiling (30 second, Vibroseis) has been completed on a 100-km segment of the profile on the Azov Massif (part of the Ukrainian Shield) and a 47-km segment in Crimea. These will be complemented by additional, offshore, near-vertical (CDP) and wide-angle reflection ("DSS") profiling on the shelf zones of the Azov (~53 km) and Black (~160 km) seas using a combination of onshore seismograph stations, ocean-bottom seismometers, onshore and offshore explosive energy sources, as well as conventional ship-borne seismic acquisition. Reinterpretations of old seismic (DSS) data as well as potential field modelling have also been carried out as part of the project.

IMC-P04

DEEP STRUCTURE OF THE BARENTS-KARA REGION ALONG REGIONAL LINE 3-AR (WHITE SEA-IS. PIONER-NORTH KARA SEA)

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In 2006 SEVMORGEO completed complex geophysical investigations (seismic wide-angle reflection/refraction profiling, multichannel seismic survey, high-frequency profiling and gravity/magnetic measurements) along regional line 3-AR. Line 3-AR (2400km total length) traverses the White, Pechora and Kara seas, goes to Is. Pioneer (the northern part of the Kara Sea). By a result of complex geophysical investigations along the regional line 3-AR for the first time a deep structure of the Earth's crust has been studied in offshore part of large geostructures: the Baltic Shield, Russian Plate, Pechora Plate, offshore continuation of the West-Siberian Plate, North-Kara Plate and their junction zones – the Kanin-Timan Ridge, Paikhoy-Novozemelskiy Fold Belt and North-Siberian Weir. Location of the regional line 3-AR allowed to conduct a tie of composition of main sedimentary basins: the Mezenskaya Syneclise of the Russian Plate, Pechora Syneclise, as a part of the Pechora Plate, the South-Kara Syneclise of the West-Siberian Plate, the North-Kara-Syneclise of the North-Kara Plate. Forming of these large basins may be connected with process of riftogenesis. Several grabens are revealed: the Riphean Kandalakshskiy Graben in the Mezenskaya Syneclise, the Lower Paleozoic Oksinskiy Graben and Devonian Pechora-Kolvinskiy Aulacogen in the Pechora Syneclise, the Triassic Noyabr'skiy and Chekinskiy grabens in the South-Kara Syneclise and the Riphean Predseverozemelskiy Graben in the North-Kara Syneclise. The presence of an uninterrupted lateral series of rift complexes testifies to continuous spreading processes in the crust from Riphean to Triassic in the Barents-Kara Region.

IMC-P05

THERMOBARIC PETROSTRUCTURAL MODELING OF THE EARTH'S CRUST AND THE NATURE OF SOME SEISMIC BOUNDARIES

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For the first time some methodical approaches to the domain of petrophysical modeling and DSS data interpretation are proposed. The modeling based on the present geoinformation and the results obtained in the high P and T petrophysics specifies the material composition and the features of the deep crustal structure of the specific regions.
A common analysis of geophysical data and petrophysical thermobaric models based on the data of experimental studies of the physical characteristics of most common mineral formations at high P and T with considering the results of ultradeep boring let us reasonably suggest the nature of some seismic boundaries in particular the K_2- discontinuity. The latter is in most cases thought to be thermodynamic rather than material one. It is marked in the 8-18 km depth range when the mineral matter structural perfection occurs that favours the increase of the elastic parameters of the medium with increasing P and T just after a zone of elastically discompacted horizons. These zones have been experimentally detected for most rocks in different programmed PT-conditions of experiments. Depending on the thermobaric conditions of the Earth's crust, its stress, the elastic anomaly zones and the K_2-discontinuity may be laterally disrupted and migrate to greater depths.

SEISMIX 2006

HAYAMA JAPAN

AUTHOR INDEX

Notes