京都大学防災研究所年報 第 62 号 A
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一般研究集会（ 課題番号 ：30K-06）

集会名： スロー地震の発生メカニズムを探る:観測・調査・実験・理論・モデリングからの情報の統合化と南海トラフ巨大地震との関連性の解明に向けて

主催者名： 平成 28−32 年度 文部科学省・日本学術振興会科学研究費助成事業 新学術領域研究「スロー地震学」

研究代表者：内田 直希

所属機関名：東北大学大学院 理学研究科

所内担当者名： 山下 裕亮, 伊藤 喜宏

開催日：平成３０年 ９月 ２１―２３日

開催場所：アクロス福岡

参加者数：107 名 (所外 100 名，所内 7 名)

・大学院生の参加状況：42 名（修士 31 名，博士 11 名）（内数）*修士・博士の課程が不明な学生は「修士」とした.

・大学院生の参加形態 [口頭発表，ポスター発表，聴講，運営補助]

研究及び教育への波及効果について

本課題から，研究集会に参加した一部の学生の旅費のサポートを行なった．学生および若手研究者らのサポートを本課題で進めることで，学生・若手研究者間の交流に加えて，彼らと国内外の一流の研究者間の交流や，新たな共同研究への展開により，当該研究領域の拡充が進められた.

研究集会報告

(1)目的

21 世紀初頭に発表されたスロー地震の発見論文（Obara, 2002）を契機として発展してきた本研究は，2011 年に甚大な災害を招いた東北沖地震が一つの局面となり，巨大地震とスロー地震の関連性を強く示唆する結果を生み出した（例えば Kato et al, 2012）．将来の南海トラフ巨大地震とスロー地震の関連性についての理解を深めることを目的とする研究集会を開催し，地質調査・地球物理観測・物性実験・数値モデリングなど，様々なアプローチによるスロー地震研究の内外の最新の結果および情報を持ち寄り，目的に向けた各々の結果の有機的な共有，結合を図る.

(2)成果のまとめ

本研究集会では，SATREPS 防災メキシコプロジェクト（代表：伊藤喜宏）や科研費新学術領域研究「スロー地震学」（代表：小原一成）の参画者に加えて，東京大学地震研究所・地震・火山予知研究協議会「海溝型地震」研究推進部会（部会長：小原一成）の参画者が出席し，世界中で実施されているスロー地震の地球物理学的観測，路頭調査，理論，統計力学的モデル等，その最新の研究事例を踏まえ，将来の巨大地震との関連を踏まえた高いレベルでの議論が行われた.

(3)プログラム

別紙参照

(4)研究成果の公表

研究集会の概要やアブストラクトについては，以下のサイトから参照・ダウンロードが可能である.

日本語：https://sites.google.com/site/wssloweqs2018/japanese

英語：https://sites.google.com/site/wssloweqs2018/

別紙プログラム

International Joint Workshop on Slow Earthquakes 2018
Date: September 21-23, 2018Venue: ACROS Fukuoka (Kyushu, Japan)

Time Schedule （Detailed)

Oral

Day 1 (21 Sep.)

Chair Hitoshi Hirose

Opening 9:00 9:05 5 Satoshi Ide
Opening remarks Annoucement 9:05 9:15 10 Aitaro Kato Venue announcement
O1-01 9:15 9:30 15 Ryo Kurihara
Detection of volcanic deep low frequency earthquakes and temporal variation of its activities in Japan
O1-02 9:30 9:45 15 Dimas Sianipar
Systematic search for dynamic triggering in the eastern Sunda-Banda arc, Indonesia
O1-03 9:45 10:00 15 Saeko Kita
Variations in seismicity rate, stress orientations and b-values before and after ETS events in the subducting slab beneath Kii Peninsula
O1-04 10:00 10:15 15 Satoru Baba
Detection of very low frequency earthquakes off the Pacific coast of Tokachi and Tohoku regions by using synthetic waveforms of three-dimensional velocity model
O1-05 10:15 10:30 15 Naoki Uchida
Detection, evaluation and application of repeating earthquakes in the science of slow earthquakes

Break 10:30 11:00 30

Chair Akiko Takeo

O1-06 11:00 11:15 15 Yoshiyuki Tanaka
Precise gravity observation in slow slip areas
O1-07 11:15 11:30 15 Masa Kinoshita
Drilling into Nankai Trough seismogenic zone
O1-08 11:30 11:45 15 Kuo-Fong Ma
Featuring fault zone behavior and evolution after a large earthquake from in-situ seismological observations
O1-09 11:45 12:00 15 Eiichiro Araki
Planning and development toward seafloor strain observation network in the Nankai Trough seismogenic zone
O1-10 12:00 12:30 30 Susan Schwartz
Slow slip behavior of the shallow megathrust from seafloor observations and the presence of burst-type repeating earthquakes

Lunch 12:30 14:00 90

Chair Wataru Tanikawa

O1-11 14:00 14:15 15 Ikuo Katayama

Migration of acoustic emission controlled by hydraulic diffusivity and implication for tremor migration along a subducting plate interface

O1-12 14:15 14:30 15 Kohtaro Ujiie

Geological perspectives of tectonic tremor and slow slip: Insights from subduction mélanges

O1-13 14:30 14:45 15 Naoki Nishiyama

Migration of mantle-derived fluid along plate boundary and its relation to episodic tremor and slip

O1-14 14:45 15:00 15 Christopher J. Tulley

Deformation of metabasalt in tremorgenic megathrust mélanges exposed on Kyushu Island, Japan.

O1-15 15:00 15:30 30 Noah Phillips

Physical Properties of the Shallow Slow Earthquake Source

Poster 15:30 17:00 90

Chair Kohtaro Ujiie

O1-16 17:00 17:30 30 Hiroko Kitajima

Experimental constraints on in-situ stress and strength in the Nankai accretionary prism

O1-17 17:30 17:45 15 Gaku Kimura

A superimposition of fast and slow slip? - Micro-tectonics of a frontal decollement in the Nankai Trough -

O1-18 17:45 18:15 30 Laura M. Wallace

Using scientific drilling to unlock the secrets of slow slip events at the Hikurangi subduction zone

O1-19 18:15 18:30 15 Ake Fagereng

Mixed deformation styles and fault slip behaviour of a shallow subduction thrust, Hikurangi margin, New Zealand

Social Partyat Tenjin Skyhall 19:00 21:00

Tenjin 16 Skyhall (10 min walk from the venue. 16F at the Nishinipponshinbun kaikan)

Day 2 (22 Sep.)

Chair Naofumi Aso

O2-01 8:45 9:00 15 Takeshi Tsuji

Continuous geophysical monitoring of Nankai subduction zone and Japanese Island: Insight from ambient noise interferometry for DONET and Hi-net

O2-02 9:00 9:15 15 Aitaro Kato

Along strike variation of slow slip style

O2-03 9:15 9:30 15 Kazushige Obara

Spatiotemporal characteristic activities of slow earthquakes: Tremor migration beyond gaps

O2-04 9:30 10:00 30 Heidi Houston

Spatio-temporal relationships between tremor and slow slip: Constraints on fault strength

Break 10:00 10:30 30

Chair Tomoaki Nishikawa

O2-05　10:30　11:00　30　Noel M. Bartlow
Properties of geodetically detected slow slip in Cascadia: slip rates, total slip budget, and temporal patterns
O2-06　11:00　11:30　30　Kenneth Creager
A model of Low-Frequency Earthquake Slip using the Northern Cascadia Array of Arrays
O2-07　11:30　11:45　15　Naofumi Aso
Slow slip and tremors driven by stochastic stress perturbation
O2-08　11:45　12:00　15　Ryosuke Ando
Brittle-plastic heterogeneity model for depth-dependent modes of slow earthquakes

Group photo　12:00　12:10　10
Lunch　12:10　13:30　80
Project meeting　13:30　13:45　15　全体アナウンス（領域関係者限定）／ Announcements for the slow earthquakes project members (in Japanese)

Chair　Tetsuo Yamaguchi

O2-09　13:45　14:00　15　Takehito Suzuki
Sensitivity of the Final Slip Amount to the Initial Fluid Pressure
O2-10　14:00　14:15　15　So Ozawa
Longer Migration and Spontaneous Decay of Aseismic Slip Pulse Caused by Fault Roughness
O2-11　14:15　14:30　15　Yutaka Sumino
Slow Earthquake as the Benjamin-Feir instability---from the view point of bifurcation analysis
O2-12　14:30　14:45　15　Hiroshi Matsukawa
Rate and State Friction Law and Static Friciton Force
O2-13　14:45　15:15　30　Jean-Francois Molinari
Emergence of self-affine roughness during dry sliding: insights from atomistic simulations

Poster　15:15　16:45　90

Chair　Ryosuke Ando

O2-14　16:45　17:15　30　Pascal Audet
Structural environment of deep episodic slow earthquakes from geophysical data
O2-15　17:15　17:30　15　Kansuke Uemura
Criticality of Self-similar Earthquake Rupture Propagation against Energetic Barrier
O2-16　17:30　17:45　15　Kimihiro Mochizuki
Relationship between seismicity and the properties of the plate interface
O2-17　17:45　18:15　30　Geoffrey A. Abers
Multiscale seismic structure of the megathrust

Project meeting　18:20　19:40　80　総括班会議（領域関係者限定）／Administrative Group Meeting (in Japanese, project member only)
Project meeting　19:40　20:00　20　各班会議（領域関係者限定）／Project Group Meeting (in Japanese, project member only)

Day 3 (23 Sep.)

Chair Takeshi Akuhara

O3-01 9:00 9:30 30 Sergio Ruiz

Some slow slip signatures in the Chilean subduction zone: Slow and fast dynamic ruptures of 2014 Iquique and 2017 Valparaíso earthquakes

O3-02 9:30 9:45 15 Miguel Sáez

Intense tremor activity detected by OBS stations in the Chile Triple Junction: A manifestation of a continuous slow slip?

O3-03 9:45 10:00 15 Masaru Nakano

Seismic energy radiations from shallow tremor beneath the Kumano and Muroto basins along the Nankai trough

O3-04 10:00 10:15 15 Satoshi Ide

2D PCA model for broadband slow earthquakes

Break 10:15 10:45 30

Chair Kimihiro Mochizuki

O3-05 10:45 11:00 15 Takuya Nishimura

Bimodal depth distribution of slow slip events detected using GNSS data in the Hikurangi subduction zone, New Zealand

O3-06 11:00 11:15 15 Tomoaki Nishikawa

Comparison between earthquake swarm and slow slip activity in the Ryukyu Trench and Hikurangi Trench

O3-07 11:15 11:30 15 Baptiste Rousset

Characterization of slip pulses within the upper Cook Inlet 2008 - 2013 slow slip event in Alaska

O3-08 11:30 12:00 30 David R. Shelly

San Andreas Fault tremor and low-frequency earthquakes: past progress and future directions

Lunch 12:00 13:30 90

Poster 13:30 15:00 90

Chair Takanori Matsuzawa

O3-09 15:00 15:30 30 Vlad C. Manea

Slow-slips and tectonic tremors diversity in subduction zones

O3-10 15:30 15:45 15 Yingdi Luo

Slow-Slip recurrent pattern changes: perturbation responding and possible scenarios of precursor towards a megathrust earthquake

O3-11 15:45 16:00 15 Ryoichiro Agata

Quasi-static simulation of slow-slip cycle based on finite element modeling

O3-12 16:00 16:30 30 Kaj M. Johnson

A decadal-scale slow slip event in Northern Japan driven by erosion of locked asperities

Closing 16:30 16:35 5 Kazushige Obara

Closing remarks

Guidance 16:35 16:55 20 Yasushi Mori &Kohtaro Ujiie

Guidance of field excursion

Poster (15:30-17:00 on 21; 15:15-16:45 on 22; 13:30-15:00 on 23 Sep.)

P01　Tyler Newton
Stress Regime of the Nankai Trough
P02　Hiroshi Ichihara
Marine EM surveys in the off-Miyazaki and off-Kochi area between 2017 and 2018
P03　Makoto Uyeshima
On the Network-MT survey in the western part of Shikoku Island facing the area of the Bungo Channel long-term slow slip event
P04　Yusaku Tanaka
Recent Report on “Slow Earthquake Database”
P05　Akiko Takeo
Broadband seismic observation of very low frequency earthquakes around Bungo channel in southwest Japan by temporal stations
P06　Ayumi Kinjo
Low Frequency Earthquakes Triggered by Teleseismic Earthquakes
P07　Mamoru Nakamura
Seasonal and long-term variation in the tidal response of very low frequency earthquakes in the Ryukyu Trench
P08　Saki Watanabe
Seismic Energy Released by Shallow Tremor Activity in the Hyuga-nada, Revealed by Ocean Bottom Seismological Observation
P09　Yusuke Yamashita
Does a focal region of shallow slow earthquake become a source area of tsunami?-Approach of geophysical and geological survey for a large historical earthquake-
P10　Koji Tamaribuchi
Shallow Low Frequency Earthquake after the 2004 off the Kii Peninsula Earthquakes revealed by Ocean Bottom Seismometer
P11　Takeshi Akuhara
Beyond receiver functions: Green’s function estimation by trans-dimensional inversion and its application to OBS data
P12　Akira HIkita
Receiver function imaging around source region of slow earthquakes in western Shikoku, Japan by using a dense array
P13　Katsuhiko Shiomi
Seismological features around the LFE zone beneath western Shikoku (2): Numerical tests
P14　Satoshi Katakami
Dynamic triggering of shallow slip in the Nankai subduction zone enhanced by overlying sedimentary wedge
P15　Masayuki Kano
Temporal variation of SSEs in the southern Ryukyu subduction zone: Implications for frictional parameters on the fault
P16　Hidenobu Takahashi
Attempt to detect low-frequency dominant events in Tohoku-Oki using local short period OBS records
P17　Sachiko Tanaka
Low frequency tremor off Tokachi and off Sanriku
P18　Miyuu Uemura
A trial for detecting low-frequency tremors, using seismic interferometry of ambient noise
P19　Ryohei Ikeda

Triggered tremors and stress perturbation due to surface waves

P20　Shukei Ohyanagi

Very slow migration of non-volcanic tremor in the San Andreas Fault

P21　Hitoshi Hirose

A small slow slip event in the Bungo Channel from December 2015 to March 2016 detected by a GNSS observation network

P22　Wakako Tamura

Slip distributions based on tilt change data for short-term slow slip events in western Shikoku, southwest Japan

P23　Hiromu Sakaue

Spatio-temporal evolution of long-term and short-term slow slip events in the Tokai region,central Japan estimated from a very dense GNSS network, during 1997-2010

P24　Kodai Sagae

An array analysis of deep low frequency tremors around the Kii Peninsula using the MUSIC method

P25　Tadafumi Ochi

Relation between the coupling and tremor rates in the transition zone around the Shikoku region

P26　Satoshi Itaba

Detection of shallow SSE off the Kii Peninsula, Japan by onland borehole strainmeter

P27　Ryota Takagi

Source parameters of long-term slow slip events in the Nankai subduction zone

P28　Tomohiro Inoue

Analyses of Ocean Bottom Pressure in Nankai and Hikurangi subduction

P29　Yasunori Sawaki

Detection of the structural variation around regions with slow earthquakes in southwest Japan using receiver function method

P30　Akiko Toh

Relations between shallow VLFEs and tremors, based on near-filed BBOBS records

P31　Suguru Yabe

Seismic energy estimation of shallow slow earthquake

P32　Miki Aso

Focal mechanisms and seismicity of LFEs on Parkfield

P33　Pierre Romanet

New Tremors Detection in New Zealand

P34　Keita Nakamoto

Spatial features of non-volcanic deep low frequency tremors occurring during the L-SSE period in southwest Japan

P35　Takanori Matsuzawa

Numerical modelling of slow slip events in the Shikoku and Hyuganada region

P36　Ryoko Nakata

Discussion based on spatial distribution of long-term slow slip events beneath the Bungo Channel

P37　Keisuke Ariyoshi

Quantitative relationship between slow slip migration speed and frictional properties

P38　Takane Hori

Monitoring Method for Crustal Activity with 3D Heterogeneous Medium Using a Large-Scale High-Fidelity Finite Element Simulation

P39　Jodie Buckby

Classification of non-volcanic tremor observations

P40　Ta-Wei Chang

A Common Axis Study on Mainshock Slip and Aftershock Distributions

P41　Kellen Azua

Tomography of Mejillones Peninsula using cross-correlation of ambient seismic noise

P42　Javier Ojeda

High frequency sources controls strong motion of Mw 8.8 Maule 2010 earthquake

P43　Anthony Sladen

Spatio-temporal distribution of outer-rise seismicity

P44　Yuta Mitsui

Decay characteristics of afterslip and aftershocks following the 2011 Tohoku Earthquake

P45　Shoubiao Zhu

Effect of the Gaochuan right bend on fault spontaneous rupture propagation in the 2008 Wenchuan earthquake

P46　Daya Shanker

Assessment of earthquake hazard in Indonesian region

P47　Deepa Mele Veedu

A simple model to explain a spectrum of fault slip behaviors

P48　Satoshi Takada

Friction of granular matter with aging contacts

P49　Hiroki Ishikawa

Dynamic pattern formation of brittle viscoelastic fluid under shear –a model of plate boundary between seismic and aseismic zone

P50　Tetsuo Yamaguchi

Slow slip to giant earthquake transition in laboratory experiments

P51　Michio Otsuki

Slip and nonlinear response in sheared granular materials

P52　Miho Asada

Preliminary results from an exploration cruise focused on mud volcano activity in the off-Shikoku and Hyuga-nada areas

P53　Rina Fukuchi

Textural, chemical and mineralogical features of the shallow plate boundary fault in the Nankai accretionary prism

P54　Yuichi Okuma

Changes in deposition rate of slope sediments overlapping Nankai accretionary prism off-Muroto: reflecting seamount subduction?

P55　Yohei Hamada

Geological investigation for slow earthquake faults

P56　Kazuya Noro

Fluid-rock interaction in subducted mélanges and its implications for fluid flow along the subduction plate boundary

P57　Yasushi Mori

Metasomatic dehydration of serpentinite in subduction mélanges

P58　Keiya Yamada

Effect of pore pressure on attenuation of seismic waves in thermally cracked granite

P59　Makoto Otsubo

Pore fluid overpressures for tensile cracking at depth of episodic tremor and slow slip

P60　Keishi Okazaki

Evolution of hydraulic and frictional property of hemipelagic sediments during diagenetic reactions

P61　Wataru Tanikawa

Dynamic permeability measurement on simulated fault rock in laboratory test

P62　Masaki Oku

Paleo-geothermal structure analysis and fault rock analysis around the Aki Tectonic Line using Raman spectroscopy

P63　Akito Tsutsumi

Factors affecting frictional properties of a plate-boundary fault: The Costa Rica subduction zone