

一般研究集会（課題番号：2019K-02）

集会名：南海トラフ巨大地震の次回発生までにスロー地震の何を明らかにすべきか？

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」

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所内担当者名：山下 裕亮, 伊藤 喜宏

開催日：令和元年 9 月 21 日－23 日

開催場所：東北大学片平さくらホール

参加者数：140 名（所外 126 名，所内 14 名）

- ・大学院生の参加状況：43 名（修士 23 名，博士 20 名）（内数）※学部生 10 名
- ・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，研究集会への参加者の旅費サポートを行った．本課題のサポートにより，学生および若手研究者と国内外の第一線級の研究者との交流が進み，新たな共同研究の萌芽が生まれることに繋がった．これにより，当該研究領域の拡充・新展開が後押しされたと考えられる．

研究集会報告

(1)目的

過去に繰り返し発生してきた南海トラフ巨大地震の次回発生を見据え，同じ断層上で発生する巨大地震とスロー地震との関連性についての理解を深めることを目的とする．観測・調査・実験・理論・モデリングなど，様々なアプローチによる国内外の最新の結果および情報を持ち寄り，地震学・測地学・地質学・物理学分野の垣根を超えたスロー地震学研究成果の有機的な共有，結合が図れるような議論の場とする．

(2)成果のまとめ

本研究集会では，海外から招聘した研究者や，科研費新学術領域研究「スロー地震学」（代表：小原一成），SATREPS 防災メキシコプロジェクト（代表：伊藤喜宏），開催地である東北大学の研究者らの参画者も交えて，世界中で観測されているスロー地震の最新の研究事例に基づき，スロー地震の発生メカニズムや南海トラフをはじめとする将来の巨大地震との関連についての議論が行われた．特に本研究集会では，従来の学会方式に準ずる研究集会から，複数の主テーマを設定し，それらのテーマに即した発表を募って最後に主テーマ毎の議論の時間を設ける方式が採用され，今後のスロー地震学の方向性についての議論が大いに深まった．

(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・ダウンロード可能となっている．

日本語：<https://sites.google.com/site/slowlows2019/japanese>

英語：<https://sites.google.com/site/slowlows2019/home>

Oral

Day 1 (21 Sep.)

"Opening Announcement" 9:00 9:10 0:10

Theme 5 (General) Chair Masayuki Kano

O5-01 9:10-9:25 0:15 Florent Aden-Antoniow

Low-Frequency Earthquakes Accompany Deep Slow-Slip beneath the North Island of New-Zealand

O5-02 9:25-9:40 0:15 Guillermo González

Characteristic Tectonic Tremor Activity Observed Over Multiple Slow Slip Cycles in the Mexican Subduction Zone

O5-03 9:40-9:55 0:15 Koki Masuda

Detection of slow earthquakes in the microseism frequency band (0.05–1.0 Hz) by large-scale waveform stacking

O5-04 9:55-10:10 0:15 Satoru Baba

Comprehensive detection of deep and shallow very low frequency earthquakes along the Nankai Trough, southwest Japan

O5-05 10:10-10:25 0:15 Yutaro Okada

Detection of short-term slow slip events and estimation of their duration by using three components of GNSS data in the Shikoku region

Break 10:25-10:45 0:20

Theme 5 (General) Chair Yuta Mitsui

O5-06 10:45-11:00 0:15 Allen Husker

Layered anisotropy throughout the crustal column in the Mexican subduction zone correlates with tectonic tremor activity

O5-07 11:00-11:15 0:15 Pierre Romanet

Tremor activity before and after the Mw 7.8, 2016 Kaikoura earthquake

O5-08 11:15-11:30 0:15 Yusuke Yokota

New detection of undersea slow slip events along the Nankai Trough megathrust zone by the GNSS-A

O5-09 11:30-11:45 0:15 Mathilde Radiguet

Systematic detection and characterization of slow slip events along the Mexican subduction zone from 2000 to 2019

O5-10 11:45-12:00 0:15 Naoto Mizuno

Analysis of slip evolution of tectonic tremor using similarity search

Lunch 12:00-13:30 1:30

Theme 2 Moderator Satoshi Ide

O2-01 13:30-14:15 0:45 Jessica Hawthorne

10-minute subevents and atmospheric modulation: implications for the physical mechanism of slow slip events

O2-02 14:15-15:00 0:45 William Frank

The transient and intermittent nature of slow slip

Break 15:00-15:20 0:20

O2-03 15:20-15:40 0:20 Heidi Houston

Along-dip migration within large and small SSEs in Cascadia is preferentially up dip

O2-04 15:40-16:00 0:20 Jean-Pierre Vilotte

Low-frequency earthquakes in western Shikoku: source characteristics, spatial-temporal activity and interactions between slow earthquakes

O2-05 16:00-16:20 0:20

Satoshi Ide Detection of low frequency earthquakes in broadband random time sequences: Are they independent events?

Discussion 16:20-17:00 0:40

Poster 17:00-18:30 1:30

Social Party 19:00-21:00 2:00

Day 2 (22 Sep.)

Theme 3 Moderator Kimihiro Mochizuki

O3-01 8:30-9:15 0:45 Ryota Hino

Along-strike variations of crustal structure in Japan Trench and its relevance to slow-slip generation

O3-02 9:15-10:00 0:45 Laura Wallace

The relationship of slow slip events, seismicity and tremor to the structure of the plate boundary at the Hikurangi subduction zone, New Zealand

Break 10:00-10:20 0:20

O3-03 10:20-10:40 0:20 Naoki Uchida

Repeating earthquakes and interplate coupling along the western North Anatolian Fault

O3-04 10:40-11:00 0:20 Akiko Toh

Further evidence for the influence of a subducting-ridge on the distribution of shallow VLFs in the eastern Nankai Trough

O3-05 11:00-11:20 0:20 Kazuya Shiraishi (Gou Fujie)

Detailed 3D crustal structures and very low frequency earthquakes: the Nankai trough off Kumano

Discussion 11:20-12:00 0:40

Lunch 12:00-13:30 1:30

Theme 4 Moderator Kohtaro Ujiie

O4-01 13:30-14:15 0:45 Stephen Cox

Fluid involvement in crustal faulting: insights for slow earthquake phenomena?

O4-02 14:15-15:00 0:45 Demian Saffer

Fluid Pressure, Stress, and Fault Properties in Shallow SSE Source Regions

Break 15:00-15:20 0:20

O4-03 15:20-15:35 0:15 Kazushige Obara

Spatial properties of slow earthquake activity and its geophysical and geological environment

O4-04 15:35-15:50 0:15 Ryosuke Ando

Role of rheological heterogeneity on depth-dependent modes of slow earthquakes

O4-05 15:50-16:05 0:15 Gaku Kimura

Microtectonics of the plate boundary frontal thrust beneath the Nankai accretionary prism

O4-06 16:05-16:20 0:15 Yutaka Sumino

Behavior of injection front in the structured cell with the formation of precipitates

O4-07 16:20-16:35 0:15 Masaoki Uno

Fluid pressure gradients and permeability fluctuations estimated from metamorphic fluid-rock reaction zones

O4-08 16:35-16:50 0:15 Saeko Kita

Interactions between intraslab seismicity and ETS beneath Kii peninsula, controlled by fluid migration

Discussion 16:50-17:00 0:10

Poster 17:00-18:30 1:30

Project Meeting 18:30-19:30 2:00

Day 3 (23 Sep.)

Theme 1 Moderator Takahiro Hatano

O1-01 8:30-9:15 0:45 Aitaro Kato

Migrating foreshocks: The interplay between slow and fast slip modes

O1-02 9:15-10:00 0:45 Ahmed Elbanna

Modeling earthquake cycles in complex fault zones using a hybrid finite element -Spectral Boundary Integral Approach: From slow to fast and back again!

Break 10:00-10:20 0:20

O1-03 10:20-10:40 0:20 Naofumi Aso

Temporally stochastic stress perturbations enable slow ruptures

O1-04 10:40-11:00 0:20 Keisuke Ariyoshi

Quantitative relationship between aseismic slip propagation speed and frictional properties

O1-05 11:00-11:20 0:20 Tetsuo Yamaguchi

Laboratory experiments of plate boundary earthquakes based on design of friction behavior

Discussion 11:20-12:00 0:40

Lunch 12:00-13:30 1:30

Poster & Break 13:30-15:00 1:30

Theme 5 (General) Chair Hitoshi Hirose

O5-11 15:00-15:15 0:15 Atsuko Namiki

Depth dependence of the maximum seismic magnitude

O5-12 15:15-15:30 0:15 Hiroki Tanaka

Can network theory quantify seismicity? : From tremors to fast earthquakes

O5-13 15:30-15:45 0:15 Satoshi Katakami

Stress condition for dynamic triggering of a shallow slow slip

O5-14 15:45-16:00 0:15 Diana Mindaleva

Geological evidences of short fluid activity at crustal P-T conditions in the low permeable metamorphic rocks triggered by crustal fracturing

O5-15 16:00-16:15 0:15 Morgan McLellan

Uncovering the physical controls of slow slip using machine learning

O5-16 16:15-16:30 0:15 Zhen Liu

Investigate Episodic Tremor and Slow-slip Variability in Cascadia Subduction Zone

Wrap-up 16:30-17:00 0:30

Poster

- P1-01 Takane Hori
Theme 1 A mechanical model of regular and slow earthquakes
- P1-02 Takehito Suzuki
Theme 1 Eddy viscosity for turbulent flow in porous media and its effect on dynamic earthquake slip process
- P1-03 Fukuda Kota
Theme 1 Modeling tremors with nonconservative sandpile cellular automaton model
- P1-04 Ikuro Sumita
Theme 1 "Evolution of stress distribution and vertical displacement during seepage triggered laboratory landslides"
- P1-05 Miyuu Uemura
Theme 1 Temporal variation of elastic waves during reproduction experiment of Slow Slip Event on a biaxial friction experiment
- P1-06 Sumanta Kundu
Theme 1 Quantifying characteristics of slow and fast earthquakes using complex network analysis
- P2-01 Shinichi Oba
Theme 2 Inertia term governs displacement of stick-slip experiment
- P2-02 Akiko Takeo
Theme 2 "Activities of deep very low frequency earthquakes around Bungo channel, southwest Japan in 2018–2019"
- P2-03 Fukumizu Hidekazu
Theme 2 Broadband monitoring of Acoustic Emission during granular shear
- P2-04 Hiromu Sakaue
Theme 2 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 1997-2017
- P2-05 Hitoshi Hirose
Theme 2 Slip distributions of short-term slow slip events in the Shikoku area, southwest Japan from 2001 to 2019 based on tilt change measurements
- P2-06 Kodai Sagae
Theme 2 Backprojection analysis of deep low frequency tremors using dense seismic array data at the Kii Peninsula in Japan
- P2-07 Lou Marill
Theme 2 Exploring Aseismic Slip Complexity on the Japan Subductions
- P2-08 Masaru Nakano
Theme 2 Event size distribution of shallow tectonic tremor in the Nankai trough
- P2-09 Ohta Kazuaki
Theme 2 Comparative study on the source process of ambient and triggered tremor based on the slip inversion analysis
- P2-10 Ryota Takagi
Theme 2 Systematic detection of slow slip events beneath Kanto, Japan
- P2-11 Sawako Teshiba
Theme 2 Interplate slip around the Hyuganada - Bungo Channel from 1996 to 1998 based on GNSS data
- P3-01 Makoto Uyeshima
Theme 3 On the Network-MT survey in the western part of Shikoku Island facing the area of the Bungo Channel long-term slow slip event
- P3-02 Miki Aso
Theme 3 "Focal Mechanisms of LFEs in Parkfield by the amplitude inversion using synthetic waveforms"
- P3-03 Ryuta Arai
Theme 3 Structural controls on shallow slow earthquakes: Implications from three-dimensional seismic structure of the Northern Hikurangi

subduction zone, New Zealand

P3-04 Shunsuke Takemura

Theme 3 Migrations and clusters of shallow very low frequency earthquakes and structural characteristics along the Nankai Trough

P3-05 Akira Ishigami

Theme 3 Phase velocity estimation based on spatial gradient of surface wave arrival time of teleseismic earthquakes observed by S-net

P3-06 Gou Fujie

Theme 3 High-resolution seismic imaging of the subducting Philippine sea plate in the Nankai subduction zone

P3-07 Hidenobu Takahashi

Theme 3 Attempt to detect LFTs by clustering of records of short-period ocean-bottom seismometers

P3-08 Jensen DeGrande

Theme 3 Application of full waveform inversion to OBS data acquired in an active-source seismic survey: a synthetic test for the 2020 Bungo-channel profiles

P3-09 Kazuya Tateiwa

Theme 3 Spatiotemporal change of source parameters of repeaters due to the afterslip of the 2011 Tohoku-Oki earthquake

P3-10 Kimihiro Mochizuki

Theme 3 Heterogeneous structure around a slow earthquake activity in the off-Ibaraki region along the Japan Trench

P3-11 Seiichi Miura

Theme 3 Marine Seismic Survey Plan around the Hyuga-nada in FY2020

P3-12 Shukei Ohyanagi

Theme 3 An intimate analysis of shallow ambient and triggered tremor in the Japan Trench by the OBS Array of Arrays

P3-13 Takuya Nishimura

Theme 3 Complementary distribution between SSEs and LFTs in the Ibaraki-oki and Boso-oki regions along the Japan trench

P3-14 Tomohiro Inoue

Theme 3 Improvement in detection of seafloor crustal deformation due to shallow SSE using ocean bottom pressure by removing broad-band tide components

P3-15 Yasunori Sawaki

Theme 3 "Seismological Structural Changes during Bi-axial Experiments Inferred from Receiver Functions

P3-16 Yohei Kinoshita

Theme 3 Detecting surface displacement associated with the 2018 slow slip event around Boso peninsula by use of Sentinel-1 InSAR with atmospheric correction

P3-17 Ryoichiro Agata

Theme 3 Introduction of covariance components in slip inversion of geodetic observation data with bias in its spatial distribution

P4-01 Asuka Yamaguchi

Theme 4 "Occurrences of quartz veins in Sanbagawa metamorphic belt at depths of crust/wedge mantle interface

P4-02 Hiroki Ishikawa

Theme 4 Rolling deformation and fracture formation of brittle viscoelastic fluid under shear

P4-03 Kazuya Noro

Theme 4 Metasomatic reactions and localization of viscous shear observed in subduction mélanges exhumed from source depths of deep slow earthquakes

P4-04 Keiya Yamada

Theme 4 Response of seismic wave attenuation and velocity to the change of pore pressure in thermally cracked granite

P4-05 Ken-ichi Hirauchi

Theme 4 Semi-brittle flow in mantle wedge serpentinites linked to the generation of deep low-frequency earthquakes

P4-06	Koujirou Otoguro
Theme 4	Injection of fluid into a cell filled with gel particles-effect of swelling
P4-07	Makoto Otsubo
Theme 4	Temporal changes of mechanical properties controlled by accumulation of silica during seismic cycles of slow earthquakes
P4-08	Naoki Nishiyama
Theme 4	Role of metasomatic reactions of metabasite on plate-boundary shear localization at slab-mantle interface
P4-09	Ryo Kurihara
Theme 4	Characteristic activities of volcanic deep low-frequency earthquakes all over Japan
P4-10	Yoshiyuki Tanaka
Theme 4	A possible behaviour of high-pressure fluids in the Tokai area suggested by GNSS and gravity observations
P4-11	Yuta Yamaguchi
Theme 4	"Reproducing the variety of slip for slow earthquakes based on Stokesian dynamics simulations
P4-12	Wataru Tanikawa
Theme 4	Fault permeability changes by slow to fast frictional sliding
P5-01	Daya Shanker
Theme 5	Probabilistic Seismic Hazard Analysis (PSHA) for State of Uttarakhand Himalaya India
P5-02	Akito Tsutsumi
Theme 5	Frictional properties of a shallow subduction-zone fault in biogenic silicic sediments
P5-03	Futoshi Yamashita
Theme 5	Foreshock activities controlled by slip rate on a 4-meter-long laboratory fault
P5-04	Genki Oikawa
Theme 5	Mechanisms analysis of Volcanic Deep Low Frequency Earthquakes in Northeast Japan
P5-05	Junki Komori
Theme 5	The crustal deformation history of the Sagami Trough subduction zone, central Japan
P5-06	Katsuhiko Shiomi
Theme 5	Complex geometry of the Moho discontinuity and its relationship with low-frequency earthquake activity in Shikoku, southwest Japan
P5-07	Lingsen Meng
Theme 5	Detecting Offshore Seismicity by Combining Back-projection Imaging and Matched-filter Processing
P5-08	Mamoru Nakamura
Theme 5	Triggered slab earthquakes by swarm of very-low-frequency earthquakes in the central Ryukyu Trench
P5-09	Masayuki Kano
Theme 5	Episodic tremor and slip silently invades strongly locked megathrust in the Nankai Trough
P5-10	Norifumi Yamaga
Theme 5	Machine learning of postseismic deformation of the 2011 Tohoku-Oki earthquake based on recurrent neural network
P5-11	Raymundo Omar Plata Martinez
Theme 5	First insight in OBS data and shallow tremor detection at the Guerrero Gap, Mexico
P5-12	Ritsuya Shibata
Theme 5	Slip inversion with radiation-corrected empirical Green's functions
P5-13	Ryoko Nakata
Theme 5	Spatial distribution of long-term slow slip event from 2018 to 2019 beneath the Bungo Channel under sparsity constraints
P5-14	Suguru Yabe
Theme 5	Seismic energy estimation for shallow tremors

P5-15	Takanori Matsuzawa
Theme 5	Possible deep low frequency tremor in the Tokai region in 1980s on the recording paper of the Kanto-Tokai Observation Network
P5-16	Takashi Tonegawa
Theme 5	The distribution of sVLFE epicentres in the Hyuga-nada region
P5-17	Ta-Wei Chang
Theme 5	Towards Comparable Relative Locations between Mainshock Slips and Aftershocks
P5-18	Tomoaki Nishikawa
Theme 5	"Realtime monitoring of seismicity anomaly around Japan using the ETAS model
P5-19	Yuko Onoe
Theme 5	Hydration and amorphization of quartz rocks during high-velocity fault sliding
P5-20	Yusaku Tanaka
Theme 5	Attempt to Detect Intra-Plate SSEs based on F3 Solutions of GEONET
P5-21	Yusuke Yamashita
Theme 5	"Shallow low-frequency tremor activity during 1st observation of "Science of slow earthquakes"
P5-22	Yuta Mitsui
Theme 5	Long-term slow event at the Tonga Trench inferred from GNSS, GRACE, and seismicity