

PREFACE

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# Preface for the special issue of “New Perspective of Subduction Zone Earthquakes”

Gaku Kimura<sup>1\*</sup>, Juichiro Ashi<sup>2</sup>, Masataka Kinoshita<sup>3</sup>, Christie Rowe<sup>4</sup> and David Shelly<sup>5</sup>

Giant subduction zone earthquakes such as the recent 2004 Sumatra and 2011 Tohoku-oki earthquakes and their accompanying tsunamis cause significant damage to human society, and it is our earnest desire to scientifically elucidate how they occur. In the Nankai Trough, Japan, great earthquakes and tsunamis have occurred repeatedly, and more are predicted for this site in the near future. Super-deep drilling by the drilling vessel *Chikyu* will enable us to directly sample seismogenic faults as well as conduct analyses, experiments, and in situ borehole measurements. These efforts should significantly improve our understanding of pre- and co-seismic processes of great subduction zone earthquakes. The Integrated Ocean Drilling Program (IODP, 2003–2012) and International Ocean Discovery Program (2013–2022) have decided to promote the Nankai Trough Seismogenic Zone experiments (NantroSEIZE) using *Chikyu*, although the deep target of the plate boundary fault has not yet been reached as of 2015.

We created a Japanese partnership program with NantroSEIZE (new perspective on great subduction zone earthquakes from super deep drilling: Kakenhi for the Nankai trough megaquakes, KANAME program, with financial support from the Ministry of Education, Culture, Sports, Science, and Technology from 2008–2015). The scientific objective of the program is to improve our understanding of pre- and co-seismic processes of great subduction zone earthquakes by directly sampling seismogenic faults and conducting analyses, experiments, and in situ borehole measurements in the Nankai Trough region. To realize this goal, our strategy consists of the following three schemes: (1) understanding the overall framework of the Nankai Trough seismogenic zone, (2) revealing the materials and mechanical and hydrologic properties of seismogenic faults, and (3)

construction and verification of a comprehensive model for pre- and co-seismic processes.

On March 11, 2011, during the middle phase of the KANAME program, the Tohoku-oki earthquake and tsunami took place. *Chikyu* was damaged by the tsunami in the Hachinohe harbor in northeast Japan, and all programs that had been planned for implementation using *Chikyu* had to be delayed or canceled, including NantroSEIZE and KANAME. On the other hand, IODP immediately planned and conducted drilling at the Japan Trench, at the site of the Tohoku-oki earthquake, after *Chikyu* was repaired. We modified the KANAME project to include research on the Japan Trench and drilling at other subduction zones, such as Costa Rica. Many new findings and papers have been produced as a result of the KANAME project. The project was completed in 2015, but the NantroSEIZE effort is ongoing. This special issue presents some of the results of the KANAME project, mainly by scientists who took part in the project, although many papers have already published in other journals. Drs. Shelly and Rowe were invited as guest editors in addition to our internal guest editors (Kimura, Kinoshita, and Ashi).

This issue includes 33 papers:

- (1) The Nankai trough (14 papers; Sugihara et al. 2014, Yamano et al. 2014, Tsuji et al. 2014, Idehara et al. 2014, Akuhara and Mochizuki 2014, Hyodo et al. 2014, Ashi et al. 2014, Tanikawa et al. 2014, Takahashi et al. 2014, Yamada and Shibamura 2015, Hamada et al. 2015, Takeshita et al. 2014, Hino et al. 2015, and Toki et al. 2014)
- (2) The Japan trench (6 papers; Aochi and Ide 2014, Nakamura et al. 2014, Koge et al. 2014, Lin et al. 2014, Sawai et al. 2014, and Boston et al. 2014)
- (3) Other trenches and fault zones (4 papers; Maekawa et al. 2014, Namiki et al. 2014, Ishikawa et al. 2014, and Yabe et al. 2014) and ancient accretionary complexes and faults on land (7 papers; Schumann et al. 2014, Hamahashi et al. 2015, Fukuchi et al. 2014,

\* Correspondence: gaku@eps.s.u-tokyo.ac.jp

<sup>1</sup>Department of Earth and Planetary Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku 113-0033, Tokyo, Japan

Full list of author information is available at the end of the article

- Kameda et al. 2014, Yamaguchi et al. 2014, Kogure et al. 2014, and Hashimoto and Yamano 2014)  
 (4) Theoretical treatments of fracture and earthquake (2 papers; Kame et al. 2014 and Nishiyama et al. 2014)

The papers are also categorized into three scientific issues, focusing on different regions within each topic:

- (1) Framework and setting of the seismogenic zone from the view point of seismicity in the Nankai trough (Idehara et al. 2014, Akuhara and Mochizuki 2014), Japan Trench (Aochi and Ide 2014), Hikurangi margin (Yabe et al. 2014), or from the geological and geophysical points of view for the Nankai Trough (Tsuji et al. 2014, Ashi et al. 2014, Sugihara et al. 2014, Yamano et al. 2014) and Japan Trench (Boston et al. 2014, Koge et al. 2014, Nakamura et al. 2014, Lin et al. 2014)
- (2) Material and physical properties or conditions of the fault for the Nankai Trough (Takahashi et al. 2014, Tanikawa et al. 2014, Hamada et al. 2015), the Japan Trench (Sawai et al. 2014), and the Costa Rica margin (Namiki et al. 2014)
- (3) Analysis of water–rock interaction with faulting in an ancient accretion complex and fault in the Shimanto Belt, Japan (Schumann et al. 2014, Hamahashi et al. 2015, Fukuchi et al. 2014, Kameda et al. 2014), Chelunpu Fault, Taiwan (Maekawa et al. 2014), Alaska (Yamaguchi et al. 2014), Median Tectonic Line, Japan (Ishikawa et al. 2014), crustal rocks on land (Kogure et al. 2014), and theoretical treatment of fracturing, friction, and earthquakes (Nishiyama et al. 2014, Kame et al. 2014)

Traditional research on earthquakes is physics-based, but physico-chemical processes and their geological record in fault rocks, both in active and inactive fossilized rocks, are of recent concern. Many studies of natural records of seismic faulting have been conducted in terms of their physico-chemical processes. The Japanese islands are composed mainly of ancient and modern accretionary complexes, some of which were exhumed from the seismogenic depth of the plate boundary megathrust and yield the best analog of seismogenic fault rocks in the subduction zone. This special issue will present such examples.

#### Authors' contributions

GK wrote the draft of the paper and others confirmed the contents. All authors read and approved the final manuscript.

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#### Author details

<sup>1</sup>Department of Earth and Planetary Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku 113-0033, Tokyo, Japan. <sup>2</sup>Atmosphere and Ocean Research Institute, the University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa,

Chiba 277-8564, Japan. <sup>3</sup>Kochi institute for Core Sample Research, Japan Agency for Marine-Earth Science and Technology, 200 Monobe Otsu, Nankoku City 783-8502, Kochi, Japan. <sup>4</sup>Earth and Planetary Sciences Department, McGill University, Montreal, QC H3A 0E8, Canada. <sup>5</sup>US Geological Survey, 345 Middlefield Road MS910, Menlo Park, CA 94025, USA.

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