Preface

This special issue consists of contributions from the 2nd International Symposium on Slip and Flow Processes in and below the Seismogenic Region, which was held in Tokyo, Japan from March 10 through 12, 2004.

"Comprehensive Research on Slip and Flow Processes In and Below the Seismogenic Region" is the title of a research project that has been conducted from 1999 to 2003 (fiscal year) under the Special Coordination Fund for Promotion of Science and Technology scheme. At the end of the first phase of the project, we held the first "International Symposium on Slip and Flow Processes in and below the Seismogenic Region" in Sendai in November 2001 to review preliminary results and related activities. The special issue (Earth, Planets and Space, Vol. 54, No. 11, 2002) was published by contributions from this symposium. This time, we held the second international symposium at the end of the second phase of the project to review the results and recent progress on this topic around the world, and clarify the subjects for future research.

This project has been fostered by collaboration between geologists, geophysicists, and seismologists. It closely integrates field observations, laboratory experiments, and numerical modelling to clarify the mechanisms by which inland (i.e. non-subduction interface) earthquakes occur, in particular the role of the lower crust beneath the seismogenic fault.

Strong inland earthquakes occur directly below populated areas and cause enormous damage to human lives. In order to minimize seismic risk due to inland earthquakes, it is important to forecast the occurrence of such earthquakes beforehand. At present, the forecasting of inland earthquakes is conducted by statistical methods based on historical and geological data of fault activities, and a long-term seismic hazard for major active faults in Japan is successfully being revealed by these methods. However, temporal resolution of such a long-term prediction is of the order of several hundred years and is not good enough to perform effective risk management. Furthermore, there appears to be little scope for improving the accuracy of prediction using this approach. Therefore it is essential to understand the mechanism by which inland earthquakes occur and to establish a physics-based forecasting method, which focuses on the state of active faults and its temporal change.

The generation mechanism of inland earthquakes, however, is poorly understood in contrast to the case for interplate earthquakes. It has been a common idea that inland earthquakes are a phenomenon that is basically confined to the upper crust, regarded as an elastic medium, and that inland earthquakes occur when the shear stress accumulated in the upper crust by relative plate motions exceeds a threshold value, 'the strength'. This idea, however, cannot explain fundamental characteristics of inland earthquakes, such as recurrence times much longer than those of interplate earthquakes. In recent years, several observations suggest the possibility that the lower crust plays an important role in generating intraplate earthquakes. A new hypothesis, in which slow slip and flow processes in and below the seismogenic region play an important role in the mechanism of earthquake occurrence on active inland faults, is now being widely considered (e.g., Iio and Kobayashi, 2002).

Key questions to be addressed are as follows.

1. Is deformation localised in the lower crust?
2. How is deformation localised in the lower crust? What is the geometry of localised shear zones in the lower crust? Do they flatten with depth?
3. Why is deformation localised in the lower crust? Is the lower crust the "master" or the "slave" of the upper crust?
4. How is stress accumulated in intraplate regions? Are seismogenic faults loaded from below (ductile deformation in the localized shear zone) or from the side (by regional stress accumulations)?
5. What kind of constitutive relationships govern the deformation in fault zones, friction law and/or flow law?

The papers presented in this special issue try to answer these questions from various points of views and indicate much recent progress on these topics. The guest editors, however, regret that several important papers were not included in this special issue, partly because of tight deadline for rapid publication and the limited space available in the special issue.

We would like to thank the participants of the symposium, in particular those from outside Japan, and the members of the organising committee; Norihito Umino, Hisao Ito, Takeshi Sagiya, Bunichiro Shibazaki, Hiroshi Sato, Shigetsugu Uehara, and Makoto Ogata. Finally, we would like to express our gratitude to the Ministry of Education, Culture, Sports, Sciences and Technology (MEXT) for sponsorship and to Prof. Yoshimori Honkura for his continuous encouragement for the special publication.

Guest Editors: Yoshihisa Iio
Yasuo Ogawa
Koichiro Fujimoto
Richard J. Norris

Reference

Iio, Y. and Y. Kobayashi, A physical understanding of large intraplate earthquakes, *Earth Planets Space*, **54**, 1001–1004, 2002.