IODP Proposal Cover Sheet

KKanto Asperity Project: Observatories

770 - Full 3

Title	Kanto Asperity Project KAP Program B Geodetic and geophysical monitoring of slow-slip events in the southern Kanto region for revealing the processes of slow-slip events and establishment of earthquake generation models
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Area	Off Boso Peninsula

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Abstract:

KAP Program B is a long-term monitoring project for observing several cycles of slow-slip events (SSEs) to reveal slow-slip phenomena and to improve earthquake generation models. The discovery of SSEs has added a major new factor to our understanding of how plate boundaries accommodate relative plate motions. Plate boundaries were previously thought to relieve stress through either continuous aseismic sliding or earthquakes with instantaneous failure. SSEs are an important global mechanism regulating stresses on plate boundaries, and a key to a full understanding of tectonic behavior at plate boundaries.

To investigate SSEs, many studies have applied earthquake generation models, usually used for typical earthquakes, to SSEs. Although these simulation studies are useful for understanding the processes of SSEs, earthquake generation models are not yet fully successful. Among the issues to be addressed, two are especially important: (1) previous models were developed using data from laboratory experiments rather than natural events, and (2) previous models have used several different fault constitutive laws. Continued progress in earthquake generation models requires data from long-term observations over entire event cycles, with which simulations using several fault constitutive laws can be conducted. This project proposes to improve earthquake generation models and better understand the processes of SSEs based on data from SSE monitoring and simulations.

For these observations and simulations, the Boso SSEs are one of the best candidates because they occur every 4–6 years, allowing us to obtain data on two or three whole event cycles during 10–15 years of observation. Unlike most studies of geologic processes, KAP Program B holds the promise of quickly achieving model improvements by repeated forecasting and observation of SSEs, allowing feedback from observations to the model. Therefore, establishing earthquake generation models using data from SSEs holds out the promise of a great and rapid advance in earthquake science.

This project proposes drilling at six offshore sites and constructing an observation network covering the Boso SSEs to record the slip distribution during entire SSE cycles. Measurements will be made with highly sensitive tiltmeters, broadband seismometers, and depth sensors installed in boreholes.

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Scientific Objectives

To observe all parts of the event cycle and develop realistic earthquake-generation models using the resulting SSE data, we propose the following strategy:
1) We plan to estimate spatial and temporal distributions of slip at each step of the event cycle to insert into earthquake generation models, including coupling rates, nucleation processes, dynamic behaviors, and aftershocks and afterslips. To do this, we need an observation network with a spatial resolution of ~20 km.
2) We will assimilate the slip distribution data to determine the distribution of parameters such as stress drop and critical displacement (Dc) through the relation between stress change and slip amount or slip rate.
3) Using numerical simulations of event cycles using the estimated parameters and various fault constitutive laws, we will try to reproduce the estimated slip distributions and determine the optimum constitutive law and its parameters.

Through the above observations and simulations, we hope to answer major questions about SSEs: (1) What parameters affect slip duration and slip speed? (2) How are SSEs related to seismic events such as swarms and tremor? (3) What governs frictional properties in areas that are transitional between creeping and fully locked states? (4) What confining stresses are needed for slow slip? We also hope to establish realistic earthquake generation models using SSE monitoring and simulations. This will contribute to the quantitative forecasting of earthquakes and will be useful for mitigation of earthquake hazards.

Non-standard measurements technology needed to achieve the proposed scientific objectives.

Long-term monitoring observatories will require installation of tiltmeters, broadband seismometers, and pressure gauges (= depth sensors).

Proposed Sites

Site Name	Position (Lon, Lat)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
KAP-1A	140.497846, 34.714983	2000	300	100	400	KAP Program B is a long-term monitoring project for observing several cycles of slow-slip events (SSEs) to reveal slow-slip phenomena and to improve earthquake generation models. At KAP-1, we propose to drill to 400 meters below sea floor (mbsf) and install simple long-term monitoring system, constraining the southern margin of the SSEs region.
KAP-2A	140.656748, 34.881025	1645	600	100	700	KAP Program B is a long-term monitoring project for observing several cycles of slow-slip events (SSEs) to reveal slow-slip phenomena and to improve earthquake generation models. At KAP-2, we propose to drill to 700 meters below sea floor (mbsf) and install simple long-term monitoring system, detecting the dominant slip behavior of the SSEs.
KAP-3A	140.809153, 35.040507	1225	500	100	600	KAP Program B is a long-term monitoring project for observing several cycles of slow-slip events (SSEs) to reveal slow-slip phenomena and to improve earthquake generation models. At KAP-3, we propose to drill to 600 meters below sea floor (mbsf)

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-	-	-	-	-	-	and install simple long-term monitoring system, detecting the dominant slip behavior of the SSEs.
KAP-4A	141.109503, 35.340191	565	600	100	700	KAP Program B is a long-term monitoring project for observing several cycles of slow-slip events (SSEs) to reveal slow-slip phenomena and to improve earthquake generation models. At KAP-4, we propose to drill to 700 meters below sea floor (mbsf) and install simple long-term monitoring system, constraining the northeast margin of the SSEs region.
KAP-5A	140.765538, 34.596611	3460	300	100	400	KAP Program B is a long-term monitoring project for observing several cycles of slow-slip events (SSEs) to reveal slow-slip phenomena and to improve earthquake generation models. At KAP-5, we propose to drill to 400 meters below sea floor (mbsf) and install simple long-term monitoring system, constraining the southeast margin of the SSEs region.
KAP-6A	140.887397, 34.954181	1840	800	100	900	KAP Program B is a long-term monitoring project for observing several cycles of slow-slip events (SSEs) to reveal slow-slip phenomena and to improve earthquake generation models. At KAP-6, we propose to drill to 900 meters below sea floor (mbsf) and install simple long-term monitoring system, detecting the dominant slip behavior of the SSEs.