Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SCG60-01 Room:105 Time:May 24 09:00-09:15

Deformation structure around the Sagami Knoll and Manazuru Knoll observed by seismic reflection data

NO, Tetsuo[1*], TAKAHASHI, Narumi[1], MIURA, Seiichi[1], YAMASHITA, Mikiya[1], TAKIZAWA, Kaoru[2], KODAIRA, Shuichi[1]

[1]JAMSTEC, [2]Nippon Marine Enterprises

Great earthquakes (e.g., the 1923 Great Kanto earthquake, the 1703 Genroku earthquake) have frequently occurred in the Sagami Trough, including Sagami Bay, causing very strong vibrations, large tsunamis, and serious damage around the Kanto and Tokai areas. In January 2010, we conducted a multi-channel seismic reflection (MCS) survey in Sagami Bay using the *R/V Kairei* of the Japan Agency for Marine-Earth Science and Technology. The survey lines were set according to the drilling sites proposed for the IODP (Integrated Ocean Drilling Program) expedition of the Kanto Asperity Project.

The following results were obtained from seismic reflection data. The Manazuru Knoll was formed as an asymmetrical anticline and its height difference is smaller towards the east. The Manazuru Knoll forms a Z-shaped bend toward the south near its eastern end, with its easternmost point located at the bottom of the Sagami Knoll. The offset distance of the strike of the Z-shaped fold is approximately 7 km. According to the results of seafloor geodetic observation in Sagami Bay (Saito et al., 2008), Sagami Bay has been moving to the northwest at a speed of 4.1 cm/year. From the results of seafloor geodetic observations and the offset distance of the Manazuru Knoll, the formation of the L-shaped bend has taken approximately 0.17 Ma. Furthermore, the growth of a reverse fault that is related to the formation of the Manazuru Knoll is clearly confirmed on the west and south sides of the knoll. This reverse fault formed when the Manazuru Knoll was forming by the relative motion of the Philippine Sea Plate to the north. When the relative motion of the Philippine Sea Plate shifted northwest, strike-slip plate motion occurred near the survey area resulting in the Z-shaped bend of the Manazuru Knoll. Moreover, the knoll on the west side of plate boundary is thought to have moved to the northwest. Subsequently, the Sagami Knoll is assumed to have accreted to the easternmost part of the Manazuru Knoll. This may explain the differences in the geological ages of the north and south regions of the Sagami Knoll obtained from dating of calcareous nanofossils (Kanie et al., 1999). Inside the Sagami Knoll we identified a clear reflector inclined toward the northeast from the western margin of the knoll. The inclination angle of this reflector becomes high toward the north. Compared with the results of the two-ship seismic reflection survey in the Sagami Trough (Sato et al., 2010), this reflector is believed to be part of a splay fault from the plate boundary, which is the extension of the Kozu-Matsuda fault. The reflector from the Philippine Sea Plate, which is estimated to be just below the knoll, returns a very weak seismic signal and the location indicated that it deepens gradually toward the north.

Keywords: Sagami Knoll, Seismic reflection survey, Manazuru Knoll, Sagami Bay, Kanto Asperity

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SCG60-02 Room:105 Time:May 24 09:15-09:30

Chemical and mineralogical characteristics of the slip zone within the Boso accretionary complex

MATSUTA, Noriko[1*], ISHIKAWA, Tsuyoshi[2], HIRONO, Tetsuro[1]

[1]Earth and Space Science, Osaka Univ., [2]JAMSTEC kochi

To understand the chemical and mineralogical characteristics of the slip zone within subduction-boundary fault and its branching thrust, we investigated a major reverse fault in a fossil accretionary prism, the Emi Group (burial depth 1 to 4 km), Boso Peninsula, Japan. We examined the slip-zone rocks and the surrounding host rocks microscopically, and analyzed their trace elements, isotopes, and mineralogy. Using the X-ray diffraction spectrum, smectite, illite, and their mix layer were decreased within the slip zone. In addition, anomaly of the fluid-mobile trace elements such as Li, Cs, and Rb was observed showing that the slip zone experienced frictional heating of $>$350 degree celsius caused by high-velocity sliding. In this presentation, we show these preliminary results and discuss the causes of the characteristics and their implication on the seismogenesis and earthquake slip

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SCG60-03 Room:105 Time:May 24 09:30-09:45

Estimation of slip distributions of the 1923 Kanto and 1703 Genroku earthquakes using curved fault plane

KOBAYASHI, Reiji[1*], KOKETSU, Kazuki[2], MIURA, Seiichi[3], NO, Tetsuo[3]

[1]Kagoshima Univ., [2]ERI., Univ. Tokyo, [3]JAMSTEC

Great earthquakes along the Sagami trough, where the Philippine Sea slab is subducting, have repeatedly occurred. The 1703 Genroku and 1923 (Taisho) Kanto earthquakes (M 8.2 and 7.9, respectively) are known as typical ones, and cause severe damages in the metropolitan area. The recurrence periods of Genroku- and Taisho-type earthquakes inferred from studies of wave cut terraces are about 200-400 and 2000 years, respectively (e.g., Earthquake Research Committee, 2004).

We have inferred the source process of the 1923 Kanto earthquake from geodetic, teleseismic, and strong motion data (Kobayashi and Koketsu, 2005; Sato et al., 2005). Kobayashi and Koketsu (2008, AGU Fall Meeting) introduced a new curved fault plane by integrating models of the Philippine Sea slabs (Sato et al., 2005; Hagiwara et al. 2006; Takeda et al. 2007), and inverted geodetic data for the slip distributions of the 1703 earthquake and inverted simultaneously geodetic and teleseismic data for the source process of the 1923 earthquake.

The inversion method is based on Yoshida et al. (1996). We modified it for triangular subfaults. For source process, to obtain the times when the rupture front with a given constant velocity reaches at the point source, the distance between hypocenter and each point source is measured because rupture propagate along the curved fault plane. We applied the Dijkstra method to measure the distance.

The Green's functions are calculated by the frequency-wavenumber method of Zhu and Rivera (2002) for geodetic data, and by a ray theory for teleseismic data. At the present stage, we assumed a 1-dimensional seismic structure model for both geodetic and teleseismic data. The strikes and slips of subfaults differ from those of others.

We inverted the same geodetic and teleseismic data as those of Kobayashi and Koketsu (2005) and Sato et al. (2005) for the source process of the 1923 Kanto earthquake by using the developed method for a curved fault plane. The preliminary result of the slip distribution is roughly consistent with that of Sato et al. (2005), suggesting that our method is considered to be adequate.

We improved the geodetic Green's functions so that the fitness between observed and synthetic data. Previously we distributed one point source at the centroid of each subfault, and calculated the Green's function. Slips on the shallowest part of subfaults can cause large displacements at closest stations. The Green's functions with one point source can not reflect such effects. Thus we divided the subfaults into 16 small triangles and located point sources at the centroids of the small triangles. We calculated 16 Green's functions and average them. The average is a new Green's function of the subfault.

We also attempt to update the curved fault plane, because several seismic surveys have been performed recently and new upper surface models of the Philippine sea plate have been presented. We incorporate the new models into our fault plane model.

Keywords: the 1923 Kanto earthquake, the 1703 Genroku earthquake, asperity

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SCG60-04 Room:105 Time:May 24 09:45-10:00

Fault slip of the Genroku EQ from Holocene paleoshoreline data on Boso and Miura using an earthquake cycle model - III

SATO, Toshinori[1*], TSUMURA, Noriko[1], ITO, Tanio[2], HASHIMOTO, Chihiro[3], MATSU'URA, Mitsuhiro[4], MIYAUCHI, Takahiro[1], ENDO, Kaori[1]

[1]Earth Sciences, Chiba Univ., [2]Teikyo-Heisei Univ., [3]Environmental Studies, Nagoya Univ, [4]Institute of Statistical Mathematics

1. Introduction

South Kanto district has suffered repeatedly from large earthquakes such as the 1923 Kanto Earthquake (Taisyo type) and the 1703 Genroku Earthquake (Genroku type). Sato et al. (2006, 2007) and Higuchi et al. (2006) developed a new method that can divide the coseismic, interseismic and permanent displacements from marine terrace data using our earthquake cycle model, and estimated slip distribution of the 1703 Genroku earthquake from marine terrace data on the Boso Peninsula. Recently, Endo & Miyauchi (2011) presented a reexamination in ages and altituds of Holocene emergent coastal geomorphology at the Boso Peninsula. In this presentation, we use the revised data on the Boso and add data on the Miura, and conduct an inversion analysis with larger slip area and a slip direction constraint.

2. Method

Our earthquake cycle model can estimate the permanent displacements if we have two or more paleoshoreline data whose ages are different, and can divide the coseismic, interseismic and permanent displacements (Sato et al. 2006). We estimate slip distribution of the 1703 Genroku Earthquake with constraints of smooth slip distribution and slip direction parallel to plate convergence using ABIC inversion method (Matsu'ura et al. 2007). In this calculation, we use a plate boundary configuration between the Philippine Sea plate and the North American plate proposed by Tsumura et al. (2009). They showed a subducted sea mount at the off Boso Peninsula. The data on Holocene paleoshorelines in south Boso region are from Endo & Miyauchi (2011) and Shishikura (2001), and in Miura region from Kumaki (1981) and Shishikura and Echigo (2001).

3. Results

The estimated slip distribution of the 1703 Genroku earthquake shows large slip amount more than 28m beneath the Sagami Bay and the southern Boso Peninsula. The estimated Magnitude is about Mw 8.5. Most of slips occur at shallow part (less than 10 km depth) of the plate boundary. Amount of coseismic uplift is about 4m at south tip of the Boso Peninsula from estimation of post seismic viscous rebound, permanent deformation and slip deficit by interplate coupling. This amount is smaller than that formerly known as 5-6m.

Keywords: source mechanism, marine terrace, earthquake cycle model, megaquake

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A thinned portion of the Philippine Sea slab and the Quaternary crustal deformation at the Kanto region

SASAJIMA, Ryohei[1]*

[1]Nihon University

Recently, it has revealed that strange geometry of the Philippine Sea slab (=the PH slab) underlying the Boso Peninsula; eastern Tokyo metropolitan area in Japan. The upper surface of the PH slab has a dent sharply there. At this area, the upper surface and the underside of the PH slab touches the North American plate and the Pacific plate respectively. So there is no space for deformation like this.

Then, in this study, I formulate and test two hypotheses that the Philippine Sea slab (= the PH slab) is locally thinned under the Boso peninsula. And moving the PH slab holding its geometry has caused the noticeable Quaternary crustal deformation in this area. If it is true that the PH slab is locally thinned, a depth of upper surface of the PH slab deepens and shallows with the slab subducts. Therefore, it is presumed that the noticeable crustal deformation appears to the hanging wall as it subducts. Then, I calculate the crustal deformation of the hanging wall which caused by moving the thinned part of the PH slab. And so, I try to test that hypothesis by whether the calculated data are coincident with the observed Quaternary crustal deformation or not. I approximate moving the thinned portion of the PH slab by opening and closing dozens of rectangle faults along the upper surface of the PH slab. Thus, I calculate the crustal deformation by a program of the dislocation model. As a result, the calculated crustal deformation corresponds very well with the Quaternary crustal deformation at southeastern Kanto region; a subsidence area at the Tokyo bay, the Kashima-Boso uplift zone and rapid uplift zone at southern part of the Boso Peninsula; in terms of the pattern, relative amount, location, course of movement of the pattern and velocity of movement of one. It also shows the same pattern as the uplift of the 1703 Genroku earthquake at the southern Boso Peninsula.

The most possible reason why this part of the PH slab was thinned is that the oceanic crust was torn off the PH plate and accreted to the hanging wall several years ago. In other words, the subduction boundary of the PH plate was shift to more offshore; southern off the Boso peninsula. I try to restore the PH plate and the Central Japan plate; at Kanto and Tokai region from present to 5Ma according to the Euler pole on the paper. Then I reach one assumption that the oceanic (arc) crust was torn off the PH plate and accreted to the southern part of the Boso peninsula and southeastern off the southern tip of the Boso peninsula; the area enclosed between the Kamogawa fault belt and the Sagami trough, from 5Ma to 0.5Ma. In this area there is the age-old oceanic crust in the Mineoka tectonic zone. The existence of this age-old oceanic crust at this location confirms the existence of the thinned part of the PH slab paradoxically.

Keywords: thinned slab, Quaternary crustal deformation, stripping a oceanic crust, sifting of a subduction boundary, subcidence area at the Tokyo bay, Kashima-Boso uplift zone