Puglia 2003 - Final Conference
Project IGCP 437

Coastal Environmental Change
During Sea-Level Highstands:
A Global Synthesis with implications
for management of future coastal change

Otranto / Taranto - Puglia (Italy) 22-28 September 2003
Quaternary coastal morphology and sea level changes

Project 437

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Two types of characteristic earthquake along the subduction zone of Sagami Trough, central Japan, identified by Holocene paleoshoreline indicators.

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Keywords: *paleoshoreline, characteristic earthquake, seismotectonics, Holocene, Sagami Trough, central Japan*

Abstract

Sagami Trough extending NW-SE off South Kanto, central Japan is convergent plate boundary where the Philippine Sea Plate subducts beneath the North American Plate (Fig. 1).

Two major historical earthquakes of the 1703 Genroku Kanto Earthquake (*M* 8.2) and the 1923 Taisho Kanto Earthquake (*M* 7.9) occurred along the trough. As a result of the coseismic crustal movements associated with these earthquakes and repeated pre-historical earthquakes, Holocene paleoshoreline indicators (e.g. emerged wave-cut bench, fossilized mollusk etc.) classified into 15 levels are distributed below 30 m asl. along the coast of the Miura Peninsula and the Boso Peninsula. The lower two levels of paleoshorelines are related to the 1703 and 1923 events respectively. The height distributions of them in the Miura Peninsula are measured at 1.0-1.5m (the 1923 shoreline) and 2.2-2.6m (the 1703 shoreline) above mean sea level (Fig. 2). The amounts of uplift of both events are therefore estimated to be almost equal as 1.0-1.5m. On the contrary, the trends of coseismic crustal movement deduced from the historical documents and the height distributions of paleoshorelines in the Boso Peninsula were quite different between two events. Although the Boso Peninsula was gently tilted by uplift of 0.5- 2.0 m during the 1923 event, it had resulted steep tilting accompanied with uplift of more than 5 m in the southernmost area and subsidence of ca. 1 m in the central area during the 1703 event (Fig. 1). This tectonic difference is expressed as the shape of marine terraces. The 1703 terrace is about ten times wider than the 1923 terrace because of large uplift.

Based on above results, it is inferred that the fault source model of the 1703 event consists of dual fault system of fault A and B (Fig. 1).

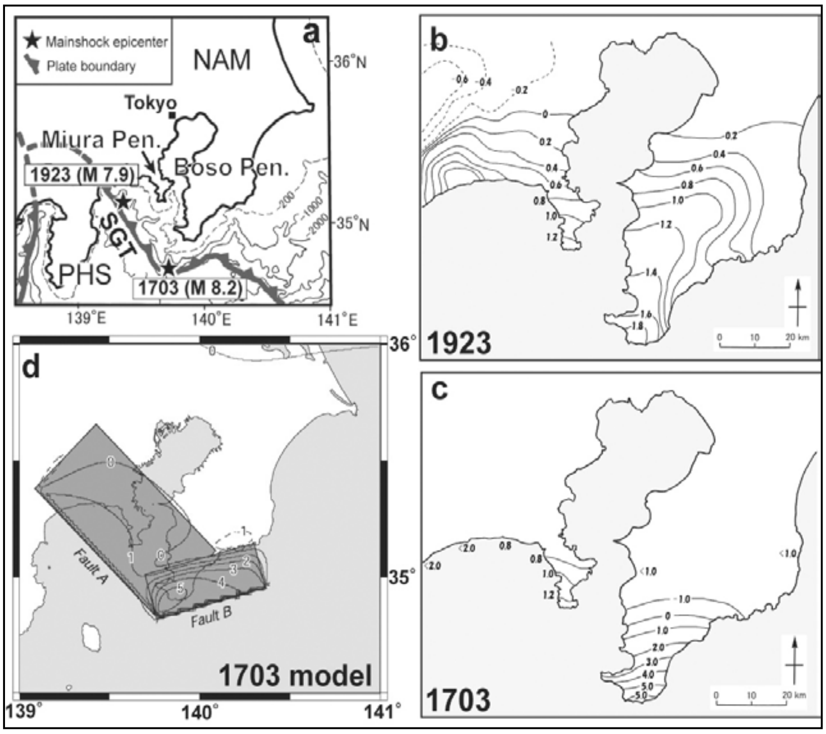

Figure 1. Tectonic setting and seismotectonics during the historical earthquakes. **a:** Tectonic setting around South Kanto (SGT: Sagami Trough, NAM: North American Plate, PHS: Philippine Sea Plate). **b**: Coseismic vertical displacement during the 1923 Taisho Kanto Earthquake, based on geodetic data after Miyabe (1930). Contours are in meters. **c:** Coseismic vertical displacement during the 1703 Genroku Kanto Earthquake, deduced from the historical documents and the height distributions of paleoshorelines. Contours are in meters. **d:** Fault source model of the 1703 Genroku Kanto Earthquake, estimated by inversion analysis.

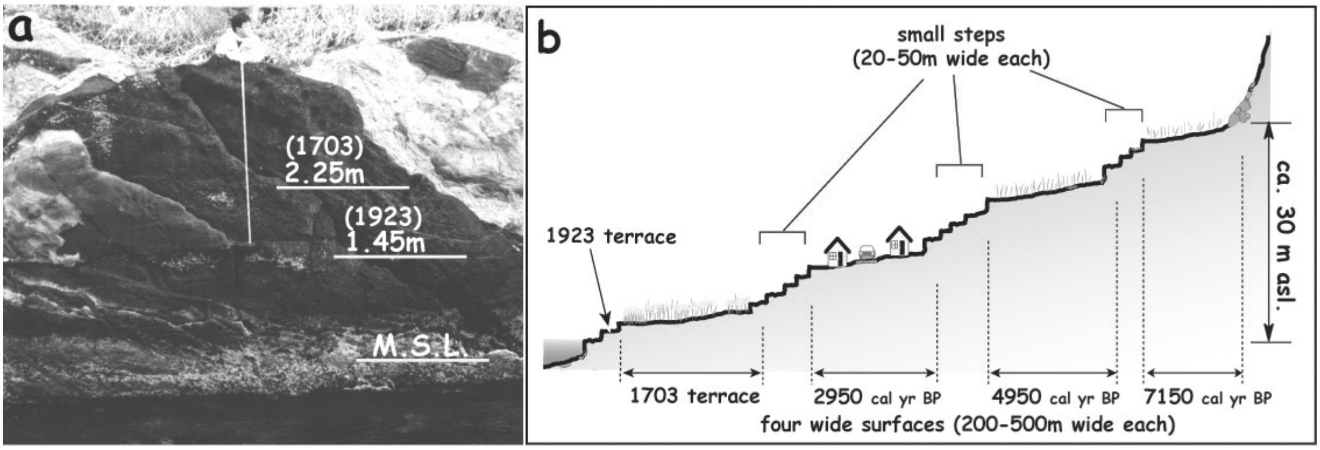

Figure 2. Paleoshoreline indicators in the Miura Peninsula and the Boso Peninsula. **a:** Photo of historical uplifted sessile assemblages (*Pomatoleios Kraussii*) in the Miura Peninsula. **b:** Schematic geomorphic profile in the southernmost part of the Boso Peninsula.

The fault A is same as the model of the 1923 event which has already been estimated by Ando (1974). The uplift of the Miura Peninsula (both the 1703 and 1923 events) and the Boso Peninsula (only the 1923 event) can be explained by about 6.7 m slip of the fault A. The fault B is low angle dip thrust located off the southeast of the Boso Peninsula. The unique movement of the 1703 event in the Boso Peninsula has been derived from about 12 m slip of the fault B.

Regional and historical differences of seismotectonics can be recognized also in the distribution of the upper paleoshoreline indicators. Marine terraces developed along the southernmost coast of the Boso Peninsula are composed of four levels of wide surfaces accompanied with several narrow steps between of them (Fig. 2). This geometry suggests that four large uplift events of the 1703 type occurred at one of several times of repeated small uplift events of the 1923 type. However, in the Miura Peninsula, there is no variable distribution of paleoshoreline indicators. Uplift movements seem to have been occurred increments of 1.0-1.5m characteristically.

Emergent ages of the paleoshorelines were estimated from ^{14}C ages of shells and humic samples. Although every small uplift event of the 1923 type could not be dated, it occurred at least three times until 5,300 cal yr BP since 6,800 cal yr BP. And after more three non-dated events, it occurred at 3,200 cal yr BP, around 2,300 cal yr BP, 1,300 cal yr BP, around 900 cal yr BP and AD 1923. Four levels of wide terraces representing the 1703 type events had already been dated by Nakata et al. (1980) as 7150, 4950, 2950 cal yr BP and AD 1703.

These occurrence ages of events indicate that the characteristic earthquake generated from the fault A has been occurred repeatedly about every 400 years. Recurrence interval of the 1703 type earthquake accompanied with the slip of fault B is 2000-2700 years. Therefore, the slip rate of these faults are calculated to be 16.8 mm/year (fault A) and 5.2 mm/year (fault B) respectively. These value are greatly different each other and smaller than the recent back-slip rate (30 mm/year) estimated from GPS data (Sagiya, 1998).

References

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