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Geomorphic Evidence of Uplifting Associated with Old Kanto Earthquakes Before 1703 in a Coast of Miura Peninsula, Japan

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The 1923 Kanto earthquake (M7.9) and the 1703 Kanto earthquake (M˜8.2) were two of recent great earthquakes generated by the slip on the boundary between the subducting Philippine Sea plate and the overlying plate. These earthquakes devastated the southern Kanto area, resulting in more than 105,000 deaths mainly in Tokyo in 1923 and in more than 10,000 deaths in 1703, respectively.

In 1923, the amount of the coseismic uplift was measured as ˜1.5 m in the southern part of the Miura and Boso peninsulas. On the other hand, in 1703, the amount of the coseismic uplift was measured as ˜1.5 m in Miura and 4-5 m in Boso, respectively, from the emerged wave-cut-bench and -notch, and the fossil remains along the coast [eg., Matsuda et al. (1978), Shishikura et al. (2007)].

In Miura Peninsula, in additon, three additional steps of marine terrace surface are formed at 7 to 20 m above MSL, at ˜5200,˜3300 and ˜1500 cal. BC, and these are called Nobi 1, 2 and 3 in order from top [Kumaki, 1985; 14C Age was calibrated]. These terraces are inferred to have been formed with coseismic uplift. In addition, two or three additional steps of marine terrace surface are identified in the levels between the Nobi 3 and 1703 emerged coast at the Bishamon Bay in the southern tip of the Peninsula [Geographic Department of Geographical Survey Institute, 1981]. However, the formation date is very poorly taken. Recently, at the head of Koajiro bay in southwestern Miura, tsunami deposits associated with pre-1703 earthquake was dated between 1060 and 1400 cal. AD [Shimazaki et al. (2011)]. However, the amount of uplift is not studied.

We need to know the amount of the vertical crustal movement and the occurrence date for the Kanto earthquake prior to 1703, for better understanding the earthquake cycle, and thus to estimate the average recurrence time and the magnitude of earthquake for estimating the future earthquake hazard. So we sought the trace of the crustal movement along the coastal region in the southwestern Miura Peninsula. To identify the uplifts associated with recent great Kanto earthquakes, we made a high-density (50 cm mesh) digital elevations map by aerial measurements of the Light Detection and Ranging (LiDAR) in southwestern coast of the Peninsula. In addition, we analyzed air photos taken in 1946, 1963 and 1966.

As a result, five to six steps of marine terrace surface were observed between the Nobi 3 surface and the present coastline, including the 1923 and 1703 emerged terrace surfaces, in the alluvial valley. These terrace surfaces are edged in a small cliff of the height of 1-2 m. In addition, LiDAR data indicate flights of wave-cut-bench on rocky coast (8 m above MSL) in Jogashima, southernmost tip of Miura. These marine terrace surfaces may indicate additional evidence of the uplift associated with the Kanto earthquakes.

Compared the 1:25,000 of old topographic map made in 1921 by Land Survey Department and in 1966 by Geography Survey Institute, the regradation of the coastline is identified in the coast area of Miura. The coastline was shifted from the land side to the sea side, thus the zone between 1921 and 1966 coastlines was dried from the sea to the land. At the bay head of Koajiro, the sea was dried up approx. 300 m in the length. The lowest level of terrace surface which was identified from LiDAR Data and old topographic map have been formed by 1923.

Keywords: Pre-1703 Kanto Earthquake, Recurrence time, Amount of Uplift, Marine terrace sruface, Coastline