Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SCG57-30 Room:IC Time:May 28 15:45-16:00

Modeling and simulation for the development of Holocene marine terraces in the Boso peninsula

NODA, Akemi[1*] ; MIYAUCHI, Takahiro[2] ; SATO, Toshinori[2] ; MATSU'URA, Mitsuhiro[3]

[1]Kozo Keikaku Engineering Inc., [2]Graduate School of Science, Chiba University, [3]The Institute of Statistical Mathematics

In the southernmost part of the Boso peninsula, we can observe the well-developed Holocene marine terraces, called the Numa I-IV terraces. It has been confirmed that the lowest terrace (Numa IV) is the shore platform emerged at the time of the 1703 Genroku earthquake, which is considered to be a megathrust earthquake occurred at the plate interface beneath the Boso peninsula. From the similarity in the present altitude pattern between the Numa IV terrace and the others, it has been believed that the Numa I-III terraces also emerged by the occurrence of past Genroku-type earthquakes (Matsuda et al., 1978; Shimazaki & Nakata, 1980; Shishikura, 2003). In the case of large interplate earthquakes, however, the coseismic slip region is stuck soon, but the remaining parts of the plate interface go on slipping aseismically during the interseismic period. Then, the coseismic vertical displacement pattern gradually fades out with time (Matsu'ura & Sato, 1989). Therefore, the formation of the Numa I-III terraces should not be ascribed to the occurrence of past Genroku-type earthquakes, but to the Holocene sea-level fluctuation and the steady uplift of the southern Boso peninsula due to steady plate subduction (Matsu'ura & Noda, SSJ 2014 Fall Meeting, Abstracts, D11-03). In the present study, to verify such an idea, we developed a quantitative model for coastal landscape evolution by considering erosion, deposition, land uplift, and sea-level fluctuation, and then performed numerical simulations for the formation of Holocene marine terraces in the southern Boso peninsula.

The evolution of coastal landscape can be described by the following conceptual equation: altitude change = - erosion + deposition + land uplift - sea-level rise. In modeling sea-land interaction at shore, we supposed that the erosion rate is proportional to the dissipation rate of wave energy (Anderson et al., 1999), and the deposition rate of the floating materials produced by erosion decays exponentially as they are transported seaward. In the numerical simulation of Holocene marine terraces in the southern Boso peninsula, we used the steady uplift rate (1-4 mm/yr) due to plate subduction (Hashimoto et al., 2004). For the Holocene sea-level changes, we used a fluctuation curve obtained from the time series data of mean sea-level altitudes based on deep-sea oxygen isotope ratios (Siddall, et al., 2003) by fitting with cubic B-splines.

A set of sea cliff and shore platform is rapidly formed about a stationary point of the sea-level fluctuation curve. The Holocene sea-level fluctuation curve (from 10 kyrBP to the present) has seven stationary points, and so basically seven marine terraces are formed one by one over the period. In the case of low uplift rate, however, most of older terraces sink beneath the present sea level, and so we cannot observe them. Even in the case of high uplift rate, the relationship between the age and the present altitude of terraces is not simple, because the overlap and/or reverse of older and younger terraces occur frequently. Endo and Miyauchi (JSAF 2011 Fall Meeting, Abstracts, P-06) have confirmed such complexity through the reexamination in ages and altitudes of Holocene emergent coastal geomorphology in the southern Boso peninsula. In the present numerical simulation, taking the uplift rate to be 3-4 mm/yr, we obtained four well-developed marine terraces, corresponding to the Numa I-IV terraces. Even in this case, it should be noticed that the highest terrace is not the oldest terrace.

Keywords: Marine terrace, Sea level change, Steady land uplift, Erosion, Deposition