

## Discussion on the conditions of liquefaction sites caused in The 2011 off the Pacific coast of Tohoku Earthquake

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### 1. Introduction

Liquefaction, one type of seismic phenomenon, tends to occur in the lowland where a lot of people live. It occurs at unconsolidated sand ground with high groundwater level. The study of liquefaction started after two earthquakes struck Alaska earthquake and Niigata earthquake, which occurred in 1964.

Many studies of liquefaction have focused on the relationships between liquefaction sites and micro topography, in order to predict the risk of liquefaction. However, The 2011 off the Pacific coast of Tohoku Earthquake (Tohoku Earthquake) revealed that the present study was not able to make an accurate prediction. Among such situations, the liquefaction study focusing on landform changes or landform history was done after the Tohoku Earthquake.

Thus, this study clarifies the liquefaction sites in Tohoku earthquakes and tries to evaluate the influence of artificial landform changes on liquefaction occurrence. The previous study 3.11 after the Tohoku Earthquake focused on surface geology. In addition, this study focused not only on surface geology but also on incised river valley filled with thick (over several ten meters) soft sediments deposited since the Last Glacial stage, ca. 20 ka.

### 2. Study Area

This study focused on two study sites in the Kanto plain, reclaimed land of the Tokyo bay area (Tokyo bay area) and the lower reaches of the Tone river lowland (Tone river lowland). At these typical liquefaction sites during Tohoku earthquakes, artificial landform changes can be seen.

### 3. Method

To determine out the area of artificial landform, this study utilized aerial photo interpretation and bibliographic survey. To identify the sites of liquefaction, this study used previous literature sources and Google Earth which has the advantage of being able to observe damaged wide areas soon after the occurrence of the liquefaction associated with Tohoku Earthquake even if we can not assess the damaged areas. The thickness of the sedimentary fill was calculated from the geologic column and the N-value.

### 4. Result and Discussion

In Tokyo bay area, construction method of landfills have two steps. The first step was to fence the bank, and second was filling of the fenced areas with the sand pumped up from the adjacent sea floor. The areas built by these steps have been densely developed along the Tokyo bay. There is no clear relation between the liquefied site and the landfill age. In contrast, if the thickness of sedimentary fill is over 50m or valley area, liquefaction tends to occur.

The artificial change of the landform in Tone river lowland was confirmed from former river channels, former ponds, former lakes, former coastal sand dunes and former river bank dunes. Liquefaction has occurred in former river channels, former ponds, former lakes, margins of former sand dunes, margins of natural levee and cutting of sand dune. There is no clear relation between the liquefied site and the thickness of sedimentary fill. In contrast, if sand layer got into mud layer, liquefaction tends to occur.

Keywords: Earthquakes, Liquefaction, landform change, sedimentary fill