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# Impact of the 20110311 tsunami on the geography and sediment distribution in Kesennuma Bay, Miyagi, Japan.

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MMany tsunami deposits on land have been studied in order to evaluate the height and landward penetration of a tsunami and the age of the occurrence of the associated earthquake. However, the construction of disaster measures requires the age and scale for each earthquake using all tsunami deposits, including those traveling long distances such as the 2010 Chilean Tsunami, in the marine sediments in a coastal area. Currently, few data regarding the change in the geography and sediment distribution after a recent tsunami are available to assist in analyzing ancient tsunami deposits in marine sediments.

In Kesennuma Bay, the study area, the sea bottom was scoured, the geography and sediments were altered, and much debris, oil, and chemical materials flowed into the sea from land as a result of the 2011 tsunami. The change of geography and sediment distribution by this tsunami are the modern analog for analysis of the tsunami record in strata. Thus, highly precise information applicable to the restoration of historical tsunami deposits can be obtained by this investigation. We collected data on water depth, refraction intensity by acoustic systems, and four sediment samples, interpreted the intensity related to the physical properties (density, particle form and grain size) of the sediment, made a three-dimensional topographical map and distribution map of the sediment and debris, and evaluated the marine environmental change based on a comparison with a chart published before 11 March 2001.

The altitude at three bench marks around the bay decreased about 0.7 m after the earthquake. This value compares favorably with our map, which suggested a drop of 1 m in water depth after the earthquake, with geographical changes restricted to the inner and near mouth of the bay.

A north-south geographical rise ($<$ 8 m water depth) on the east side and a depression ($>$ 16 m water depth) on the west side excavated by the tsunami are present in the inner area of the bay off Kesennuma Port. No excavations are present in the shallower bottom from the central to south area of the bay. Thus, the excavation resulting from the tsunami is restricted to the inner bay.

Acoustic reaction is strong in the uneven geography present in the dune field which intersects perpendicularly with the bay axis in the joint area between the inner and central area of the bay. Coarse sediment and woody material are present in the area. The tsunami deposit of the Chilean earthquake is distributed here as well (Shiomi, et al., 2011).

Three clusters composed of many dunes are also distributed in the southeast area of the bay. The reflective intensity is strong at the top of the dune and is weak at its bottom. Fishermen stated that muddy sediment was widely distributed in the bay before this earthquake and that the sea bottom in the southwest area of the bay was exposed at the time that the water surface reached its lowest point during the tsunami. Thus, the evidence suggests that much debris and clastic particles were transported and the dune was formed by the backwash of the tsunami.

The unique distribution of the excavation and inflow materials is an important phenomenon in the recognition of tsunami deposits in ancient marine strata.

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Keywords: Tsunami, acoustic systems, geography, sediment, debris, Japan