

Distribution and Characteristics of Sediment-related Disasters Induced by the Great Kanto Earthquake in 1923

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Introduction

The Great Kanto Earthquake (M7.9), which occurred in the Kanto Region on Sept. 1, 1923 caused unprecedented damage, leaving 105,000 people dead or missing due to its severe shaking and ensuing fires. Another fact not commonly known is that the earthquake triggered sediment-related disasters at 167 locations and victimized 1,056 people and or more, included the dead and missing (Fig. 1). The deadliest sediment-related disasters occurred in Odawara City (former Kataura Village), Kanagawa Prefecture. We conducted a survey of the disaster site, focusing on the deep-seated landslide and the ensuing debris flow that started at Obora and ran down the Shiraito River, engulfing the Nebukawa community. The results of this survey are reported.

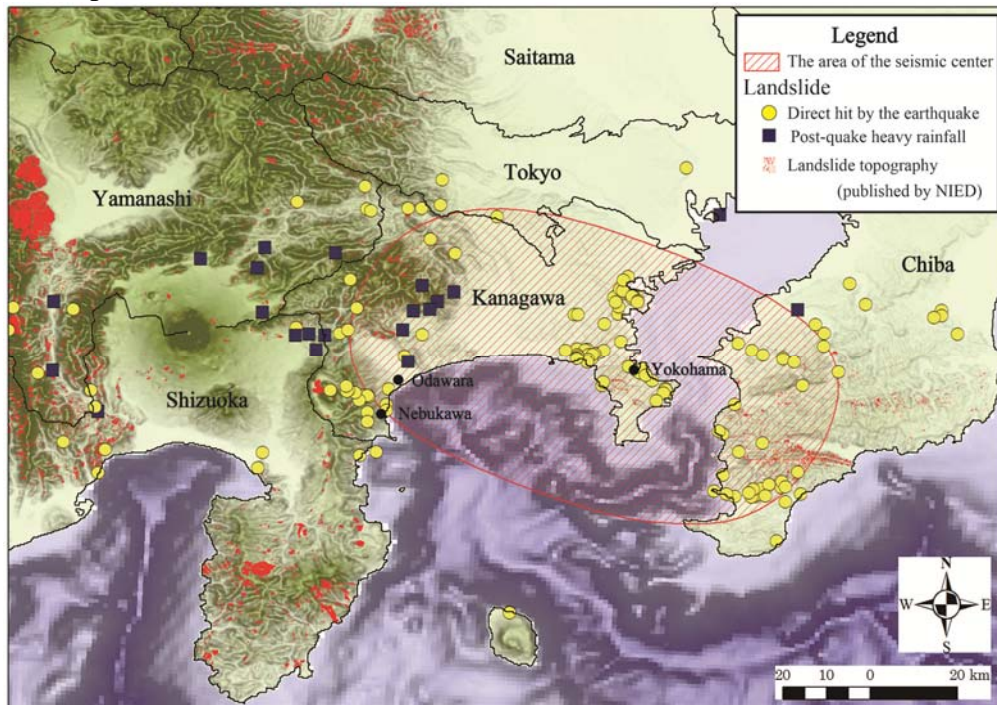


Fig.1 Distribution of sediment related-disasters induced by the Great Kanto Earthquake in 1923

Deep-seated landslide at Obora and Shiraito River debris flow damage

The earthquake triggered severe sediment-related disasters on the eastern slope of the somma of Hakone Volcano in western Kanagawa Prefecture, devastating village communities such as Nebukawa and Komekami. During the debris flow at the Shiraito River that engulfed the Nebukawa community, Kazumasa Uchida, who was 10 years old at the time of the earthquake, later became a local historian, left valuable information by producing survey maps (1975) and a personal note (2000). The debris flow started at an area called Obora and the scars of the deep landslide remain there to this day. We conducted a survey at the upper portion of the Shiraito River in December 2012 and April 2013.

The Shiraito River is a steep river flowing eastward from the somma of Hakone Volcano. From an old topographic map, it is estimated that 1.08 million m³ of debris collapsed in the deep landslide at Obora. Of this volume, an estimated 0.26 million m³ remained at hummocky hills (small hills) immediately below the collapsed site. The remaining 0.82 million m³ ran

down the Shiraito River as debris flow for a length of 3,500 m and an elevation difference of 500 m at a velocity of 12 m/s (42 km/h) and reached the Nebukawa area in five minutes, according to our inference. From the geological survey, we found that lava domes called Hokurei (North peak), as well as a number of linear depressions existed near Obora. Lavas containing conspicuous platy joints existed on the hummocky hills at the lower area of the slope. There was heavy rain in this region on Aug. 31, the day before the earthquake. Therefore, it is inferred that the groundwater level around Obora was raised, triggering a deep-seated landslide when the ground was severely shaken by the Great Kanto Earthquake.

According to Uchida's personal note (2000), he fled from his house as soon as he heard screams "A mountain is coming! Get away quickly!" soon after the second earthquake subsided (the M7.3 aftershock at 12:03 on the same day). He fled to a point 30 m from the mulberry field north of his house. When he looked back, most houses in Nebukawa, including his house, were swallowed by debris in less than one minute. From the passage of time, it is inferred that the deep landslide at Obora was triggered by the main shock at 11:58, and developed into debris flow by the aftershock at 12:03. From there, it ran down the Shiraito River which was swelling with river water due to heavy rain from the previous day. Of the 159 households in the Nebukawa community, 78 were buried under debris, and 289 people were killed. 20 children who were playing at the beach were also killed, sandwiched by the tsunami from the sea and the debris flow from the mountain.

A total of 131 people were also killed due to a landslide that occurred near Nebukawa Station. The Shiraito Bridge on Atami Line of Japan Railways was completely carried away by the debris flow. The bridge was restored in March 1925.

Trailing the evacuation route of O.M. Poole in Yokohama

In Yokohama City, 27,000 people were killed due to the collapse of buildings and the ensuing fires. Sediment-related disasters occurred at 27 locations and 68 people were killed, a little known fact. O. M. Poole (age 43) was the Japan regional manager of a British trading company, Dodwell & Co. Ltd. and had lived in Yokohama for 35 years before the earthquake. 45 years later, he wrote a book, "The Death of Old Yokohama in the Great Japanese Earthquake of 1923", vividly describing his escape during the ensuing several hours after the earthquake. His office was not destroyed, but most of the buildings around his office collapsed and fires erupted here and there. In order to evade the fires, he headed for his house on the hill side and was able to meet his wife and three children. They decided to go to his father-in-law's yacht which had been berthed at the French wharf in the port, but their evacuation route was blocked by the approaching fires. They desperately climbed down the steep slope with a height of 40 m located near the British Naval Hospital and finally evacuated to their yacht.

AFTERWORD

It is however feared that many sediment disasters would occur at such mountains, hills and steep slopes where no serious damage occurred due to the Great Kanto Earthquake despite debris flows or slope failures because housing construction has been widely promoted near or on the steep slopes. It is likely that sediment disasters in densely populated areas would cause damage greater than in 1923. From this viewpoint, it is considered necessary to revise current earthquake-induced sediment disaster control or response measures in areas expected to be affected by large-scale earthquakes that are predicted to occur, such as a large ocean-trench earthquake or a major inland earthquake under the Tokyo Bay.

Keywords: Kanto Earthquake, deep-seated landslide, Shiraito River, debris flow