Paleotsunami History in Hachinohe, Aomori Prefecture, northern Japan

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Along the history, the Pacific coast of the Tohoku region has been characterized for facing a vast number of tsunamis associated with the highly active subduction of the Japan Trench. Most of the paleotsunami research has been focused on the south and central third of the Pacific coast of Tohoku, while in the northern third the number of this kind of studies is reduced; on the other hand, on the Pacific coast of Hokkaido paleotsunami research has been conducted to establish the recurrence linked to the Kuril trench (Minoura et al., 2013; Chagué-Goff et al., 2017; Inoue et al., 2017; Sawai, 2017). In Hachinohe, this type of research has not been done, being the results of Inoue et al., 2017 the closest at just 60 km southeastward and where the tsunami heights of the 2011 event were similar (Haraguchi & Iwamatsu, 2011). Because of this paleotsunami studies in Hachinohe are of enormous importance since its position could show tsunami activity related to both Kuril and Pacific trenches and its junction, where large tsunamigenic earthquakes have not been historically registered, hence, being this the primary objective of the present research.

The study site is located on a marine terrace surface elevated between 5-10 MAMSL, on the Kamikita coastal plain (Miyauchi, 1985) and 1.2 km inland from the present shoreline; at the same time, this surface is positioned between the Oirase and Gonohe rivers. We have identified eight sand layers, interbedded with mud and occasional tephra layers. Based on tephra analysis, some of them were possible to confirm as the To-a and To-cu tephra at the top and bottom of the sequence, respectively, giving a range of 6 thousand years of geological history, while the last 1000 years has been apparently eroded, removed or disturbed by human activity. To-a tephra layer contained many diatoms, which implies a water flow or shallow water body as deposition environment. Soils from the top of the section.

The stratigraphic correlation shows that four of the eight sand layers can be well traced landward, and grain analysis shows upward and landward fining. Diatom analysis reveals the presence of marine spices in some sand layers, on the other hand, freshwater and reworked freshwater extinct species were found in the uppermost sand layer (under To-a), suggesting a freshwater inundation event as a genetical source for that. CT number profiles (Hounsfield Units) evidence density changes related to lithological variations between the sand and mud layers. Moreover, XRF core scanner (ITRAX) shows that most of the sand layers are strongly related to a marine origin and exposes concentration of Ti that could be related to heavy minerals concentration and, in consequence, suggesting a sedimentary environment of high energy. Therefore, described evidence suggest a marine origin to the seven sand sheets.

In order to clarify the origin of the sand layers, we performed the numerical simulation to differentiate tsunami sands from storm sands proposed by Watanabe et al. (2018), by comparing wave penetration capacity for each phenomenon; the calculation showed that the only way to carry marine sediments on such further inland is with a tsunami event, if we assume present topography.

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