Preliminary GPR study on the effects of topography on the preservation of paleotsunami deposits

*Hiraku Takeda[1], Kazuhisa Goto[2], Hideaki Matsumoto[3], Daisuke Sugawara[4], James Goff[5]

1.Graduate School of Earth Science, Tohoku University, 2.International Research Institute of Disaster, Tohoku University, 3.Tohoku Gakuin University, 4.Museum of Natural and Environmental History, Shizuoka, 5.School of Biological, Earth and Environmental Sciences, University of New South Wales

In order to better understand the paleotsunami record at any one location it is important to choose places where deposits are likely to be thickest and best preserved (Sawai, 2012). However, even when apparently appropriate study areas have been selected, tsunami deposits may not be present. For example, studies in the marshes of the Sendai Plain have shown that there is considerable variability over even a few tens of meters (Sawai et al., 2008). This is largely because the plain consists of a prograding beach ridge topography with numerous ridges having no surface expression because they are now buried beneath surface peats. The preservation potential of tsunami deposits on the Sendai Plain therefore seems likely to vary with the thickness of the peat relative to the undulating subsurface beach ridge topography. Indeed, while the 2011 Tohoku-oki tsunami deposits showed a thinning trend inland, it also varied markedly in thickness depending upon local variations in topography (Goto et al., 2011; Yamada and Fujino, 2013). In the case of the 2011 event, this was further exacerbated by artificial topographic variations such as roads, although for most paleotsunami deposits this would not be the case.

Given the recognized control of deposit preservation/thickness imparted by the contemporary paleo-topography it is preferable to obtain as much information about subsurface structures as possible during the early stages of any research project in order to more effectively identify the appropriate study sites for ongoing work. In this study we report on a Ground Penetrating Radar (GPR) survey carried out on Ishinomaki plain to help clarify the relationship between paleo-topography and tsunami deposit preservation/thickness. GPR transects were measured along 10 profiles within a 50 ×30 m grid. The non-invasive data collected by GPR was validated by studying the deposits preserved in a series of trenches or cores taken at each transect intersection point. Using these data we recreated the three-dimensional paleo-topography dated to around 3,000~3,500 yr ago that currently underlies the contemporary peat surface throughout the study area. This reconstruction included the spatial distribution and thickness of tsunami deposits, beach ridges and peat sequence.

In summary, we found that tsunami deposits were well preserved/thicker where they are associated with paleo-topographic depressions, and are overlain by a relatively thick peat sequence. Conversely, the peat is thin and tsunami deposits are either non-existent or difficult to distinguish from beach ridge deposits when associated with paleo-topographic highs. While this work in essence concurs with findings from historical events, it highlights the value of GPR surveys for identifying the best paleotsunami study sites based upon an understanding of subsurface paleo-topography. This will greatly enhance the success of future paleotsunami fieldwork.

Keywords: paleotsunami deposits, paleo-topography, GPR

