Three-dimensional structures of sand dykes revealed by X-ray computed tomography of boring cores

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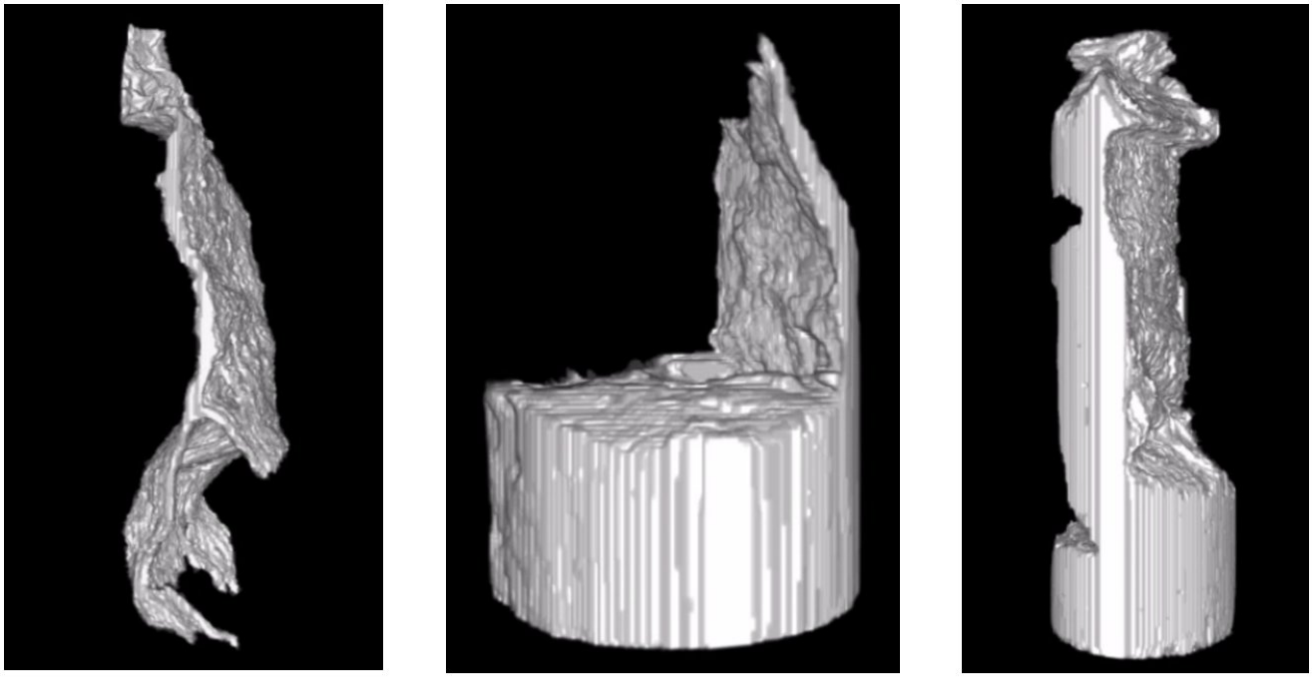
Near surface geophysics is employed for the risk assessment of liquefaction induced by earthquakes. The laboratory analysis of boring cores sampled at the liquefied sites is useful for the interpretation of the obtained geophysical data because it contributes to the accurate determination of the occurring depth, spatial extent, and degree of strength of the liquefaction, which is essential for the reliable risk assessment of the sites. Three-dimensional imaging technique such as X-ray computed tomography (CT) is useful to detect the liquefaction-induced sand dykes embedded in the cores without fail. We applied medical X-ray CT to liquefied cores (depth 0 to 10 m) obtained from the Kanto region, Japan, where the 2011 off the Pacific coast of Tohoku Earthquake occurred (Nakashima and Komatsubara, 2016). Sand dykes intruding into silt layers can readily be detected by taking advantage of the significant difference in density and mineral composition between sand and silt. In contrast, sand dykes (i.e., disturbed sand) embedded in undisturbed sandy sediments with laminations were more difficult to detect due to little difference in density and composition between the disturbed and undisturbed sands. However, we successfully extracted the three-dimensional complex structures of sand dykes embedded in the sandy sediments (see attached figure) using a specific digital image segmentation technique (i.e., cellular automaton model) originally developed by Vezhnevets and Konouchine (2005). These results demonstrate that X-ray CT coupled with advanced digital image processing is a promising tool for the liquefaction identification in boring cores.

Reference:
Nakashima, Y. and Komatsubara, J. (2016) Seismically induced soft-sediment deformation structures revealed by X-ray computed tomography of boring cores. Tectonophysics, 683, 138-147 (open access). http://dx.doi.org/10.1016/j.tecto.2016.05.044



Three-dimensional images of sand dykes in a core (diameter, 64mm) obtained by X-ray CT (Nakashima and Komatsubara, 2016)

