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Liquefaction sites and distribution of alluvium

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The 2011 off the Pacific coast of Tohoku Earthquake liquefied large areas of the Kanto plain. The eastern coast of Tokyo Bay was liquefied intensively along with the lower reaches of Naka River (Furutone River) and Tone River. A former body of water filled artificially as a reclaimed land has begun to be considered as a place of especial vulnerability. Much larger landfilling than the human-induced one has occurred after the postglacial transgression to form alluvial plains along the lower reaches of major rivers in Japan. The thickness and softness of alluvium which is sandwiched between the present river-profile (PRP) and the last glacial river-profile (LGRP) is one of the most important factors to control liquefaction. Alluvial plains along the lower reaches are identified as depositional surfaces of the alluvium named as coastal prism (CP). LGR developed basal gravel layers (BG) in Japan and thick CP with BG lengthens the secondary seismic wave period and its duration because of a slow s-wave velocity and multi-reflection, resulting in increased internal water pressure and liquefaction of the upper sandy layer of the CP.

Historic liquefaction sites compiled by Wakamatsu (2011) showed close relationships with the distribution of the CP. The inland limit of the liquefaction area roughly coincides with the upstream edge of the CP. Subduction-zone large earthquakes caused repeated liquefaction in an alluvial plain where the CP was more than 30 m thick. Post glacial marine transgression enlarged inner bay area along the valley incised by last glacial river in the low sea level period. Deeper valleys tend to have thicker inner bay mud, and river valleys deeper than 30 m mostly contain inner bay mud in CP. This may reflect the deceleration of sea-level rise at around 9 ka when the sea-level reached 25-30 m below present sea-level under the active fluvial sedimentation during the Holocene. Because Holocene inner bay mud contains much water and is one of the softest natural deposits, inner bay mud probably makes alluvial plain more vulnerable to liquefaction. Along the Naka River (Furutone River) plain, the Great East Japan Earthquake liquefied inland areas almost 100 km distant from the river mouth. This is partly because the river has the longest CP with inner bay mud in Japan.

Keywords: river long-profile, inner bay mud, marine transgression, coastal prism, Holocene, histrical earthquake