Overview of the Special Issue
“Liquefaction Phenomena in the Downstream Basin of the Tone River, Eastern Kanto Region, Japan from the Viewpoint of Earth Science: Toward Future Studies on Liquefaction”

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I. Purpose of this special issue

This special issue, “Liquefaction Phenomena in the Downstream Basin of the Tone River, Eastern Kanto Region, Japan from the Viewpoint of Earth Science: Toward Future Studies on Liquefaction” is a sequel to a special issue of the same main title published in this journal (Journal of Geography (Chigaku Zasshi) Vol. 126, No. 6, 2017). The 2011 off the Pacific coast of Tohoku Earthquake generated major liquefaction phenomena in the lowlands of the Kanto and Tohoku districts in eastern Japan, especially in the downstream area of the Tone River. The liquefied sites caused by the earthquake did not always correspond closely with the preestimated high-risk sites of liquefaction. We summarize the research results of earth scientists, and try to advance to the next stage by applying new methodologies for estimating liquefaction risk in practice.

II. Outline of articles

Four papers, consisting of a geologic and geomorphologic article by T. Komatsubara et al., a geologic and geo-technical letter by Saito et al., a geologic and geomorphologic letter by Koarai et al., and a review article by Une et al., are published in this issue.

Komatsubara et al. (2018) sum up the results of borehole and trenching surveys on liquefied strata affected by the 2011 off the Pacific coast of Tohoku Earthquake at two sites. This paper presents the following conclusions. (1) Sand layers, which were deposited by dredging during the Showa era (AD 1926 to 1989), were liquefied at both two sites. (2) Shear intensity of sand layers dropped due to liquefaction. (3) A better match is obtained between liquefied strata with bulk density and rigidity of layers measured using borehole PS logging rather than N-values measured using a standard penetration test. (4) Geological structures in the subsurface are a major factor in the occurrence of violent liquefaction phenomena such as sand boiling.

Saito et al. (2018) describes the significance of trenching surveys on liquefied strata and their procedures. Special attention is given to lowering groundwater level and removing surfaces from trench walls, because trenching surveys targeting liquefied strata are generally carried out in unconsolidated sediments with a high groundwater level, which collapse readily.

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This article describes procedures and issues in detail. We recommend referring to this paper when considering future investigations.

Koarai et al. (2018) rearrange the relationships between landform classifications and liquefied points induced by the 2011 off the Pacific coast of Tohoku Earthquakes in the downstream area of the Tone River and around Tokyo Bay. They confirm that land-history and landform classifications are, in general, closely related to liquefied points as noted in former studies. Besides, they conclude that landform classification with multi-time series land-history data and boring database sets are basically needed for liquefaction hazard assessments.

Une et al. (2018) refer to hazard maps made using two approaches—the earth scientific approach and the geotechnical approach. They compare the results of these two approaches, analyzing various types of hazard map made by organizations including local governments. Finally, they propose the following remedial subjects. (1) A more accurate hazard assessment is needed to prevent damage by integrating geotechnical and earth scientific approaches. (2) A more appropriate land classification is needed based on micro-geomorphological classification, surface geology, and land-history using GIS, instead of simple routinely partitioned grids. (3) It is important to obtain an overview of land-history by overlying data such as DEM on a micro-geomorphological classification. (4) Therefore, practical use of historical documents such as old-edition maps, air-photos, local histories, etc. is needed. (5) An integrated evaluation of land based on land-evolution is needed for liquefaction hazard assessments. (6) More substantial guidance on making liquefaction hazard assessments is needed. (7) The processes and bases of hazard assessments should be disclosed and explained for residents.

III. Conclusion

Due to major disasters caused by the 2011 off the Pacific coast of Tohoku Earthquake, public interest in geo-hazards including liquefaction phenomena has increased. Liquefaction phenomena and their hazards also occurred following previous major earthquakes, and the characteristics of liquefied sites have been discussed at each time. However, a problem mentioned by Une et al. (2018) related to existing liquefaction hazard maps is that lessons from past liquefaction experience have not always been fully applied to liquefaction prediction and risk determination. An important issue for earth scientists is how geological and geographical information can be used to improve the accuracy of liquefaction predictions and to prepare more accurate liquefaction hazard maps, and how they can contribute to liquefaction disaster prevention. In particular, there are many problems to be discussed further in the future, including the methodology for making a liquefaction hazard map. Although many research topics could not be covered in the special issues, the editors hope both will provide a springboard for future studies on liquefaction. The editors feel that both special issues may be useful for future liquefaction investigations and improving liquefaction predictions and risk determination studies.

References

Koarai, M., Nakano, T. and Une, H. (2018): Relationship between liquefaction damage and landform classification in preparing liquefaction risk assessments: Cases in middle and lower reaches of the Tone River and the Tokyo Bay area. Journal of Geography (Chigaku Zasshi), 127, 409–422. (in Japanese with English abstract)

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