Acta Geologica Sinica (English Edition), 2019, 93(supp.1): 158–159

Impact, Mechanism, Monitoring of Land Subsidence in Coastal Cities (Annual Work of IGCP 663)

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Citation: Yan et al., 2019. Impact, Mechanism, Monitoring of Land Subsidence in Coastal Cities (Annual Work of IGCP 663). *Acta Geologica Sinica* (English Edition), 93(supp. 1): 158-159

Land subsidence is a worldwide geohazard consisting in the lowering of the ground surface due to natural and human-induced processes occurring in the shallow and deep subsoil. Over the last two decades, land subsidence has caused damages and widespread impacts to a variety of infrastructures in coastal cities (Ma et al., 2011; Liu et al., 2016; Minderhoud et al., 2018). Meanwhile, it is particularly alarming as it reduces the ground elevation with respect to the sea level. The IGCP 663 aims to jointly carry out international academic communication and cooperation, to further and promote the international understanding, advanced technical analysis and evaluation methods of land subsidence, and exchange experiences and research results worldwide, especially in coastal cities and regions.

The joint researches of IGCP 663 carried out during 2018 have improved the understanding of the land subsidence in typical coastal areas and cities, and the main causes of land subsidence in global coastal cities were figured out through several case studies in China, Italy, the Netherlands and Indonesia: groundwater withdrawal for drinking water (e.g., Jakarta, Chaussard et al., 2013), groundwater lowering for construction (e.g., Shanghai, Wang et al., 2018), oxidation of peat and compaction of soft soils (e.g. the Netherlands, Sanneke et al., 2018), extraction of hydrocarbons (e.g., northern Netherlands, Koster et al., 2018) and natural consolidation of Holocene deposits (e.g., Venice, Da et al., 2018; Tosi et al., 2018). Shanghai was set as an example of how could deal with land subsidence by taking measures of constructing comprehensive monitoring network, taking artificial recharge, restricting groundwater pumping, and making politics and regulations, etc (Wang et al., 2014).

Moreover, we investigated the spatial distribution characteristics, physical and mechanical properties of the reclaimed soil and its underlying natural sedimentary soil along the coast of Shanghai, in order to accurately predict and take measures to reduce future potential land subsidence in the coastal reclamation areas. The reclaimed soil in most studied areas was directly exposed to the ground surface, and was generally developed with heterogeneous mechanical properties and high compressibility (Yang et al., 2018). Figure 1 shows the thickness of reclaimed soil on the eastern shore of Hengsha Island of Shanghai revealed by deep boreholes. The reclaimed soil thickness varied greatly, basically ranging from 4m to 9m. According to the land formation history, the development of the reclaimed soil in middle section was later than that of the western and eastern section. It can be seen that the distribution of the reclaimed soil on eastern Hengsha Island was highly consistent with the land formation process.

Key words: land subsidence, coastal cities, case studies, reclaimed soil

Acknowledgments: This is a contribution of the IGCP 663 project of the IUGS and UNESCO.

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