波浪对黄河水下三角洲浅表沉积物非均匀改造过程监测与机制研究

郭秀军1，2，蒋甫伟1，许国辉1，2，朱大伟1*

(1. 中国海洋大学 环境科学与工程学院，山东 青岛 266100；2. 中国海洋大学 海洋环境与生态教育部重点实验室，山东 青岛 266100)

MONITORING AND MECHANISM RESEARCH ON SILTY SOIL LAYER HETEROGENEITY INDUCED BY WATER WAVE IN YELLOW RIVER SUBMERGED DELTA

GUO Xiujun1，2，JIANG Fuwei1，XU Guohui1，2，ZHU Dawei1*

(1. College of Environmental Science and Engineering，Ocean University of China，Qingdao，Shandong 266100，China；
2. Key Laboratory of Marine Environmental Science and Ecology of Ministry of Education，Ocean University of China，Qingdao，Shandong 266100，China)

摘要 黄河水下三角洲浅表沉积物的空间非均匀性导致了一些地质灾害的发生。为揭示非均匀化形成机制，在实验室模拟波浪对粉土体作用过程并实时监测土体强度、孔压和粒径组分变化。监测结果显示土性非均匀变化和强浪后期改造作用直接相关。强浪作用导致沉积物液化后，细粒物质向上迁移引起垂向非均匀变化的同时，一定深度位置还会出现强度和粒径非均匀体。在三角洲潮滩上原位模拟波浪循环荷载作用，利用电阻率测试等技术监测的土体状态变化特征进一步表明：除垂向迁移过程外，深部液化区细粒物质还会发生横向迁移；两个变化过程共同对浅表沉积物进行非均匀改造。波致超孔隙水压力急剧增大是造成物质迁移的主动力，波浪剪切作用造成的土颗粒横向位移对迁移起促进作用。研究还同时发现波浪作用过程中液化区下部始终有稳定层存在。

关键词： 土力学 波浪 粉土层 非均匀改造 电阻率法

Abstract： The superficial saturated silty soil of the Yellow River submerged delta represents space heterogeneity，which leads to some geological disasters happening. To reveal the formation mechanism of heterogeneity，flume experiment is used to simulate the process of waves to the silty soil seabed. The soil strength，pore pressure and particle size changes are real-time monitored. Monitoring results show that the soil nonuniform changes are directly related to the strong wave later reconstructions. After the liquefaction of surface soil under the action of waves，fine particle material upward migration causes sediment vertical nonuniform of sediment. In a certain depth，also strength and particle size nonuniform body appears at the same time. For further analysis of the causes of formation，wave cyclic loading is in-situ simulated in the tidal flat of delta and the electrical resistivity testing technology is used for monitoring the state changes of soils. The research shows that in a certain depth，for fine grains of material，lateral migration occurs under the cyclic load，which causes uneven distribution of material. Vertical and lateral migrations contribute together to the nonuniform transformation of superficial sediments. Sharp increase of excess pore water pressure caused by wave is the major impetus of material migration；and the lateral displacement of soil grain induced by wave shearing action promotes the migration. In the process of wave action，it is also found that there is a stable layer under the violent area of silty soil all along.

Keywords： soil mechanics water wave silty soil layer nonuniform transformation electrical resistivity method

Received 2011-10-31;

引用本文:

郭秀军1，2，蒋甫伟1，许国辉1，2，朱大伟1.波浪对黄河水下三角洲浅表沉积物非均匀改造过程监测与机制研究[J] 岩石力学与工程学报, 2012,V31(4): 799-805

GUO Xiujun1，2，JIANG Fuwei1，XU Guohui1，2，ZHU Dawei1.MONITORING AND MECHANISM RESEARCH ON SILTY SOIL LAYER HETEROGENEITY INDUCED BY WATER WAVE IN YELLOW RIVER SUBMERGED DELTA[J] ，2012,V31(4): 799-805