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The Application of Optical Fiber Monitoring Technique in Environmental Geological Survey

JIANG Yuehua[1, *], MEI Shijia[1], SHI Bin[2], ZHOU Quanping[1] and LI Yun[1]

[1] *Nanjing Center, China Geological Survey, Nanjing 210016, Jiangsu, China*
[2] *Nanjing University, Nanjing 210023, Jiangsu, China*

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Abstracts: The economic zone of the Yangtze River delta in eastern China has experienced the stage of urbanization spread development. The serious over-exploitation of groundwater has led to environmental geological problem of the serious regional land subsidence (Xue et al., 2003; Yin et al., 2005), with the accumulative subsidence of more than 200mm reaching nearly 20,000 square kilometers (Jiang et al., 2015).After years of prevention and control, the land subsidence in Shanghai, Suzhou and Wuxi has been effectively controlled, and the subsidence rate tends to slow down. In recent years, the subsidence is generally less than 7 mm.However, in Jiangsu Yancheng, Dafeng and other places found a new land subsidence phenomenon, and the development trend, the current maximum subsidence of more than 25 mm.The economic losses caused by land subsidence and ground fissures amounted to nearly 380 billion yuan (Jiang et al., 2015). Therefore, it is of great significance to strengthen the monitoring, warning and risk control of ground subsidence and ground fractures.

At present, the Yangtze River delta economic zone mainly usesIn-Sar (Gao et al., 2019), GPS, leveling, bedrock standard, stratified standard and other means to monitor ground subsidence and ground fractures, but these methods also have their limitations.This work mainly monitors ground fissures and ground subsidence through the optical fiber sensing technology. The principle is that the ground fissures and ground subsidence deform the stratum soil and make the optical fiber generate strain. By monitoring the strain of the optical fiber sensor, the site where the strain is generated and the resulting soil deformation are deduced.

By developing different sensors, embedding different optical cables and adopting different embedding methods, 19 monitoring demonstration points of ground subsidence and ground fissure optical fiber were established in the economic zone of the Yangtze river delta, and the monitoring demonstration bases of ground fissure and ground subsidence optical fiber were preliminarily built.In the near future, we detected ground fissure activity precise displacement values (two displacement were 0.4 mm and 0.7 mmrespectively) (Fig.1) in Yangshuli,Wuxi.It was found in the distributed fiber optic monitoring hole of ground subsidence that the deformation of four types of sensing fiber optic cables were uniformly concentrated in the upper and lower soil adjacent to the local groundwater main production layer (70–90 meters) (Fig.2) in Shengze, Suzhou, and the monitoring effect was very significant. It is found that compared with the original GPS, leveling, stratification standardand other methods for monitoring ground subsidence and ground fractures, this optical fiber monitoring technology of stratum deformation has the advantages of economy, safety, anti-electromagnetic interference, waterproof and moisture-proof, anti-corrosion and long durability, can achieve accurate spatial positioning and can replace the existing expensive monitoring technology, for the ground fissures and land subsidence monitoring is breakthrough significance.

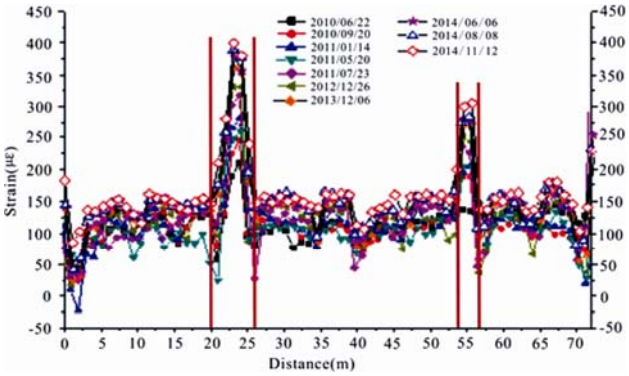

Fig. 1. Fiber optic monitoring strain map of ground fissure in Yangshuli, Wuxi.

Key words: optical fiber monitoring, land subsidence, ground fissure, environmental geology,the Yangtze River delta

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* Corresponding author. E-mail: 316664105@qq.com

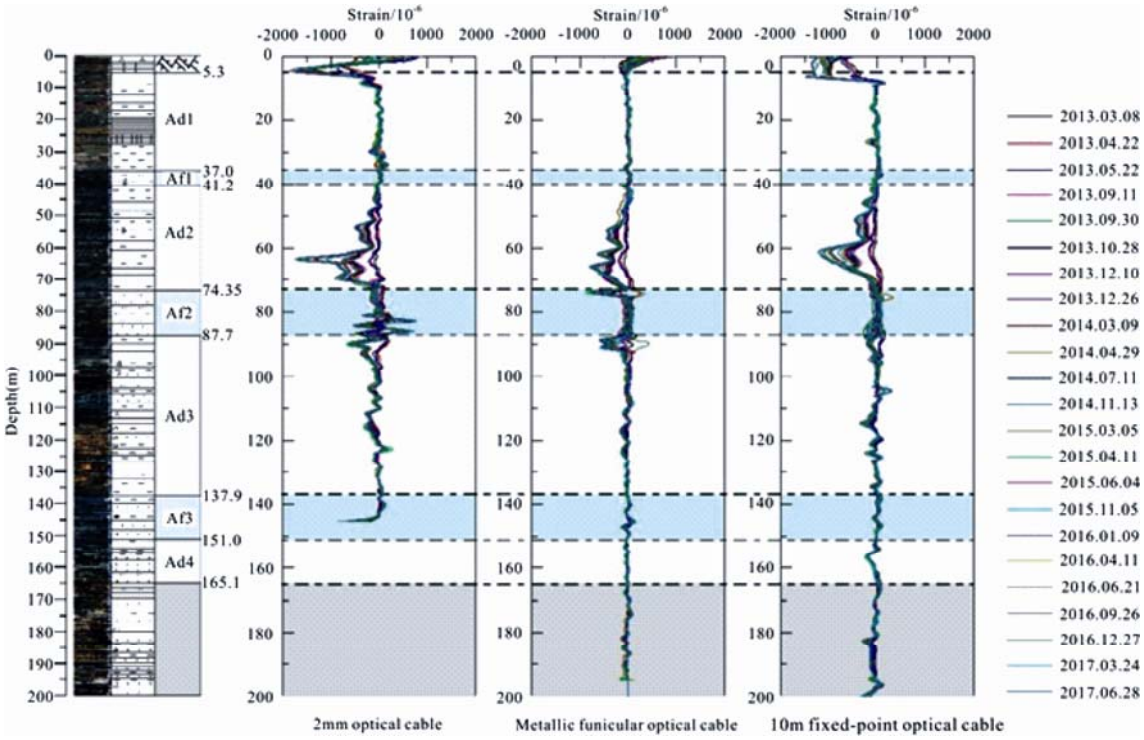

Fig. 2. Fiber optic monitoring strain map of land subsidence in Shengze, Suzhou (Af- aquifer, Ad- aquiclude).

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About the corresponding author

JIANG Yuehua, male, born in 1963 in Kunshan City, Jiangsu Province; doctor; graduated from China university of geosciences; fellow of Nanjing Center, China Geological Survey. He is now interested in the study on environmental, hydrological and engineering survey. Email: 316664105@ qq.com; phone: 025–84897926, 18951692616.