THE DEVELOPMENT AND ENGINNERING APPLICATION OF BOREHOLE RADAR IN CHINA

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Abstract—**Ground-penetrating radar (GPR) is an efficient geophysical method for the detection and the location of fractures and fracture or anisotropic zones in electrically resistive rocks. In near-surface environments, GPR can, arguably, be considered as the most flexible and wide-ranging of all the geophysical investigation tools with applications as diverse as forensic sciences, planetary exploration and utility detection. Borehole radar is a special subsurface detection technology originally designed for imaging geological targets in resistive formations below the subsurface, with its antennas being located relatively close to the anomalies or targets to be measured, resulting in more precise and high-resolution targets response in deep subsurface exploration. Although rather limited Chinese geophysicists have used borehole radar techniques than the surface GPR method, borehole radar methods have been used tentatively for the wide application fields since 1990's, such as the site investigation for geotechnical engineering, the groundwater hydrology, the cavity detection, and the quarry mine investigation and so on. For the tenth anniversary of the first practical engineering application of borehole radar in China, it is necessary to review some case histories on the engineering application of borehole radar in China, and to perceive and comprehend the development trend in the research and practical use of borehole radar in China. The technique still has its skeptics with users unfamiliar with the GPR theory, and the application and data interpretation are often considered to be too 'unreliable' as compared to other geophysical methods.**

In this paper, we introduce some case histories on the engineering application of borehole radar in China. The first one was conducted for delineating the cavities and fractures in limestone, and the second one was conducted for characterizing the geological strata in depths using the technique of cross-borehole radar tomography, and the third one was performed to image the subsurface fractures

at a granite hill in Beijing. Furthermore, a new method for ensuring the safety of a certain construction site using the dynamic exploration survey based on the borehole radar and digital imaging was introduced. Through these case histories, it reveals that the diverse reflection and diffraction characteristic itself can give us effective and important information for understanding the internal status of basement rock in condition that the subsurface material is anisotropic. BHGPR (Borehole GPR) has a broad expertise base with geophysicists, electrical engineers, mathematicians, physicists and computer scientists all being involved, in some way, in its scientific and technological development over the past decades. It is believed that the practical merits of BHGPR will be well established and, from a ground investigation point of view, BHGPR can, quite rightly, be considered as an effective technique in China's future geological logging.

Keywords-borehole radar, ground penetrating radar (GPR), subsurface investigation, single drillhole reflection, tomography, Dynamic Exploration Survey

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