Foreword

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The Chinese Geophysical Society and China University of Geosciences (CUG) hosted the last three International Conferences on Environmental and Engineering Geophysics (ICEEG) on the campus of CUG in Wuhan, China, biannually from 2004 to 2008. The ICEEG has become one of the main international conferences on near-surface geophysics in the world and the most influential near-surface geophysics conference in China. More than 200 people from more than 10 countries attended each conference, including practitioners, academicians, researchers, and students. The proceedings of each conference have been included in the Index to Scientific & Technical Proceedings (ISTP) and the first conference proceedings were also included in the Engineering Index (EI).

Presentations by the invited speakers at the ICEEGs conveyed the most advanced developments in near-surface geophysics. The Editor-in-Chief of the *Journal of Earth Science*, Prof. Hengjun Wang, initiated the idea of compiling a special issue on near-surface geophysics that mainly contains articles of these invited speakers. I am very pleased that about half of the invited speakers of the ICEEGs accepted our invitation to submit full-length articles and completed their work on time. This special issue, *Near-Surface Geophysics*, contains 12 articles that cover almost the full spectrum of near-surface geophysics currently researched and practiced in the world.

High-resolution seismic body-wave methods have been widely applied to the environmental and engineering problems for more than 30 years. Compressional (P)-wave reflections have been studied and practiced for the same period of time at the Kansas Geological Survey. They have been used effectively to

investigate sinkholes formed from the dissolution of a bedded salt unit found throughout most of central Kansas. Miller et al. discussed seismic reflection characteristics of naturally-induced subsidence affecting transportation and seismic reflection images that have helped correlate active subsidence to dormant paleofeatures, project horizontal growth of active sinkholes based on subsurface structures, and appraise the risk of catastrophic failure.

As theory dictates for a series of horizontal layers, a pure, plane SH wave refracts and reflects only SH waves, and does not undergo wave-type conversion as does incident P or SV waves. Because of their higher vertical resolution, SH-wave reflections possess great potential in mapping near-surface geologic features. Harris tested the method in the Mississippi Embayment region of the Central United States and showed interpretable reflection arrivals in the depth range of <10 m to >100 m with the potential for increased resolution when compared to P-wave data. Shear (S)-wave reflection profiles were used to help interpret the significance of neotectonic surface deformation at five sites in the Mississippi Embayment.

P-wave refractions are common tools in environmental and engineering applications. Palmer's study provided a compelling demonstration that 2D inversion algorithms provide significantly greater lateral resolution than 1D algorithms. The major conclusion of his study is that the acquisition and processing of near-surface refraction seismology should aim to maximize the superior lateral resolution of the refraction method.

High-frequency surface-wave techniques are of increasing interest in the near-surface geophysics community because they can provide near-surface S-wave velocity, a key parameter in environment, en-

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gineering, construction, and earthquake risk zoning, etc.. Site characterization requires multidisciplinary participation by the geologists, seismologists, and geotechnical and earthquake engineers. Yilmaz et al. demonstrated a uniform workflow by determining the seismic model of the soil column within a residential project site in Istanbul, Turkey, in which a seismologist can provide a P-wave velocity-depth model of the soil column using nonlinear refraction traveltime tomography, and an S-wave velocity-depth profile for the soil column using the Multichannel Analysis of Surface Waves (MASW) method.

Near-surface geophysicists are often requested to perform site-response investigations in efforts to reduce potential earthquake hazards. Luke et al. developed a three-dimensional model of near-surface S-wave velocities, determined using the Spectral Analysis of Surface Waves (SASW) and ReMi methods, in the deep alluvial basin underlying the metropolitan area of Las Vegas, Nevada, USA. The resulting velocity model exhibits reasonable values and patterns. The investigations that applied a preliminary version of the velocity model support a two-zone ground-shaking hazard model for the valley.

The MASW method that analyzes dispersive energy in the frequency-velocity domain possesses the advantages of ease in recognizing surface waves, eliminating the body-wave energy, and defining phase velocities of surface waves. Xia et al. summarized the main research results of the MASW techniques, such as acquiring surface-wave enhanced data, generating dispersion images with high resolution and synthetic seismic records, separating modes, utilizing higher modes, calculating near-surface Q , and assessing an inverted model, achieved by research groups at the Kansas Geological Survey and China University of Geosciences over the last 15 years.

Multi-method geophysical surveys can help to bridge the inherent gap that exists with regard to spatial resolution and coverage for classical hydrological methods. This has led to the emergence of a new and rapidly growing research domain generally referred to as hydrogeophysics. One of the major challenges in near-surface geophysics is integration of the resulting vast and diverse database into a unified model of the probed subsurface region that is consistent with all

available measurements. Dafflon et al. presented a novel approach for hydrogeophysical data integration based on the Monte-Carlo-type conditional stochastic simulation method and the results of its application to the integration of porosity logs and tomographic crosshole georadar data to generate stochastic realizations of the detailed, local-scale porosity structure.

Magnetic Resonance Sounding (MRS) is a newly establishing geophysical exploration method that provides unique information about hydrogeophysical properties due to its direct sensitivity to hydrogen protons and proton dynamics. In the review article, Yaramanci and Müller-Petke started with the complete MRS formulation and gave a detailed view on how to solve the equation for all model parameters: water content, decay time, and resistivity. They also presented the extension of MRS to Magnetic Resonance Tomography (MRT). In the end, they discussed restrictions, limitations, and inconsistencies as well as future developments.

The other common methods widely applied to environmental and engineering problems are electric resistivity profiling/sounding. With computed the apparent formation factor, Carpenter et al. estimated leachate resistivity, the degree of saturation, and possibly even hydraulic conductivity of the waste from non-invasive electric resistivity measurements at three landfills with different types of waste. Contaminated areas may be diagnosed by models from inverted sounding curves exhibiting unusually low resistivity layers.

Understanding null-components in surface electromagnetic data would help determine the geometry of subsurface bodies. Szarka discussed extensive analog (physical) modeling results, in certain conditions, that give more detailed information about the geometry of subsurface resistivity inhomogeneities by using null-components than the routinely used parameters. The author pointed out, however, that one should be very careful in practice, especially for 2D and 3D applications, since they are too sensitive to the actual measuring and geological noise.

A new branch of geophysics, microgeophysics, is of great interests in applications of civil engineering and cultural heritage. Cosentino et al. presented their investigation results from using different tomographic

2D and 3D approaches as well as different energy sources such as sonic, ultrasonic and electromagnetic (radar) waves, electric potential fields, and IR thermography. The results seem to be very promising and suggest that it is the moment to dedicate time and effort to microgeophysics, so that these methodologies can be used even more to diagnose, monitor, and safeguard not only engineering buildings and structures, but also ancient monuments and cultural artifacts.

High-resolution 3D seismic reflection is gathering momentum in near-surface applications. Raef's tutorial article discussed several practical aspects of 3D data processing such as robust quality control and assurance workflow of 3D seismic data pre-processing that is suitable for near-surface applications. He provided an account of utilizing survey design specifications, noise properties, first breaks, and normal moveout for rapid and thorough graphical quality control and assurance diagnostics, which are easy to apply and efficient in diagnosis of inconsistencies.

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The fourth ICEEG will be held in China in June 2010. Whether you are a first-time or returning participant, I, on behalf of the fourth ICEEG Organizing Committee, welcome you to China.