Proceedings of the 4th International Conference on
Environmental and Engineering Geophysics
14-19 June 2010, Chengdu, China

Near-Surface Geophysics and Geohazards

Volume 1

Runqiu Huang
Xuben Wang
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Jianghai Xia
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Preface

The 4th International Conference on Environmental and Engineering Geophysics (ICEEG2010) will be held at the Chengdu University of Technology, Chengdu, China from June 14 to June 19, 2010. We publish this important conference document *Near Surface Geophysics and Geohazards—Proceedings of the 4th International Conference on Environmental and Engineering Geophysics* for the general audience of the near-surface geophysics community.

Geohazard is an important issue that our near-surface geophysics community is facing. We all remember that the Wenchuan Ms 8.0 earthquake, which is only 80 km away from Chengdu, caused tremendous damages two years ago. The tragedy made all people, especially, the geophysical workers as we are to face a serious challenge—what we can do in predicting/ preventing, monitoring, and overcoming earthquake and geohazards using geophysical methods. The near-surface geophysics is closely connected to the domestic economy, and even people's daily life, which provides important information for achieving harmony and coordinated development between the human and the nature. This is a challenge but also an opportunity. The ICEEG convention and the publication of "The Proceedings" are precisely for seizing this type of opportunity and meeting this kind of challenge.

"The Proceedings" is a compilation of works of several dozens experts and scholars from the US, Canada, Germany, Australia, France, Switzerland, Sweden, India, South Korea, Thailand, and China, with more than 180 articles contributed for the conference and to conform for the main theme of the conference— "The Near Surface Geophysics and Geohazards", which will be published officially by the Science Press Inc. as references for the attending experts and the scholars from various countries.

The content of "The Proceedings" is extremely broad. It includes not only various near-surface geophysics methods (such as seismic, electrical method and electromagnetic method, 3S technology, potential-field methods, space geophysics, etc.), newly developed theory and technologies in data acquisition, processing, and interpretation, but also the most recent achievements in the domestic economy, such as engineering reconnaissance, environment analysis protection, and remediation, and public safety and assessments of natural resources. "The Proceedings" reflect the recent progress and development in domestic and international engineering and environmental geophysics.

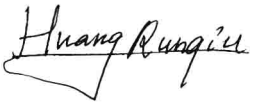
The International Conference on Environmental and Engineering Geophysics receives welcome from the domestic geophysicists and attracts attentions from the international universities and research institutes. After the inaugural (2004) and the 2nd (2006) and 3rd (2008) conferences held in Wuhan, the official journal of the Environmental and Engineering Geophysical Society (EEGS, USA) "FastTimes" and the official journal of the European Association of Geoscientists & Engineers (EAGE) "First Break" published the special articles introducing the conference. Journal

of Environmental and Engineering Geophysics, Near Surface Geophysics, and Journal of Earth Science published peer-reviewed papers originally selected from the proceedings of these three conferences in three special issues.

We would like to acknowledge the Chinese Geophysics Society, the Earth Science Branch of the National Natural Science Foundation of China, Chengdu University of Technology (CDUT), and China University of Geosciences (CUG) for their kind support. We would also like to thank all the attending experts and the scholars, particularly those specially invited representatives for their industrious work for the conference and "The Proceedings". Thanks also go to Feng Li and Keli Peng of the Science Press USA Inc. for their special contribution to ensure the publication of "The Proceedings" on time.

We hope "The Proceedings" can provide some useful information for addressing the issues we are facing, bridge the communication of environmental and engineering geophysicists from different nations, promote the development of environmental and engineering geophysics, and contribute to an even small extent for the harmony and coordinated development between the human and the nature.

We wish the 4th International Conference on Environmental and Engineering Geophysics, Chengdu, China a complete success!



Chair, Organizing Committee of ICEEG 2010

Invited Speakers

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SECTION 1

SEISMIC TECHNOLOGIES AND APPLICATIONS

Seismic reflection images of active faults on New Zealand's South Island

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Abstract

New Zealand is located along the boundary between the Australian and Pacific plates. Although there are numerous faults associated with this plate boundary setting, few have ruptured during the nearly 200 years of European settlement. Yet, paleoseismology provides clear evidence of relatively recent activity on many of them. Knowledge of the shallow structure and other characteristics of these faults is important for understanding the related seismic hazard and risk. Key properties of faults that produce infrequent large earthquakes are usually determined or inferred from paleoseismological investigations of surface outcrops, geomorphology, trenches, and boreholes. In an attempt to improve our knowledge and understanding of active faults beyond the reach of conventional paleoseismological methods (i.e., deeper than a few meters), we have acquired high-resolution seismic reflection and ground-penetrating radar (GPR) data across the following three fault systems on New Zealand's South Island: (i) a northern section of the transpressive Alpine Fault zone, (ii) numerous reverse faults hidden beneath the very young sediments that cover the northwest Canterbury Plains, and (iii) a critical portion of the reverse Ostler Fault zone in the south-central part of the Island. After subjecting our data to diverse processing procedures, the resultant seismic and GPR sections provide vivid images of the target structures. On the 2D and 3D high-resolution seismic and GPR images of the Alpine Fault zone, we see the principal fault dipping steeply through Quaternary sediments and offsetting the basement. A distinct ~25 m vertical offset of basement provides a maximum ~1.4 mm/yr dip-slip displacement rate. The more important strike-slip component of displacement has yet to be estimated at this location. Our high-resolution seismic and GPR sections across parts of the northwest Canterbury Plains display a complex pattern of faults and folds beneath a variably thick veneer of flat-lying sediments. Structural restorations of the seismic images suggest 10 - 23% compressive strain, which would correspond to an average strain rate of 20 - 50 x 10^{-9}/yr if the onset of compression coincided with the accelerated uplift of the Southern Alps approximately 5 Ma. Finally, multiple 2D high-resolution seismic images of the Ostler Fault zone reveal a 45° - 55° west-dipping principal fault and two subsidiary 25 - 30° west-dipping faults, one in the hanging wall and one in the footwall of the principal fault. Again, we are able to structurally restore models based on the seismic images. These restorations are compatible with 440 - 800 m of vertical offset and 870 - 1080 m of horizontal shortening across the Ostler Fault zone, which translate to a relatively constant deformation rate of 0.3 - 1.1 mm/yr since the Late Pliocene - Pleistocene.

Key words: 2D and 3D high-resolution seismic reflection and GPR images, Australian - Pacific plate boundary, Alpine Fault zone, faults underlying the northwest Canterbury Plains, Ostler Fault zone.