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Editorial:

Trend setting research in "blue" and "green" directions

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The timing is perfect for this special issue because its contents are in line with the strategic research directions of the National Natural Science Foundation of China, which on 14th June 2016 announced that it will promote interdisciplinary "Blue" and "Green" research as part of its 13th Five-Year Plan. "Blue" refers to scientific research associated with the oceans such as research on climate change and energy. "Green" covers research projects such as the exploration of green energy and the use of vegetation to protect and save the environment while achieving sustainable development.

Energy, climate change, and waste management are among the crucial global challenges of the 21st century. Following collaboration among researchers and engineers in geotechnical and environmental engineering since the 1980s, a new discipline called geo-environmental engineering has been established with the aim of addressing problems such as waste disposal and the cleaning up of contaminated sites. In more recent years, due to increasing energy demands and depleting natural resources, geotechnics have started to play a major role in the exploration of new forms of energy such as shale gas and methane hydrate, and in energy conservation. This has given birth to a new branch of geotechnical engineering known as geo-energy.

Geo-environmental engineering includes the management of waste to minimize or eliminate harm to the environment. It also contributes to the remediation of contaminated areas and the use of vegetation to improve the stability of slopes and landfill covers. Since the industrial revolution in the 1950s, the quantity of waste generated has increased significantly. In 2013, up to 1.3 billion tons of municipal solid waste (MSW) was produced, and this amount is expected to almost double by 2025 (World Bank, 2013). In the USA, about 65% of MSW goes to landfills (EPA, 2011). Improper design of landfills can lead to the production of leachate, contaminating the groundwater. Also, without a proper gas collection system, methane gas, which is a more potent greenhouse gas than carbon dioxide, can escape into the atmosphere. For the past century, the sea level has risen by about 2 mm per year (Cazenave and Llovel, 2010), further aggravating the problems. At this rate, 40% of the human population may be affected by rising waters within the next century (Parry *et al.*, 2007).

Extensive research work on domestic waste disposal has been carried out over the years, in particular with a new form of earthen landfill cover system making use of unsaturated soil mechanics (Ng and Menzies, 2007). Not only can this new three-layer, environmentally friendly earthen cover system prevent rainfall infiltration, it can also reduce gas emissions from domestic waste underneath (Ng *et al.*, 2015a; 2015b; 2015c; 2015d; 2015e; 2016b; Wong *et al.*, 2016a; 2016b). Research on the use of vegetation to improve slope stability has been accelerating. Recent research has focused on mechanical as well as hydraulic effects including soil suction and root architecture (Kamchoom *et al.*, 2014; Ng and Yu, 2014; Ng *et al.*, 2014b; 2015f; 2015g; 2016a; Liu *et al.*, 2016). Although some new findings have been made and insights acquired, it is clear that much more research is needed to save the Earth.

Energy consumption has grown proportionally with population and economic growth (IEA, 2015).

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The rapid increase in energy use has raised concerns about exhaustion of energy resources and adverse environmental impacts. Researchers in the new branch of geotechnical engineering, geo-energy, have sought ways to reduce energy consumption through the use of energy piles and energy tunnels. They have also been exploring alternative energy sources such as shale gas and methane hydrate to slow down global warming (Shen *et al.*, 2016). In the past three decades, ground source heat pumps (or energy piles) have been increasingly used and incorporated in geotechnical structures (geo-structures) such as foundations, diaphragm walls, and tunnels in Europe. This technology has proven to reduce energy consumption by 75% for space conditioning (Brandl, 2006). Given that 25% of the world's energy is spent on space conditioning (EEBPP, 2000), considerable savings can be made. Despite their environmental benefits, ground source heat pumps in the form of energy piles are not widely accepted due to concerns about the effect of temperature on soil-structure interactions (McCartney *et al.*, 2010). Recently, a geotechnical centrifuge was used to investigate extensively the performance of floating energy piles and new insights have been gained (Ng *et al.*, 2014a; 2015h; 2016c).

As well as energy consumption, geo-energy also looks into alternative energy sources such as deep geothermal energy, methane hydrate, and shale gas extraction. The usage of methane hydrate as an energy source began in the early 2000s (Sloan, 1998; Spalding and Fox, 2014). Early exploration in Japan discovered 11 years' worth of natural gas supply. Globally, methane hydrate can potentially provide enough energy for several hundred years (Buffett and Archer, 2004; IEA, 2012). However, its extraction is challenging, requiring careful design and consideration (Shen *et al.*, 2016). Any design failure could release a huge amount of methane into the atmosphere, and trigger underwater landslides and tsunamis (Spalding and Fox, 2014).

Another newly explored energy source is shale gas, which is often trapped during rock formation at depths exceeding 3000 m. Extraction of shale gas is usually combined with carbon sequestration (Mitchell and Green, 2015). This process involves pumping carbon dioxide at high pressure to displace the shale gas. However, the application of high pressure at this depth can induce earthquakes (McGarr, 2014).

It is clear that geotechnical engineering has been playing a crucial role in the preservation and sustainability of the environment, and will continue to do so in the future. Geotechnical engineers as well as researchers should be aware of this role and should be prepared to provide sustainable geotechnical solutions whenever possible.

All these endeavours have culminated in the 1st International Conference on Geo-energy and Geo-environment (GeGe2015), which took place between 4th and 5th December 2015 at the Hong Kong University of Science Technology (HKUST) (Ng *et al.*, 2015i). The conference provided a platform for sharing scientific breakthroughs and innovations for building a sustainable future. It was jointly organised by the HKUST, Chongqing University, Hohai University, and Zhejiang University in China, and the École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland. Support was received from the Hong Kong Geotechnical Society, the Geotechnical Division of the Hong Kong Institution of Engineers, and TC215 Environmental Geotechnics and TC308 Energy Geotechnics of the International Society for Soil Mechanics and Geotechnical Engineering. Authors who submitted excellent extended abstracts to the GeGe2015 conference were invited to submit full papers for review and publication in this special issue. Following the success of the GeGe2015 conference in providing a platform for sharing scientific knowledge, breakthroughs, and innovations for building a sustainable future, the 2nd GeGe conference will be held at Zhejiang University in 2017 and the 3rd at EPFL in 2019.

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中文概要

题　目： 引领“蓝绿”学科的前瞻性研究

概　要： 中国自然科学基金委员在 2016 年 6 月 14 日正式发布的《国家自然科学基金“十三五”发展规划》中明确指出，未来 5 年，基金委将重点支持与“绿色“（以环保为代表）和“蓝色”（以海洋、能源能为代表）相关的交叉学科研究。由于岩土地基是大多数环保和能源相关活动（如城市废弃物的填埋和覆盖、液岩气和海底天然气水合物的安全开采）的最终承载者，岩土工程师和环保、能源相关领域的学者在过去的 30 年里紧密合作，以应对人类在这两大领域所面对的严峻挑战，同时也催生了两个重要的交叉学科，即环境岩土和能源岩土。可以预见，随着环境污染和能源短缺等问题的日益凸显，针对环境岩土和能源岩土的深入研究显得愈发重要。以此为背景，香港科技大学主办了“第一届环境岩土和能源岩土国际会议（GeGe2015）”，旨在提供一个交流平台，分享探讨以岩土工程科学问题为载体的环境、能源相关领域的最新研究进展和发展趋势。此次会议由浙江大学、河海大学、重庆大学和瑞士洛桑联邦理工大学（EPFL）协办，并得到了香港岩土工程学会、香港工程师协会岩土分会以及国际土力学与岩土工程协会下属两大技术委员会（TC215 环境岩土和 TC308 能源岩土）的联合支持。参会人员包括多位外籍院士、“朗肯”讲座人、“太沙基”讲座人以及环境岩土和能源岩土领域的国内外优秀学者。为了分享此次国际会议的成果，会务组筛选了部分优秀的会议论文摘要，并邀请相关作者撰写成全文。经过国际同行专家的评审，最终 8 篇文章入选本期特刊。第二届和第三届环境岩土和能源岩土国际会议（GeGe2017 和 GeGe2019）将分别在浙江大学和瑞士洛桑联邦理工大学举行，继续探讨相关领域的突破性进展，为世界的可持续发展提供科技支撑。

关键词： 十三五规划；“蓝绿”学科；环境岩土；能源岩土；国际会议

Introducing Guest Editor-in-Chief and Guest Editors:

Guest Editor-in-Chief

Prof. Charles W.W. NG is an Associate Vice-President for Research and Graduate Studies and a Chair Professor in the Department of Civil and Environmental Engineering at the Hong Kong University of Science and Technology (HKUST). He obtained his PhD degree from the University of Bristol in 1993. After working as a post-doctoral researcher at the University of Cambridge between 1993 and 1995, he returned to Hong Kong and joined the HKUST as Assistant Professor in 1995 and rose through the ranks to become Chair Professor in 2011.

Prof. NG was elected an Overseas Fellow from Churchill College, Cambridge University, and Changjiang Scholar (Chair Professor in Geotechnical Engineering) in 2005 and 2010, respectively. He is a Fellow of the Institution of Civil Engineers (FICE), the American Society of Civil Engineers (FASCE), and the Hong Kong Academy of Engineering Sciences. Currently, he chairs the Awards Committee of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) and is Editor-in-Chief of the ISSMGE Bulletin. He is the first Chinese to hold either position since the establishment of ISSMGE in 1936. He is an Associate Editor of the *Canadian Geotechnical Journal* and has served on many other editorial boards. Prof. NG has solely supervised and graduated 27 PhD and 35 MPhil students since 1995.

Prof. NG has published some 220 SCI journal articles and 200 conference papers and delivered about 50 keynotes, general reports, and state-of-the-art reports on five continents. He is the main author of two reference books: (i) *Soil-structure Engineering of Deep Foundations, Excavations and Tunnels* and (ii) *Advanced Unsaturated Soil Mechanics and Engineering.* He has received many awards including the R.M. Quigley Award from the Canadian Geotechnical Society twice for two of his best papers. Prof. NG was awarded the 2003 Mao Yisheng Youth Award by the Chinese Institute of Soil Mechanics and Geotechnical Engineering for his significant contributions to geotechnical engineering. He received the 2nd Prize of the 2015 Scientific Advancement Award from the State Council of China and also the 1st Prize of the 2013 Scientific Advancement Award from the Chinese Ministry of Education.

Guest Editor

Prof. Li-zhong WANG is the Executive Vice Dean of graduate school and a Qiushi Distinguished Professor in the College of Civil Engineering and Architecture, Zhejiang University, China. He obtained his PhD degree from Zhejiang University in 1995 and became a full professor in 2000. Prof. WANG has been long engaged in the research on marine soil mechanics and marine geotechnology. His research includes the constitutive behavior of marine soils, offshore pipelines, mooring systems, subsea tunneling, seabed geohazards and offshore, wind turbine foundations.

Prof. WANG was appointed as Adjunct Professor in University of West Australia, and was elected Changjiang Scholar in 2015 by the Chinese Ministry of Education. He is a recipient of several academic awards, including the Distinguished Young Scholar Award of the National Natural Science Foundation of China, the First Class Award in Scientific and Technological Progress of the Ministry of Education in China, and the Mao Yisheng Youth Award. He is a member of the TC209 committee of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) on offshore geotechnics, and an Associate Editor of an international journal, i.e., *Journal of Offshore Mechanics and Arctic Engineering*.

Prof. WANG has published some 130 journal papers, including about 70 SCI-indexed papers. He has authored or co-authored five books, and held 10 patents.

Guest Editor

Prof. Liang-tong ZHAN obtained his PhD degree in geotechnical engineering from Hong Kong University of Science and Technology in 2003. He is a full professor in the College of Civil Engineering and Architecture, Zhejiang University, China. His main research area is geoenvironmental engineering, particularly geotechnical properties of municipal solid wastes, landfill cover and barrier, geo-hazards induced by environmental change, etc. He is principal investigator of one research topic of National Basic Research Program of China (973 Program), three projects of National Natural Science Foundation of China and several important consultant projects related to municipal solid waste landfills. He has published over 100 papers, including 40 peer-reviewed international journal papers.

Prof. Liang-tong ZHAN is a member of the TC106 committee of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) on unsaturated soils. He serves as an editorial board member for two international journals (i.e., *Geotextiles & Geomembrane* and *Canadian Geotechnical Journal*).

Guest Editor

Dr. Yi HONG is a lecturer in the College of Civil Engineering and Architecture, Zhejiang University, China. He obtained his PhD degree from the Hong Kong University of Science and Technology in 2012. His main research area is soil-structure interaction related to offshore geotechnics and underground construction. He has published 19 peer-reviewed international journal papers, one monograph (in Springer) and has co-authored 2 keynote papers in international conferences.