Article:
Stewart, DI orcid.org/0000-0001-5144-1234 and Clarke, BG orcid.org/0000-0001-9493-9200 (2020) Editorial. Environmental Geotechnics, 7 (7). pp. 445-446. ISSN 2051-803X

https://doi.org/10.1680/jenge.2020.7.7.445

Editorial

Douglas I. Stewart, BSc, MPhil, PhD, PE
Professor of Geoenvironmental Engineering, University of Leeds, UK

Barry G. Clarke, BSc, PhD, FICE, FGS
Professor of Civil Engineering Geotechnics, Leeds, UK

Co-Chairs of CPEG2

Themed issue on CPEG2

Welcome to this themed issue of Environmental Geotechnics on the 2nd International Symposium on Coupled Phenomena in Environmental Geotechnics (CPEG2). CPEG2 was held at the University of Leeds in the UK on 6-8th September 2017. CPEG is a quadrennial symposium organized under the auspices of the Technical Committee TC215 (Environmental Geotechnics) of the International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE). The 2nd CPEG symposium was preceded by the very successful inaugural symposium in Torino, Italy, in 2013 and will be succeeded by the 3rd CPEG symposium which is now planned for 17-19th March 2021 at Kyoto University in Japan.

We have entered the anthropocene era in which human activity is the dominant driver of increasingly challenging environmental changes. The resulting problems faced by geoenvironmental engineers are complex, and require a transdisciplinary, integrated, systems approach to innovative solutions driven by the underlying science. Challengingly, many geoenvironmental problems involve coupled processes (e.g. combinations of chemical, thermal, and hydro-mechanical processes) that interact in ways that are complex and not yet fully understood. At CPEG we heard from more than 60 participants, attending the symposium from around the world, about their innovative approaches to addressing these problems. In this themed issue we have invited the Authors of seven of these papers to present their work in more detail for a wider audience.

The themed issue starts with a fascinating paper by Malusis et al. (2020) that demonstrates the importance of coupled phenomena to predicting the performance of clay barriers. This paper is a timely reminder that advection, diffusion and chemico-osmosis must all be considered when predicting solute flux through clay barriers. Similarly, Xie et al. (2020) demonstrate the importance of correctly modelling the hydraulic boundary conditions when there is coupled advection, diffusion and retardation in a vertical cut-off wall. Likewise, Chen et al. (2020) show how coupled geochemical processes affect the chemistry of the groundwater plume that will form in the vicinity of a nuclear waste repository that is sealed with a cement

buffer material. These papers illustrate the importance of rigour in our conceptual and numerical models as geoenvironmental engineers are often required to predict engineering behaviour on time-scales that are orders of magnitude larger than the time-periods over which we can conduct experiments.

The modelling work presented at CPEG2 was complemented by many meticulous experimental studies. The examples in this themed issue include work by Al-Moadhen et al. (2020) who investigated hydraulic flow through composite soils. They propose that composite soils are either matrix dominated soils, in which the fine-grained component dictates the engineering behaviour, or clast-dominated soils, where the coarse-grained component dictates the engineering behaviour. Ören et al. (2020) discuss the experimental difficulties in determining the performance of geosynthetic clay barriers to metal chloride solutions. Rakic et al. (2020) propose a new geotechnical classification system for municipal solid waste that captures important information on the composition, shape and size of particles, factors that affect the mechanical behaviour and physical properties of MSW.

The issue closes with a case-study. Koda et al. (2020) investigated the impact of an old municipal landfill site on heavy metals pollution of soil and groundwater. They report a fascinating dataset showing pollution in the vicinity of the unlined landfill before and after construction of a groundwater protection system that consists of a clay capping layer to reduced rainwater ingress, installation of drainage to allow leachate management, and a vertical barrier that surrounds the landfill that controls leachate egress. Monitoring data from a period that extends from 8 years before site remediation to 16 years afterwards shows marked improvement in heavy metal contamination of groundwater in the vicinity of the landfill that is continuously improving with time.

The delegates at CPEG2 identified many challenges that will face geoenvironmental engineers in the coming years. Many of these were technical challenges; how do we model this process or how do we characterise that phenomenon. However, the fundamental challenge facing our community is how to solve the environmental challenges created by an increasing population, urbanisation and intensification of agriculture. Geoenvironmental engineers will have to respond to this by reducing energy and material consumption through smarter, sustainable and resilient design and implementation. Geo-structures and remediation schemes will have to be less invasive and less resource intensive using natural gradients and spontaneous processes. We started on this journey 25 years ago with permeable reactive barriers, which exploit groundwater gradients and thermodynamically favourable reactions to treat contaminated groundwater. But this philosophy must be at the heart of all future geoenvironmental schemes. We need to be the masters of coupled thermal, hydrological, biological and chemical processes. Importantly we must learn to take a synergetic view incorporating the metabolic processes of soil and groundwater

bacteria to achieve desirable outcomes. With this in mind, we look forward with great anticipation to future CPEG symposia and publications in this journal in the confident expectation that the geoenvironmental community will rise to the challenge.

Malusis MA, Scalia J, Norris AS and Shackelford CD. Effect of chemico-osmosis on solute transport in clay barriers. Environmental Geotechnics, https://doi.org/10.1680/jenge.17.00109

Chen J, Chen X, Wang M et al. The couplings of rock/carbonate groundwater/cement leachate. Environmental Geotechnics, https://doi.org/10.1680/jenge.18.00008

Xie H, Wang S, Chen Y, Jiang J and Qiu Z. An analytical model for contaminant transport in cut-off wall and aquifer system. Environmental Geotechnics, https://doi.org/10.1680/jenge.18.00021

Al-Moadhen MM, Clarke BG and Chen X. The permeability of composite soils. Environmental Geotechnics, https://doi.org/10.1680/jenge.18.00030.

Ören AH, Öztürk M, Özdamar Kul T and Nart Z. Barrier performance of geosynthetic clay liners to copper (II) chloride solutions. Environmental Geotechnics, https://doi.org/10.1680/jenge.18.00024

Rakic D, Basaric I, Caki L and Coric S. Contribution to the geotechnical classification of municipal waste landfills in Serbia. Environmental Geotechnics, https://doi.org/10.1680/jenge.18.00028.

Koda E, Miszkowska A, Sieczka A and Osiński P. Heavy metals contamination within restored landfill site in Poland. Environmental Geotechnics, https://doi.org/10.1680/jenge.18.00031.