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Editorial

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Editorial

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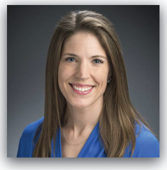

As geoenvironmental engineers we are often captivated, and constrained, by the tremendous power of water. From subsurface contaminant transport to slope stability, water is almost always at the root of our greatest geo-engineering challenges. The impacts of climate change on infrastructure, as well as consequences of changes in groundwater quality and quantity, are just some of the water-related challenges that have taken centre-stage within our engineering community. The papers in this issue highlight the important and complex role of groundwater in the stability of abandoned mine sites, long-term performance of in-situ treatment (permeable reactive barriers) and geothermal energy piles.

Worldwide water security concerns for the future are not just about water quantity, but also about water quality (Boretti and Rosa, 2019; Gunda *et al*., 2019). Increases in freshwater demand due to population and economic growth, coupled with reduced resources and increased water pollution, have led to projections that six billion people will suffer from clean water scarcity by 2050 (WWAP, 2018). One well-recognised global threat to ground and surface water quality is acid mine drainage (AMD) from abandoned mine sites (Tomiyama and Igarashi, 2022). To counter this widespread form of water pollution, extensive research has focused on effective treatment technologies for highly acidic, heavy-metal rich, AMD-impacted water (e.g., *Environmental Geotechnics* publications: Indraratna *et al*., 2017; Mahedi *et al.,* 2020). In this issue, Indraratna *et al.* (2022) evaluate the efficacy of calcite (limestone) aggregates as reactive media in permeable reactive barriers (PRBs) to remediate groundwater acidity associated with AMD. Through a series of long-term column experiments, the authors quantified spatio-temporal changes in the limestone treatment capacity. Specifically, they reported decreases in hydraulic conductivity and treatment efficiency due to clogging from iron precipitation. Although the laboratory tests exhibited significant clogging within a six-month period, related work by Pathirage and Indraratna (2014) suggests that similar performance losses in field-scale PRBs may take several years.

Continuing with the theme of long-term impacts of abandoned mines, Ito and Aydan (2022) and Adan *et al*. (2022) present complementary papers in this issue focused on lignite mines in Japan, which include discussion of the roles of groundwater and sinkhole formation in overall stability. The authors pair field observations of post-earthquake damage with results of shake-table experiments to enhance understanding of mechanisms driving sinkholes and subsidence at the abandoned mine sites. For the interested reader, related studies on lignite mines published in *Environmental Geotechnics* include Aydan *et al.* (2014) and Geniş and Aydan (2022).

Energy security is fundamentally linked to water security; water is used to generate electricity, and electricity is used to treat and transport water (Hamiche *et al.*, 2016). Energy projections for the year 2050 include an increase in world energy consumption by 50% (relative to the year 2020 (US EIA, 2021)). Consequently, energy-related water consumption is expected to increase by nearly 60% (IEA, 2016). However, reduced availability and accessibility of the water resources necessary for fuel extraction and power generation may further increase stress on energy supply. At the same time, due to increased water scarcity, more energy will be required for hydraulic infrastructure to move greater volumes of water across farther distances (IRENA, 2015). Hence the challenge for geoenvironmental engineers working at the water–energy nexus, where threats to water security and energy security under a changing climate are deeply entwined.

In this regard, substantial research and technological advancement have focused on renewable energy as an alternative to meeting growing energy demand. The previously cited energy projections from US EIA (2021) included expectations that energy consumption from renewable sources would more than double by 2050. Within the geotechnical and geothermal energy community, there has been increased interest in energy piles as ground heat exchangers, with several studies focusing on impacts of temperature cycles and climate-change scenarios on pile performance (e.g., *Environmental Geotechnics* publications: Abdelaziz and Ozudogru, 2016; Abuel-Naga *et al*., 2015; Adinolfi *et al*., 2021; Nguyen *et al.*, 2020; Wang *et al*., 2016). In this issue, Wu *et al*. (2022) present an experimental study investigating the effect of stress history (overconsolidation ratio) of saturated clay on the engineering behavior of energy piles. The energy pile was subjected to multiple heating/cooling cycles, and the pile displacement, axial force and tip resistance were evaluated.

As we look to the Sustainable Development Goals (SDGs) set forward by the United Nations in 2015, we know that we have a critical role to play as geoenvironmental engineers in protecting and managing water to achieve global targets for human health, clean water, clean energy, sustainable cities, climate action and life on land (SDGs 3, 6, 7, 11, 13, 15, respectively). As multidisciplinary experts already striving to solve complex problems at the water–environment–energy nexus, we are uniquely skilled and we are ready.

To stay informed about the latest advancements in geoenvironmental engineering, the reader is encouraged to check Ahead of Print publications at www.icevirtuallibrary.com. The articles in the issue were made available Ahead of Print in December 2020 in the *Environmental Geotechnics* Virtual Library.

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