Editorial

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This special issue of *Environmental Geotechnics* has a thematic focus on alternative barriers used in environmental geotechnics. Here we use the term ‘barrier’ in its broadest sense; that is, the engineered use of hydraulic, diffusive or reactive processes to control fate and migration of contaminant(s). This includes liners and covers as well as slurry, cement or reactive walls in various configurations. In all of these cases, the intent is to protect human health and the environment from contamination by nuclear, hazardous or solid waste. Historically, such waste was discarded indiscriminately, giving birth to our discipline, as has been well summarised in a previous paper in this journal (Reddy, 2014).

The first barriers used in environmental geotechnics were naturally occurring soils and industrial byproducts in contact with disposed waste. All porous media can be characterised in terms of its hydraulic conductivity, diffusion coefficient and reactivity; properties that, when engineered, can serve as a barrier. Over the past 40 years, our discipline has taken advantage of these properties. In the case of landfills, this initially meant specifying compacted clay, given its low hydraulic conductivity. Clay is not always readily available and is vulnerable to freeze–thaw- or desiccation-induced structural changes. The next generation of barriers thus favoured geosynthetic materials (geomembranes and geosynthetic clay liners) and these products remain the standard of care in developed countries. There will be a role for these and future product innovations for the foreseeable future. What we can also foresee is an expanding market across a developing world with more nuanced constraints and considerations, such as life cycle assessment and sustainability.

And this brings us to the present collection of papers that provide a representative portfolio of the next generation of alternative barriers. Vertically installed barriers, such as slurry walls, are effective for remedial control of contaminants released from legacy activities of open dumping and related industrial activities. These barriers often obviate the need for the unsustainable option of last resort in environmental remediation; excavation and removal, also known as ‘dig and haul’. Koda and Osinski (2017) write about the use of cement, bentonite and a special additive to create low-permeability cut-off walls to isolate an old, unlined landfill from the prevailing groundwater. Adams *et al.* (2017) provides a case study to illustrate key processes of an in situ method for creating trench barriers (i.e., trench mixing of soil with wet or dry binders to achieve a homogeneous barrier within a variety of geometries).

Barriers can also be permeable, as in the case of permeable reactive barriers (PRBs) composed of zero valent iron and other

additives intended to reduce influent contaminant concentrations to acceptable limits. Moraci *et al.* (2017) provide a practical basis to integrate laboratory and numerical methods to estimate the contaminant-specific assimilative capacity of PRBs. In some cases, a combination of barriers may be needed to achieve requisite reductions in both hydraulic and mass flux rate. Stark (2017) provides compelling evidence that a four-component composite landfill liner system performs better than conventional designs, in terms of advective leakage and mass transport for volatile organic compounds. Indeed, multiple components and multiple materials must be considered to ensure design objectives are not only met but satisfied using the most sustainable and locally available materials during the entire service life of the system. Broda *et al.* (2017) analyse potential avenues so as to minimise the infiltration of precipitation into the core zone of rock piles by applying a compacted layer on top of each bench, made of finer-grained non-reactive waste rock. Indraratna *et al.* (2017) provide analysis and simulation of the use of recycled concrete to neutralise acidic groundwater created by pyritic soils. Such results expand the existing suite of options that include coal combustion and other industrial byproducts that, when appropriately characterised, designed, constructed and maintained, can serve as alternative barrier materials. Jordan *et al.* (2017) introduce an entirely new approach to barriers (i.e., using a class of chemicals termed organo-silanes to create water repellency). Indeed, water is the source of numerous challenges in environmental geotechnics, and if one can control it then they can manage changes in leachability, swelling and strength. Also in this themed issue is a paper by Herzberg *et al.* (2017) describing the use of near-infrared spectroscopy and fibre optic waveguides to provide real-time in situ monitoring of specific classes of hydrocarbons. Indeed, the extent to which any alternative barrier can be used is predicated on its performance, the ‘proof must be in the pudding’, so to speak; and with that closing, we look forward to more innovations by researchers, as our profession inexorably evolves toward performance-, not prescriptive-, based designs.

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