

## TRANSPORT PHENOMENA IN SOFT POROUS MATERIALS

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### ABSTRACT

Transport phenomena in soft, porous materials govern numerous natural and engineered systems, from biological tissues to geomaterials and advanced functional composites. The nature of this transport is inherently coupled: fluid flow, mass and heat transport, deformation, and chemical activity interact across scales, raising significant theoretical and computational challenges. This Invited Session aims to explore recent advances in modeling, simulation, and experimental characterization of transport processes in deformable porous media. Emphasis is placed on multiphysics coupling between fluid–structure interaction, diffusion, consolidation, swelling, and reactive transport. Contributions addressing nonlinear constitutive behavior, large deformations, and evolving microstructure, and emerging perspectives from poromechanics, mixture theory, and multiphase continuum frameworks are particularly desired.

The Invited Session aims at embracing challenges in the mechanics of functional materials, including gels and polymeric mixtures, in soil mechanics, including consolidation, seepage, unsaturated flow, and in biological media, including swelling, liquefaction, interaction between charged ions. Transport-driven instabilities, localization, fracture, and phase separation in both geomaterials and hydrated soft networks are potential sources of relevant discussion. Advanced numerical strategies, including multiscale, meshless, and data-driven approaches, are welcome, alongside experimental validation techniques. Important topics such as identifying governing dimensionless parameters and scaling laws across biological and technical contexts are particularly interesting. By stimulating interactions among active scientists in the fields of mechanics, materials science, bioengineering, and geomechanics, this session aims to share and improve the knowledge of coupled transport in soft porous materials, possibly advancing predictive capabilities for biological tissues, environmental systems, and multifunctional materials.