Contribution ID: **117** Type: **Oral Presentation**

Impact of large periodic deformations on solute transport in soft porous media

Wednesday, 24 May 2023 12:00 (15 minutes)

From soils to soft biological tissues, there are many examples of materials that can be modelled as highly deformable porous media, characterised by a strong coupling between mechanical stimulation and fluid flow due to complex rearrangements of the pore space. In both contexts –subsurface geomechanics and living-tissue biomechanics or tissue engineering –the effects of large periodic deformations on solute transport and mixing can be of great interest for predicting and/or controlling the motion of contaminants or nutrients. Here, we propose a 1D continuum model based on large-deformation poroelasticiy that links an applied periodic deformation to the resulting solute transport and mixing. Transport occurs through advection, molecular diffusion, and hydrodynamic dispersion, all of which are affected by the deformation in specific ways. We explore the effects of several dimensionless parameters on the problem, focusing on the ones regulating the applied periodic load. We find that the amplitude and period of deformation influence the mechanical response of the material, which can belong to either a linear slow-loading or a nonlinear fast-loading regime. These mechanical regimes directly characterise the resultant movements of solute.

Participation

In-Person

References

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Session Classification: MS20

Track Classification: (MS20) Biophysics of living porous media: theory, experiment, modeling and characterization