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Gas-liquid phase separation in a soft porous medium

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Various biological and chemical processes can lead to the nucleation and growth of gas bubbles within the pore space of an otherwise liquid-saturated granular medium, such as in lake beds and waste ponds. The gas is typically non-wetting and, as the bubbles approach the pore size, it is energetically costly for them to invade narrow pore throats. If the solid skeleton is sufficiently soft, it is favourable for the bubbles to displace the solid grains and form macroscopic cavities. Here, we consider this process through the lens of phase separation, where thermomechanics govern the separation of a gas phase from a gas-liquid-solid mixture. We construct a phase-field model informed by large-deformation poromechanics, in which two immiscible fluids interact with a poroelastic solid skeleton. Our model captures the competing effects of elasticity and gas-liquid-solid interactions. As a model problem, we consider an initial distribution of gas in the pore space that separates into multiple gas cavities. We identify the key parameters that control phase separation, the conditions that favour the formation of gas cavities, and the characteristic size of the resulting gas cavities.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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