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From frictional fingers to stick slip bubbles

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Gas intrusion into wet porous/deformable/granular media occurs in a wide range of natural and engineered settings. Examples include hydrocarbon recovery, carbon dioxide geo-sequestration, gas venting in sediments and volcanic eruptions. In the case where the intruding gas is able to displace particles and grains, local changes in granular packing fraction govern the evolution of flow paths, resulting in complex pattern formation of the displacement flow.

Here we investigate flow patterning as a compressed gas displaces a granular mixture confined in the narrow gap of a Hele-Shaw cell. We find a surprising variety of different pattern formation dynamics, and present a unified phase diagram of the flow morphologies we observe. This talk will focus on one particular transition the system undergoes: from frictional fingers to stick slip bubbles. We show that the frictional fluid flow patterns depend on granular mass loading and system elasticity, analogous to the behaviour of the well-known spring-block sliding friction problem.