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Flow patterns and interface stability during drainage of liquid–particle mixtures

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Multiphase flow in particle–gas–fluid systems is relevant to many geophysical processes and subsurface engineering applications, such as hydrate production, methane venting, volcanic eruption, etc. Previous researches have investigated the pattern formation in frictional fluid dynamics, viscous fingering instability, wettability alteration, providing the basic understanding of the complex flow mechanisms. Here, we perform laboratory experiments of drainage of liquid–particle mixtures to study morphological patterns and interface stability. We consider both homogeneous and heterogeneous particle distributions. We characterize the flow regime transition from stable displacement to viscous fingering based on morphology and macroscopic metrics, and we compare the onset of fingering with prediction based on the linear stability theory. Compared with homogeneous mixtures, particle clusters and bands in the heterogeneous mixtures evidently promote fingering instability. Furthermore, we find that slow drainage leads to particle compaction bands due to interface ploughing effect. This work provides an improved understanding of the physical mechanism of particle–gas–fluid multiphase flow and is of relevance for practical applications in the subsurface.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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Primary author: Dr LI, Dongqi (Wuhan University)

Co-authors: YANG, Zhibing (Wuhan University); Dr ZHANG, Renjun (Wuhan University); HU, Ran (Wuhan University); CHEN, Yi-Feng (Wuhan University)

Presenter: Dr LI, Dongqi (Wuhan University)

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