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Gas Invasion Behaviors and Failure Patterns within Layered Porous Systems Investigated by X-ray CT

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Gas trapping and escaping in layered geological settings widely occur. We utilized an in-situ gas injection apparatus based on high-resolution micro-CT to investigate gas invasion behaviors and deformation patterns of layered porous media systems. The system includes a reservoir and a cap layer with carefully controlled capillarity and permeability. Results show that all cases experience cycles of a pressure built up period and a sudden pressure release when a barrier, either capillarity or effective stress, is overcome. Drainage conditions significantly impact both the trapped gas volume and deformation patterns. Effective stress analyses show that dominant factors are capillarity Pc, *effective stress σ'and excess pore fluid pressure Δu, affected by gas injection rate, cap layer thickness and permeability. Five deformation patterns, capillary invasion, fracture opening, integral uplifting, local heaving and violent liquefaction are identified according to two dimensionless number χC/E = Pc*/σ'and χP/E = Δu /σ'.

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