Focused fluid flow in porous viscoelastoplastic rocks

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Management of commercially valuable hydrocarbon resources and engineering operations such as CCS are dependent on our knowledge about interaction between rocks and fluids. Experience shows that fluid flow in sedimentary basins and reservoirs is often focused, which is evidenced from a large number of seismic cross-sections displaying chimney or pipe structures, including those from Sleipner area where one of the largest CO2 injection pilots is located. As seismic surveys are widely performed in many regions where the subsurface is of economic interest, a better understanding of the formation and evolution processes of these chimneys is vital. They should be considered when performing risk assessment linked to leakage within subsurface waste storage projects. We propose a new physical model that predicts the formation and the evolution in space and time of flow focusing due to solitary porosity waves. We use 2D implicit solver and 3D high-resolution iterative parallel GPU code to solve a thermodynamically consistent system of nonlinear equations for two-phase flow in viscoelastoplastic porous media. We discuss and highlight the importance of a proper coupling between the geomechanics and the reservoir fluid flow in subsurface fluid injection operations.