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# High permeability chimney genesis resolved in two-phase systems

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Channelised fluid flow is ubiquitously worldwide observed in the shallow subsurface and occurs at various length and time scales. The vertical high permeability chimneys play an important role in both natural fluid migration and anthropogenic reservoir operations.

However, no current model explains or predicts how, when and where these chimneys are formed.
Here we provide a physical mechanism of such chimney formation using novel high-resolution two-phase numerical calculations in three-dimensions.

To model the chimney evolution in deforming porous media we developed a parallel numerical application that solves poro-mechanics coupled to nonlinear fluid flow. To capture the strong localisation in space and time, a mega-pixel numerical grid resolution is used in each two-dimensional cross-section.

Our results confirm that a strong coupling between solid deformation and fluid flow provides a viable mechanism for chimney formation. These high permeability chimneys provide efficient pathways for fast vertical fluid migration. Using model parameters relevant for sedimentary rocks, we reproduce natural observations and their main characteristic features.

We conclude on suggesting what data is needed to further constrain the model predictions. Accurate predictions are vital to understand the formation of potential leakage pathways and are a prerequisite for reliable risk assessment in long term storage.