Pressure-saturation hysteresis of two-phase flows in disordered media

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Fluid–fluid displacements in disordered media are found in a variety of natural and technological relevant situations, from the rise of sap in plants and wetting/drying processes in soils, to filtering and printing. On the other hand, displacements in disordered media exhibit complex phenomena at multiple scales, making them challenging and interesting also from a fundamental point of view.

In this talk I will focus the attention on the relationship across scales of pore-scale capillary events, spatially-extended collective displacements (avalanches or Haines jumps), and pressure vs saturation hysteresis cycles. I will show that the return-point memory property of quasistatic imbibition-drainage cycles provides a robust means to sort out and quantify the energy losses of capillary origin. The relative importance of viscous dissipation will be deduced by comparison with the results of nearly-quasistatic experiments.

The mechanisms identified here apply to a broad range of problems in hydrology, geophysics and engineering.

References

1. R. Holtzman, M. Dentz, R. Planet & J. Ortín, The origin of hysteresis and memory of two-phase flow in disordered media, *Commun. Phys.*, **3**, 1–7 (2020).
2. R. Holtzman, M. Dentz, R. Planet & J. Ortín, The relation between dissipation and memory in two-fluid displacements in disordered media, *Geophys. Res. Lett.*, **50**, 1–8 (2023).