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A Solutal Fingering Instability during Capillary Imbibition in Porous Media W.D. RISTENPART, N.J. YOUNG, C.J. GUIDO, Dept. Chemical Engineering and Materials Science, Univ. California Davis — We report the existence of a solute-driven fingering instability that occurs during capillary imbibition into cellulosic porous media. Contacting a piece of paper with an aqueous solution containing hydrophobic solutes causes the liquid to move forward into the paper. For sufficiently low solute concentrations and sufficiently high ambient humidities, the imbibition front moves forward smoothly as expected. For higher concentrations and lower humidities, however, the imbibition front develops spatially periodic oscillations that grow with time, i.e., a fingering instability occurs. Surprisingly, under these conditions the solute concentration becomes larger at the imbibition front compared to the bulk, contrary to the behaviour expected based on chromatographic separation. We demonstrate that fingering instabilities occur with a wide variety of solutes and paper types, and we propose that the instability is driven by solute-induced changes in the air/liquid interfacial tension as liquid is absorbed into a humidity-dependent precursor film.

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