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An Asymptotic Analysis on the Universality of the Coffee-Ring Effect MATTHEW MOORE, JIM OLIVER, DOMINIC VELLA, University of Oxford — We study the evolution of the coffee ring generated by the transport of a dilute solute to the pinned contact line of a thin, evaporating droplet. The contact line is assumed to be smooth and simple, but otherwise arbitrary. We employ a novel integrated mass formulation to facilitate a systematic matched asymptotic analysis of the small-Capillary number, large-solute Pclet number limit. The analysis is presented both for evaporation limited by the vapour-diffusion and for a simple one-sided, non-equilibrium evaporative model in which the evaporative flux is essentially constant. The universal aspects of the asymptotic predictions for the evolution of the concentration profile in the bulk and coffee ring are discussed in detail and illustrated for circular and elliptical contact sets. Our results offer mechanistic insight into the effect of contact-line curvature on the coffee-ring dynamics from deposition up to jamming of the solute.

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