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Pattern formation in watercolor paintings

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The restoration of a masterpiece is essential to preserve its historical and commercial value. With the aim to find physical laws that allow us to predict the complex phenomena that emerge during the materialization of artistic work, we explore the effect of the pigment concentration and paper humidity on the pattern formation derived from evaporation of droplets of watercolor paintings. These control parameters induce the formation of color gradients, stratifications, flat regions, borders, dendritic shapes, and radial tips. Interestingly, the droplet evaporation on dry paper form coffee rings stains regardless of the nature of the pigment. The mean pixel intensity of such stains follows an exponential function that saturates at high concentration, while the thickness of the coffee ring increase for watercolor inks containing colloidal particles and does not change for non-colloidal. The experiments reveal that water distribution on the paper surface, and not on the density of water on the paper, determine the structural characteristics of watercolor stains. We show evidence that the cornerstone in the creation of complex patterns in watercolor paintings is driven by the coffee ring effect and imbibition processes. Our findings could help with the correct application of restoration processes to preserve the heritage value of watercolor artwork.