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Double-diffusive layers adjacent to cold chimney flows during transient mushy-layer growth JIN-QIANG ZHONG, TongJi University, Shanghai, China, QIWEI XUE, JOHN WETTLAUFER, Yale University, NewHaven, CT, USA — We examine the cooling effect of chimney flows in the liquid region during transient upward growth of a mushy layer in solidifying aqueous ammonium chloride. Through drainage channels in a mushy layer, cold, relatively fresh fluid is carried into the warm, salt-stratified liquid region. Double-diffusive cells form due to the cooling effect of the chimney flows and evolve into a series of downwelling horizontal layers. Using shadowgraph methods and dyed fluids we demonstrate the vigorous flow circulations and compositional mixing within each layer. Vertical concentration and temperature profiles reveal the double-diffusive staircase structure across the layers. The downward velocity of the layers decreases as they approach to the mush-liquid interface, which is interpreted by a filling-box model representing the momentum and compositional transport of turbulent continuous plumes in a confined region. The present experiment provides insight to evaluate the solute fluxes from growing mushy layers.

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