Particle Size Segregation in Granular Avalanches

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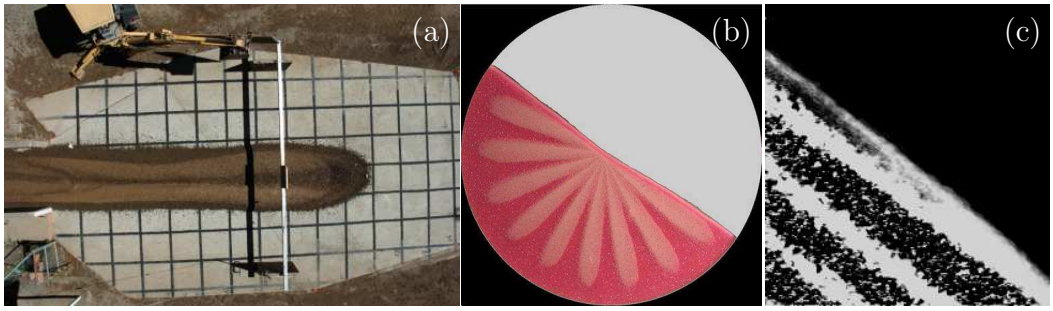

When particles with different material properties are segregated by size or density they often have a subtle feedback on the local mobility of the granular material, which can significantly modify the bulk flow. Perhaps the most striking example of this *segregation-mobility* feedback occurs in geophysical mass flows, such as debris-flows, dense pyroclastic avalanches and snow avalanches. Larger rougher particles commonly segregate to the surface, where the velocity is greatest, and are transported to the flow front where they accumulate. These bouldery margins experience much greater frictional resistance to motion than the flow interior, which can lead to the spontaneous development of stationary coarse grained lateral levees (figure 1a), that channelize the finer more mobile interior and significantly enhance the overall run-out distance [4]. Other examples include fingering instabilities [5], the emergence of petal-like patterns [2, 6] in rotating drums (figure 1b) and alternating stratified bands [1] in heaps (figure 1c). Despite their apparent complexity, mathematical models for these flows are now achievable by using a simple theory for particle size segregation [e.g. 1, 3] to couple the evolving particle size distribution to the mobility of the bulk flow. We propose to investigate the dynamics of these complex systems using a combined approach of theory, numerical computation and experiment.

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