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Bubble migration towards damaged paths in a yield stress fluid

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ABSTRACT

Understanding and managing gas release in yield stress fluids is crucial for both industrial operations and environmental sustainability. Of particular concern is the emission of carbon dioxide and methane from mining tailing ponds and other similar wastage slurries, e.g. nuclear. In these the upper layers of sediment/tailings typically contain smaller particles and often form a colloidal suspension with a yield stress. Bubbles generated within the pond may be trapped within the pond, below a critical size. Here we first present a brief overview of models to predict the depthwise distribution of yield stress and trapped bubbles. There is some evidence that trapped bubbles, when they eventually release, are attracted towards the (damaged) pathways that previous bubbles have travelled. It appears that the fluid in the wake of previous bubbles does not fully recover from its deformation and that nearby bubbles can sense this weakness, presumably via the stress field. We present limited experiments in which we purposefully shear a layer of yield stress fluid (Carbopol) and then release bubbles starting at varying distances from the damaged layer. We observe and quantify the drift of particles towards the damaged layer.