

# Quasi-2D extensional study on granular suspensions: A rheological discussion

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## 1 Introduction

One of the puzzling phenomena in volcanism is the ductile-to-brittle transition that magma undergoes when it is rapidly stretched. Magma is a complex multiphase system that comprises a melted-silica matrix, gas, and suspended solid crystals. To shed light on the rheological effects of solid crystals in magma, I have recently joined the Ichihara research group. My objective is to propose and conduct a model experiment that can help us understand the mechanical behavior of a suspension under extensional deformation modes, with the ultimate goal of better understanding the ductile-to-brittle transition of magma.

## 2 Quasi-2D pulling experiment

Experimental extensional deformation poses a challenge due to the difficulty in ensuring proper boundary conditions. To address this, I have conceptualized and built an experimental setup designed to systematically explore the thinning behavior of a granular suspension as a model for magmatic systems. This setup allows us to better understand the role of solid crystals on the rheological properties of magma during sudden stretching events, which is a striking yet poorly understood phenomenon in volcanism. A sketch of the experimental setup is presented in Fig.1.

The experimental device, shown in Fig. 1, is capable of conducting quasi-2D pulling tests at various pulling velocities and particle concentrations in suspension. It can sense the pulling force and record the deformation from both front and side views using two digital cameras.

### 2.1 Description

The deformation of the bulk mainly depends on the pulling direction and the suspension's ability to flow. As the particle concentration increases, the fluid viscosity also amplifies, impeding the flow of the mixture. With the help of the present experimental setup, we can track the local fluctuations in the

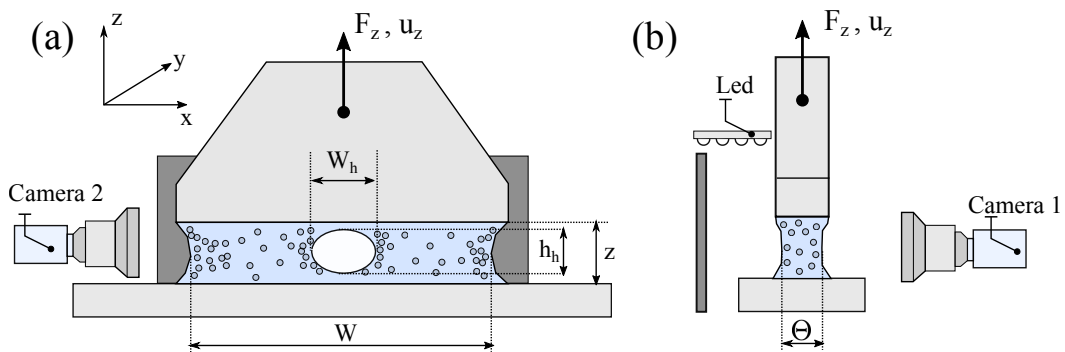


Figure 1: Schematic of experimental setup. (a) Front view (xz-plane) (b) Side view (yz-plane).

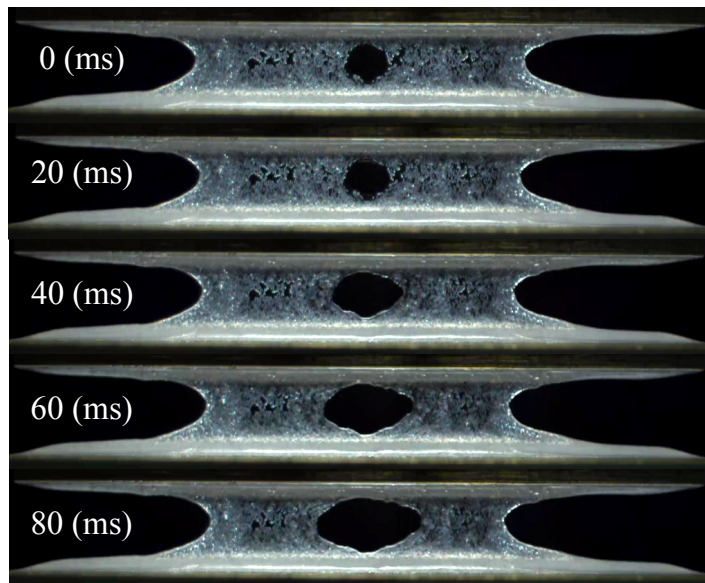


Figure 2: Screenshot of front view showing the breaking up process in the bulk of the suspension for a given concentration of solid particles.

particle concentration and correlate them with localized material breaking. This study aims to provide useful insights into the mechanical properties of a stretched viscous suspension and its correlation with fragmentation capability, in the light of magma brittle fragmentation.

## 2.2 Activities

- Writing of the scientific paper in progress to be submitted soon.
- Writing of the scientific review concerning rheological properties of suspension is in progress.
- International congress: AGU-Japan, ERI-IPGP-Japan, KITP-USCLA USA.

## 2.3 Acknowledgement

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