J160-P001 **Room: Poster Session Hall** **Time: May 27**

Experiments on granular column collapse in liquids

Fumi Shibiya[1]; Ikuro Sumita[2]

[1] Earth Sci., Kanazawa Univ.; [2] Nat.Sci.Tech., Kanazawa Univ.

Introduction:Collapse of granular column is common in nature, some examples of which are debris flows and snow avalanches. These granular collapse have a variety of styles, outflow lengths and collapse time. Granular material consists of solid particles with interstitial fluid (gas or liquid) and behave as solid-like as well as fluid-like. In order to understand the spatial and temporal scales of collapse, it is important to clarify how these scales depend on the parameters such as the grain size, fluid viscosity and the aspect ratio of the column. Previous works have been primarily made under air (e.g., Lajeunesse et al., 2004) and focused on the aspect ratio dependence. Only a few work has addressed the case under water (Thompson & Huppert, 2007). In this work, we focus on granular collapse in liquids, which is necessary to understand cases such as underwater debris flows.

Experimental method: We fill a plastic case with glass beads (diameter: 0.05-1mm) with a silicone oil of a viscosity of 50cst to form a layer with an aspect ratio of 1-9. After allowing the particles to compact for more than 7 days, we rotate the case by 90 degrees to initiate collapse, and record the collapse by digital camera or video camera. Using the images, we track the boundary of the granular layer and calculate the temporal change of potential energy. We also made complimentary measurements of the yield strength of the granular material using a rotating viscometer.

Results: Granular collapse is characterized by a surface flow whose thickness is about 10 particle diameters, which gradually erodes the column. We find that the collapse time and the outflow length are shorter for larger particles. The thickness of the surface flow during the collapse is essentially the same irrespective of the column width. As a consequence, the collapse time becomes longer for a wide column (small aspect ratio) because of the larger volume that needs to be eroded.

Discussion:

(1)Condition for surface flow: Surface flow can be considered to occur when the shear stress exerted by the flow is less than the yield strength of the packed granular material. Using Einstein-Roscoe's relation and the measured yield strength, we find that this condition is satisfied when the packing fraction at the region of surface flow is less than about 0.5. This value is slightly less than the maximum packing fraction of 0.6, and we consider it to be a reasonable value at the region of surface flow.

(2)Outflow length and slope: We may similarly consider that outflow stops when the viscous shear stress balances the yield stress. However, we find that the slope estimated from this model is proportional to (yield strength / flow thickness), which is smaller for larger particle diameter. Thus this model is incapable of explaining the experimental results. We consider that the dissipation of kinetic energy by particle collision needs to be considered to explain the outflow length.

(3)Collapse time: We may model the collapse time assuming that the granular material behaves as a Newtonian fluid, from which we find that the time scale of collapse is inversely proportional to the square of particle diameter and aspect ratio. This model agrees with the experiments when the effective viscosity of the granular material is 10ˆ3 to 10ˆ4 times larger than the suspending liquid. This value of effective viscosity corresponds to a packing fraction of 0.5-0.6 when we use the Einstein-Roscoe's relation, and seems to be a reasonable estimate.