

Mode of settling of solid particle in viscous fluid: experiments using low-cost commodity

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We used low cost commodity to observe mode of sinking of solid particle in viscous fluid to investigate the parameters that control Stokes sinking of individual particle versus Rayleigh-Taylor instability (+convection) of two phase flow. We used glass bottle (250-300ml, used jam jar) as container, syrup (relative density 1.4-1.5) as viscous fluid and glass beads (1,2,4mm in diameter with string hole, relative density 2.5) as solid particles. The syrup and glass beads are packed in the bottle and repeatedly turned over for more than 10 times before the experiment to confirm the homogeneity of the sample. Starting by inverting the bottle, upper particle-concentrated layer may initially cause Rayleigh-Taylor instability, which subsequently induce dispersion of particles in viscous fluid and Stokes settling may occur. When we use large (4 mm diameter) and small (1 mm diameter) particles together, initial phase show streaky mass sinking of particles, which is followed by massive fall of particles with relatively high speed. After the massive sinking, dispersed small particle sinks more of Stokes sinking mode. The massive sinking in the middle stage may be caused by coming off as a mass of concentrated particles from the ceiling which occupied the middle layer of higher particle concentration (mixed 4mm+1mm particles) between the upper and lower layers of more single-size dominated layers. Although the present experiment is qualitative, the transition from Rayleigh-Taylor instability to Stokes settling of particle is intuitive to understand mode of ash fall from Plinian or co-ignimbrite umbrella cloud and mode of crystal setting from crystallizing magma reservoir.

Keywords: mode of particle settling, Stokes settling, Rayleigh-Taylor instability, settling mode of volcanic ash, crystal settling in magma reservoir

Kitchen analog for rootless cone eruption; explosive bekkouame?

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The rootless eruptions, which is a series of explosions by interactions of molten-lava and waterlogged sediments, have been focused in point of both the planetology and the volcanology (Fagents *et al.*, 2002; Hamilton *et al.*, 2010; 2017). On the surface of Mars, thousands of cones formed by rootless eruptions (e.g., Greeley and Fagents, 2001) are found to exist. Since those cones are located on the young surface, they have been spotlighted as an evidence of flood volcanism and existence of subsurface water ice in recent Mars (Dundas and Keszthelyi, 2013). According to laboratory-scale experiments and numerical modelings, the amount of external water, which is available during the eruption and vaporization, influences explosion styles (e.g., Wohletz, 2002). The variety of geomorphology in rootless cones has been thought to show that style difference (Fagents and Thordarson, 2007). In spite of the popularity its formation mechanism has not been well understood even for the terrestrial cases. Why isolated cones are formed instead of widespread fragmentation? Why explosion is maintained steady? Why fragmentation similar to the scoria cone formation occurs? What is the role of vesiculation in rootless eruption? To explore probable answers we conducted kitchen earth science experiments.

In this study, we challenged to reproduce rootless eruptions by using heated syrup and soda. The basic procedure is similar to that in bekkouame (candy) and karumeyaki (honeycomb toffee) recipe. The starting materials are syrup and baking soda (sodium bicarbonate) and a small transparent container. We first heated syrup around 130°C and poured it on several types of substrate such as sugar and soda mixture so as to cover the surface of them completely. Break down of the baking soda by the heat of syrup produces CO₂ gas, which causes bubble flow in the overlying syrup. As a result, tens of petit eruptions occurred during experiments. The cellularly divided conduits were formed by stable explosions which had not changed its location. Those cells might be comparable to the repelled distribution pattern which has been interpreted in Hamilton *et al.*, 2010. We verified the relationships between explosion styles and the amounts/ratio of soda and heated syrup. In the presentation, we show changes of explosion characteristics in different conditions. Furthermore, we focus on morphology of solidified syrup (as bekkouame) then compare with those of natural rootless cones.

Keywords: rootless eruption, syrup, explosion

Flow visualization experiments on “Pele’ s hair” formation

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In the session of the kitchen Earth Science last year, we presented an analog experiment on “Pele’ s hair” which could be observed in the volcanic products in Hawaii Islands. We’ d succeeded in producing similar texture of “Pele’ s hair” by using a cotton candy machine we had invented, and showed that the texture of the sugar fibers (e.g. their thickness and length) depends on several important parameters such as rheological properties of the melted sugar, initial temperature at the outlet of the melted sugar jet, and its ejection speed. Recently we have conducted flow visualization regarding this analog experiment to understand the flow behavior around the melted sugar jet. The experimental setup for flow visualization consists of the cotton candy machine, commercial humidifiers for the flow tracers, and a LCD projector to generate multi-color light sheets. The flow behavior was recorded by a high-speed video camera; the eddies and vortices were clearly observed around the rotating dishes, which affect the formation process of the analog “Pele’ s hair” . We also examined effect of the following parameters such as the rotating speed, heating temperature, diameter of the outlets, which cause a variation in the texture of the cotton candy as reported the last presentation.

Keywords: Volcano, Experiment, viscous fluid

Analogu experiment on interdisciplinary education of science and disaster mitigation

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1. Background

In disaster education at the school, it is required to foster "the ability to utilize knowledge and skills in real life" as specified in "School Education Law Article 30-2". Activities such as utilization of disaster prevention slogans and education by preparing disaster prevention slogans were carried out, but after the earthquake disaster prevention education became emphasized "to protect lives" "to think by oneself", teaching material development is ongoing .

When excessive emphasis is placed on "easy to understand" "ease of practice", as seen in the case of the Chile earthquake in February 2010, despite the fact that the hazard map residents were abundant enough to live nearby, As in the case of the possibility (Kesenuma city, 2011) which can not lead to the application of information or behavior to be read, as in the case at the Umi-Sumi Citizen Center in Kamaishi City at the time of the Great East Japan Earthquake, it was inappropriate for tsunami evacuation Evacuation to facilities and hazard maps may be read as safety maps (Kamaishi City, 2014).

2. Survey on degree of interest in earth science and knowledge of earthquake and tsunami

Survey on 178 students who are equivalent to university in university who do not specialize in geography, about the interest in earth science and knowledge about earthquakes and tsunami, 90% of the students recognized the danger of the tsunami after the earthquake However, as for the fact that the tsunami does not necessarily arrive from the pulling wave, the misrecognition rate (about 40%) is higher than the correct answer rate (about 20%), it is in a positive correlation with the prior interest and the high interested party It was shown that it has more erroneous knowledge. It was shown that it had more erroneous knowledge, and the problem point of disaster transmission only by experience was clarified.

3. Practice of disaster education with simple analogu simulation

Since 2010, as "basic science for disaster prevention", about the mechanism of the emergency earthquake bulletin entitled "Tatenami, Yokonami, Ready Go" and actions on receiving an emergency earthquake bulletin, Spring As well as explaining the propagation of seismic waves using the earthquake warning system. At 11 elementary schools that became evacuation on the day of the Great East Japan Earthquake on March 11, 2011, from some lower grade students who participated in "Tatenami, Yokonami, Ready Go", "I made it properly!" It took a voice. It is one example that having a concrete image of the disaster phenomenon lead led to quick response for hazard.

4. Potential as regional implementation

Efforts to develop and develop educational programs tailored to regional circumstances (Yamada, Matsumoto 2015, Hasegawa et al. 2016) in areas where promotion of local disaster prevention education is aimed at promoting settlement of young people also It is beginning. According to an interview survey in the area that caused extensive damage, testimonies such as "I went to see the sea then" and "I thought that the tsunami would not come" were obtained, and regarding disaster prevention (especially tsunami disaster prevention) There was a lack of consciousness of the parties. In order to ensure safety and security of local communities, we believe that combining "soft" countermeasures such as disaster prevention education and evacuation drills with effective "hard" measures implemented by the

administration is effective, and Regional Safety Disaster prevention. Actually disaster prevention and science education means education aimed at associating disaster prevention and scientific knowledge / understanding, and aiming at improvement not only in disaster prevention but also interest in natural science, a hydraulic experiment with a small aquarium is adopted. It was shown that the evacuation behaviors after the earthquake are effective, not the evacuation behaviors after confirming the tide, by conveying the characteristics of the earthquake that generates the tsunami and the characteristics of the tsunami propagation.

Keywords: education of disaster mitigation, education of geoscience