Experimental study using aqueous suspension of volcanic ash from 2014 Ontake eruption toward an understanding of rheological characteristics of lahar

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Lahar is a secondary phenomenon following volcanic eruption. It occurs not only immediately after the eruption but also later due to rainfall or snowfall (e.g. Lavigne and Thouret 2002, Graettinger et al., 2010). The sudden onset and the long runout distance causes severe damage to the surrounding environment and human life (Lowe et al., 1986, Manville et al., 2013). To understand the onset/stop process of lahar and simulate the flow behavior precisely, unveiling the transient rheological properties is required.

We performed rheological experiments using aqueous suspensions of volcanic ash from Ontake volcano where lahar extended about 5 km downstream 5 days after the eruption in 2014 (Sasaki et al., 2016). The suspension shows flow instability within certain ranges of shear rate and shear stress. Under control of the shear stress, the shear rate shows prolonged oscillation while the shear stress fluctuates with long period under control of the shear rate. Note that the flow instabilities only occur at intermediate shear stress/rate whereas the suspension is either immobile at the lower values or smooth-flowing at the higher values. Considering the dimensionless Stokes and inertial numbers calculated by representative particle size of the volcanic ash, we propose that the transient instabilities would be generated by repeating formation and destruction of shear-induced dynamic clusters composed of self-supporting particles in the process of sweeping large particles near the rotor. Since the transient instabilities take place in the state between rest and flow, it may be a point for simulating onset/stop process of lahar.

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