Geophysical Research Abstracts
Vol. 15, EGU2013-7904-1, 2013
EGU General Assembly 2013

Particle migration within free-surface flow of a viscoplastic fluid

Guillaume Chambon, Assia Ghemmour, and Mohamed Naaim
IRSTEA, UR ETNA, St-Martin-d'Heres Cedex, France (guillaume.chambon@irstea.fr, (+33) 4 76 76 27 66)

Most natural debris-flow show clear evidences of grain-size sorting, with a higher concentration of large particles and boulders close to the free surface and in the front of the surge. Grain-size segregation is frequently advocated as an important process to explain this pattern. However, hydrodynamic interactions between the particles and the interstitial matrix, and migration processes induced by fluid shearing, can also play an important role. The interstitial matrix generally behaves as a viscoplastic fluid with a yield stress, and fluid-particle interactions within such complex fluids in flow remain poorly known.

We report on an experimental study aiming at investigating the dynamics of isolated particles within a uniform free-surface flow of a viscoplastic fluid. The flow is generated in a conveyor belt-channel allowing to create gravity-driven surges that remain stationary in the laboratory frame, and thus to monitor the dynamics of particles over relatively long times (tens of seconds). The used fluid is transparent, and particle trajectories are followed through image processing. We focus in particular on the cross-slope velocities of sedimenting particles, and show that the order of magnitude of these velocities is well captured by the classical Stokes formula calculated with a local apparent viscosity. In detail, however, sedimentation velocities appear to be systematically slightly larger than Stokes velocity. Moreover, particles that are less dense than the fluid have also been found to sink toward the bottom of the flow. These observations seem to reveal a migration of isolated particles towards zones of high shear, a process which is absent in simple Newtonian fluids. The effects of particle diameter and density, and of particle initial position, on this process are investigated.