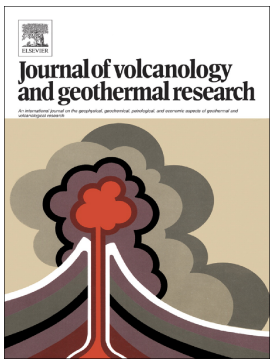

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PARTICLE TRANSPORT IN SUBAQUEOUS ERUPTIONS: AN EXPERIMENTAL INVESTIGATION

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ABSTRACT

Subaqueous volcanic eruptions are natural events common under the world's oceans. Here we report results from bench-scale underwater explosions that entrain and eject particles into a water tank. Our aim was to examine how particles are transferred to the water column and begin to sediment from it, and to visualize and interpret evolution of the 'eruption' cloud. Understanding particle transfer to water is a key requirement for using deposit characteristics to infer behaviour and evolution of an underwater eruption. For the experiments here, we used compressed argon to force different types of particles, under known driving pressures, into water within a container, and recorded the results at 1 MPx/frame and 1000 fps. Three types of runs were completed: (1) particles within water were driven into a water-filled container; (2) dry particles were driven into water; (3) dry particles were driven into air at atmospheric pressure. Across the range of particles used for all subaqueous runs, we observed: a) initial doming, b) a main expansion of decompressing gas, and c) a phase of necking, when a forced plume separated from the driving jet. Phase c did not take place for the subaerial runs. A key observation is that none of the subaqueous explosions produced a single, simple, open cavity; in all cases, multiphase mixtures of gas bubbles, particles and water were formed. Explosions in which the expanding argon ejects particles in air, analogous to delivery of particles created in an explosion, produce jets and forced plumes that release particles into the tank more readily than do those in which particles in water are driven into the tank. The latter runs mimic propulsion of an existing vent slurry by an explosion. Explosions with different particle types also yielded differences in behaviour controlled primarily by particle mass, particle density, and particle-population homogeneity. Particles were quickly delivered into the water column during plume rise following necking, with minor transfer along initial-jet margins, and for breaching explosions additional delivery from splashdown of tephra jets. Plume rise after necking also draws upward and re-entrains some groups of particles. Most delivered particles participate in initiating vertical sediment-gravity flows, some of which reached the tank floor and began lateral flow within the short