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Experimentaly generated peperitic textures and hydromagmatic ash fragments using SMILE

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Hydromagmatic interactions in general and the formation of peperites in particular, are poorly understood. We have designed and tested a new series of experiments to analyze the formation of fine hydromagmatic basaltic ash, and the processes occurring during magma/wet-sediment interaction. This study evaluates the mechanism of "turbulent shedding", (Mastin, 2007) where fine hydromagmatic ash is produced by the removal of quenched glassy rinds on clast surfaces that are rapidly deforming within turbulent transport. During magma/wet-sediment interactions the rapid heat transfer rate can lead to oscillations in the vapor film, and its possible collapse to generate a vapor explosion, between the two media producing either fluidal or brecciated peperitic textures.

In these Silcate Melt Injection Laboratory Experiments (SMILE), approximately 0.5 kg of basaltic melt is generated in an internally heated autoclave at temperatures of up to 1300 ºC and ejected via gas pressure into a low pressure tank. The autoclave can be pressurized to 50 MPa and is designed to eject the melt directly into water, wet sediments or water spray. The later technique is commonly used by powder metallurgists to produce micron-sized fragments of metallic glass, and is the desired technique to

aid in the production of fine-ash via “turbulent shedding”. Two molybdenum wound furnaces are used to produce the melt while a third Kanthal-wound furnace is used to control the temperature at the ejection orifice. Six thermocouples are used to control the furnaces and to record the thermal gradient throughout the setup. Pressure transducers in the high and low pressure section record the expansion volume due thermal interaction. The autoclave is separated from the low pressure tank with a diaphragm to prevent water from entering the high temperature zone. The goal of these experiments is to give insight into the role of hydrodynamic process during magma/water interaction and in the generation of peperites.

Initial experimentation in air resulted in the formation of Pelee’s hairs and tears reflecting the high strain rates accompanying melt ejection. A second set of experiments in water spray and in a standing water column produced abundant fine fragments. Post-experimental grain surface area analysis of the hydromagmatic clasts show thermal interaction features identical to those produced in natural settings. Magma/wet-sediment experiments have yielded interesting textures and post-experimental surface analysis of the peperitic textures is in progress to quantify the thermal interaction area.