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Experimentally produced peperitic textures

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The interaction of magma with wet sediment is commonly observed in subaqueous volcanic environments. The study of peperite is important for understanding the physical processes during explosive hydrovolcanic eruptions. The mixing mechanisms that precede explosive eruptions are analogous to the fluid coolant interactions which may occur during peperite formation. The role of sediment and magma rheology in the development of peperite, though key to understanding magma-wet sediment mingling and the rock textures produced, is still poorly constrained.

Experiments mimicking peperite formation were performed by pouring basaltic melt with 15 wt. % Spectromelt (Li2B4O5) at 1100 °C directly onto room temperature wet sediments with varying water contents. Each experiment was first conducted in static conditions and then was preformed on a shaker table to enhance the sediment fluidization process (e.g., mingling and possibly magma breakup as the bearing strength of the sediments is decreased). The samples were dried in an oven at 70 °C, then preserved using an Araldite resin, and subsequently sectioned and polished.

Experiments using low volumes of mud with high water contents (∼37 wt. % water) produced abundant limu and fluidal textures. Experiments with high volumes of mud and lower water contents (∼30 wt. % water) show fluidal textures though no notable mixing or limu are present. Additional experiments were performed in fluidized, water saturated sand to ascertain the effect of free water on the textures produced in magma-wet sediment interactions. We expected that this would generate blocky/brecciated textures. Polished slabs show no direct evidence of brecciation, mixing or fluidization of the sediments, though abundant limu are present. Therefore, we suggest that the viscosity of the magma plays a greater role in brecciation than the bearing strength of the sand and the available free water content.

Peperite experiments show that magma-sediment mingling is strongly influenced by the type of sediment, bearing strength and the volume of available free water.