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The pumice raft-forming 2012 Havre submarine eruption was an effusive eruption

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The submarine rhyolite eruption of Havre volcano in 2012 produced a > 1 km3 raft of floating pumice and a 0.1 km3 field of giant (>1 m) pumice clasts distributed down-current from the vent. We address the mechanism of creating these clasts using a model for magma ascent in a conduit. We use water ingestion experiments to address why some clasts float and others sink. We show that at the eruption depth of 900 m, the melt retained enough dissolved water, and hence has a low enough viscosity, that strain-rates were too low to cause brittle fragmentation in the conduit. There was still, however, enough exsolved water at the vent depth to make the magma buoyant relative to seawater. Buoyant magma was thus extruded into the ocean where it rose, quenched and fragmented to produce clasts up to several meters in diameter. We show that these clasts would have floated to the sea surface where air can enter pore space. We further show that clasts from the raft retain enough gas to remain afloat whereas fragments from giant pumice collected from the seafloor ingest more water and sink. The pumice raft and the giant pumice seafloor deposit were thus produced during a clast-generating effusive eruption, where fragmentation occurred above the vent, and the subsequent fate of clasts was controlled by their ability to ingest water.