Water-settled fall deposits from low to moderate intensity silicic submarine eruptions

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Submarine explosive eruption columns involving silicic magma are prone to collapse as the ejecta (hot pumice clasts and volcanic gas) mixes with the sea water, causing quenching and rapid increases in column density. However, low to moderate intensity silicic eruptions can generate water-settled fall deposits when pumice clasts are either (1) coarse (6-100 cm) clasts that are relatively slow to cool, or (2) lapilli that are erupted with near neutral to negative buoyancy. Both of these characteristics in combination with the low to moderate intensity, pulsatory eruption style promote deposition by submarine water-settled fall.

On Yali, eastern Aegean, Greece, a submarine pumice cone >150 m high, >1200 m radius has been uplifted. It comprises well sorted, essentially fines-free interbedded pumice lapilli facies and pumice block facies. Pumice clasts settled from suspension (coarse clasts) and showers (lapilli) and once deposited, were prone to syn- and post-eruptive resedimentation in modified grain flows, due to the steep flanks of the cone. We use the vesicle microtextures to track magma degassing and ascent in the conduit and to infer open-vent explosive fragmentation. Periods of low eruption intensity were critical in generating moderately vesicular pumice lapilli (45-60 vol.% vesicles) that were either negatively or neutrally buoyant. These lapilli fragmented primarily as a result of water interacting with the vesiculating magma. Lapilli in the lowest unit have weakly developed vesicle collapse textures and melt corrected vesicle number densities (Nmv) of 1.4 x 108 to 2 x 108 cm-3, suggesting that magma ascent slowed in the conduit. These moderately vesicular lapilli formed showers of pyroclasts that rained down close to the vent, forming thick proximal deposits. The coarse clasts and fragments derived from them are highly vesicular (65-80 vol.% vesicles) with relatively high melt-corrected vesicle number densities (Nmv) of 2.5 x 108 to 1.2 x 109 cm-3, suggesting magmatic-volatile-driven eruption at higher intensity rather than the previous interpretation of dome spalling (Allen and McPhie 2000). These coarse clasts remained hot and buoyant for several minutes after eruption and rose through the water column in a buoyant plume of heated water; they may have reached the sea surface before cooling and sinking.

Relatively small ejecta volumes (much less than 1 km^3) and low to moderate intensity pulsatory eruption style precluded formation of a steady column.

Allen SR, McPhie J (2000) Water-settling and resedimentation of submarine rhyolitic pumice at Yali, eastern Aegean, Greece. J Volcanol Geotherm Res 95:285-307