Mechanisms of transitions in eruption style at the end of the 1912 eruption of Novarupta, volcano, Alaska

*Bruce F Houghton[1], Samantha J Isgett[1]

1. University of Hawaii at Manoa

The 1912 Novarupta eruption consisted of five episodes ranging from strong Plinian (mass eruption rates of 1.1 –5 x 10^8 kg/s) to stable, steady dome effusion. Sixty hours of Plinian explosions erupted first predominantly rhyolite (Episode I) and then dacite with minor amounts of andesite (Episode II-III). Episode IV produced a dacitic block bed, interpreted as the product of complete destruction of a dacite plug/dome via Vulcanian explosions, before extrusion of a rhyolite dome in Episode V.
The transition in style and intensity from powerful explosions to dome growth is represented by three shifts in eruption style. We describe here the mechanisms of the first two shifts (lower Episode III to upper Episode III and upper Episode III to Episode IV).

The switch from sustained Plinian eruption to an unsteady subplinian phase during Episode III was brought about by progressive increase in the level of outgassing of the dacite melt remaining in the conduit. This is seen in a steady increase in the amount of dense dark grey juvenile ejecta as the outgassed melt slowed the rate of magma ascent and began to 'choke' the shallow conduit. The deposits are well bedded and markedly less dispersed than the Plinian falls of episodes I, II and early Episode III.

The second shift was from unsteady subplinian eruption (end to Episode III) to non-sustained transient Vulcanian explosions in Episode IV. Highly diverse juvenile blocks from Episode IV provide special insight to the state of the magma as an eruption passes from powerful sustained Plinian eruption to passive dome growth. They supply a picture of a dynamic and complex shallow conduit, now dominated by partially or completely outgassed dacitic melt that was resident at shallow levels, prior to fragmentation in repeated small Vulcanian explosions. Small total and individual explosion volume estimates, suggest that individual explosions during Episode IV disrupted the conduit to only shallow depths. Our data (1) suggest that different explosions tapped small yet diverse parts of the conduit's architecture and (2) require a more complex model than repeated progressive evacuation in a top-down fashion of a simple horizontally stratified magma-filled conduit. The shallow conduit architecture involved both the juxtaposition of domains of contrasting texture and vesiculation state and the intimate mingling of different textures on short vertical and horizontal length scales at the contacts between these domains.

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