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Eruption dynamics and explosive-effusive transitions during the ~1400 cal BP eruption of Opala Volcano, Kamchatka, Russia

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Field relations, textural analysis, and experimental petrology show that the ~1400 cal BP rhyolite eruption of Opala volcano rode the line between explosive and effusive behavior. The eruption distributed 1.5-2 km3 of rhyolite tephra fall over the southern and central Kamchatka Peninsula, and sent pyroclastic density currents over proximal areas. The eruption vent, Baranyi Crater, is located at the eastern base of Opala volcano and is occupied by ~0.35 km3 obsidian domes. Proximal and medial deposits (<10 and 10-15 km from Baranyi Crater, respectively) show that the eruption progressed through 4 episodes. The first episode, E1, is recorded by lithic-rich fall deposits overlain by pumice falls and interbedded pyroclastic density current (PDC) deposits; PDC or coignimbrite ash deposits dominate late in E1. E3 deposits are very similar to those of E1, except that the initial fall comprises mainly dense juvenile glass fragments (e.g. obsidian). E4 is recorded by the obsidian domes emplaced in Baranyi Crater. We infer that an obsidian dome(s) was also emplaced between E1 and E3, but that E2 dome was destroyed at the onset of E3, and is now recorded only by the obsidian clasts at the base of E3. Systematic analysis of pumice vesicle textures including vesicularity, size, shape, and number density, show trends consistent with fragmentation during collapse of a magmatic foam. Volume and mass flux estimates from the deposits suggest E1 and E3 durations of ~10-16 hours each. Phase equilibria and continuous decompression experiments indicate decompression from ~150 MPa at rates of >1 MPa/h (E1 and E3) and ~1 MPa/h (E2 and E4 obsidians). The switch from explosive to effusive activity was likely controlled by small changes in decompression/ascent rate. That type of effusive-explosive behavior should be expected in magmas decompressing near rates critical for bubble coalescence and volatile escape.