FORMATION OF BASALTIC TEPHRA-FALL DEPOSITS AT EITHER AGGLUTINATED OR FRAGMENTED SCORIA CONES

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Characteristics of eroded scoria cones often are used to interpret eruption processes, including the likelihood of tephra-fall deposits. Contrasting relationships from the two main 1975 Tolbachik, Russia, scoria cones show that extensive tephra falls can form with cones predominantly constructed by either agglutinated or fragmented scoria. Both Tolbachik cones have similar volumes (~0.08 km^3 [0.019 mi^3]), compositions (high-MgO basalt, 2 wt.% H_2O), and crystallinities (~10%), and formed tephra-fall deposits (~0.1 km^3 [0.024 mi^3]) with equivalent dispersal and fragmentation characteristics. Earlier-formed Cone 1 consists of fragmented scoria with crater and flank slopes of 33°. Cone 1 effused 0.03 km^3 [0.007 mi^3] of lava (22 m^3/s [777 ft^3/s]) from two boccas at the cone base. Tephra erupted from the Cone 1 central crater at 36 m^3/s [1271 ft^3/s], with an average column height of 4.2 km [2.6 mi]. In contrast, Cone 2 consists of moderately to highly agglutinated scoria and bombs (to 2 m [6.6 ft] length), with armored crater slopes of 39–44° and flank slopes of 35–38°. Lava (0.22 km^3 [0.053 mi^3]) continuously effused (70 m^3/s [2472 ft^3/s]) from the central crater of Cone 2, giving the cone a crescent morphology. However, tephra also erupted almost continuously from the central crater at a rate of 27 m^3/s [954 ft^3/s], with an average column height of 3.9 km [2.4 mi]. Mixing between partially degassed and fragmented magma in the shallow conduit appears to form cones dominated by ballistic agglutinate (e.g., Cone 2). Conversely, bocca-fed lavas may separate partially degassed magma from fragmented magma in the shallow conduit, leading to cone construction dominated by fallout from the convective eruption column (e.g., Cone 1). Basaltic magma fragmentation, and tephra deposit formation, appears unaffected by these shallow conduit processes.