



Mechanisms of ash formation at Mount Etna, Italy

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Ash is a common manifestation of explosive basaltic volcanism. At Mount Etna it accompanies a diversity of eruptive intensities and behaviours, from mild Strombolian explosions to high energy fire-fountain activity. Abundant ash venting has characterized 4 of the last 5 periods of activity at Etna since 2000, often deeply affecting people's everyday life and the overall economy of Eastern Sicily. A better understanding of ash formation has therefore the potential to improve hazard assessment and forecasting at this volcano. On the basis of visual observations of the eruptive activity and textural and compositional features of ash samples at Etna we find that the characteristics of coarse ash particles vary systematically with the eruptive style. For example, ash emitted at the peak of paroxysmal activity is more vesicular, less crystallized and less compositionally evolved than that erupted during lower energy activity or towards the end of an eruptive period, and it contains less lithic material. In light of these results, we propose three modes for ash formation at Etna: 1) ash resulting from vesiculating magma fragmenting deep in the conduit primarily owing to the superposition of two distinct degassing mechanisms (rise of a collapsed vesicle foam and syn-eruptive vesiculation); 2) ash resulting from fragmentation of partially degassed magma progressively more viscous, cold and crystallized as shifting towards the outer conduit; 3) ash resulting from intracrateric collapse of crater walls and/or conduit lining. These processes generate different amounts of ash, injected in the atmosphere with different dynamics, thus posing different volcanic hazards. Of the three mechanisms proposed, the first one usually accompanies high energy Strombolian activity or fire fountaining (i.e. 24 November 2006 event of the August-December 2006 eruption); the second one characterizes low energy to moderate Strombolian activity or impulsive ash ex-

plosions towards the final stages of a prolonged explosive eruption (i.e. second half of 2001 eruption). Finally, the third one is more commonly displayed between explosive events within a period of eruptive activity (i.e. October 2006). The three mechanisms may be taken into account while investigating modes of ash formation at other basaltic volcanoes with similar activity.