



Relationships between lava and tephra volumes erupted during the 26 October 2013 lava fountaining episode from the New Southeast Crater of Etna

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Determining the volume of the various products of a volcanic eruption can be notoriously difficult, especially if the products encompass lava, distal tephra, and proximal pyroclastics mostly deposited on a growing volcanic cone. We evaluated, for the first time at Etna, the total masses and volumes of both lava flows and pyroclastic material emitted during the 26 October 2013 episode of lava fountaining at Etna's New Southeast Crater (NSEC), correlating them with mass eruption rate and total grain-size of the fallout deposit. The episode was heralded by Strombolian activity starting on early 25 October and gradually intensifying throughout the day, blending into a continuous lava fountain early on 26 October. An eruption column started to rise to ~4 km above Etna's summit before being bent toward WSW by the wind. Lava fountaining up to 500 m high continued until ~10:00 GMT, and then started to diminish significantly; by 13:00 GMT, the episode was over. 'A'ā lava flows were emitted throughout the phase of lava fountaining, forming a three-lobed lava field toward south and a minor lava flow toward east. After the episode, we carried out field surveys to map both the fallout deposits and the lava flows. Distal tephra was deposited to at least 110 km distance from the vent and possibly beyond the south coast of Sicily. The dispersal area of the tephra deposit was quite narrow on the ground, the load per unit area declining very rapidly away from the main dispersal axis. In the very proximal area (~1.6 km from the NSEC), the fallout deposit formed a 3-cm thick bed of scoriaceous lapilli (peaked at -2 phi) amounting to 22.25 kg/m². The tephra load dropped up to 0.4 kg/m² in the town of Adrano (16 km), where we found a continuous, thin layer of medium-sized ash. Finally, the fallout consisted of fine ash (~99 % of clasts <class 0.25 mm) in Caltanissetta (~90 km distant from the vent). The volume of fallout tephra from the eruption column is 3.85 x 10⁵ m³, while more coarse-grained pyroclastics caused growth of the NSEC cone by 30 m in height, corresponding to 1.2 x 10⁶ m³; the lava flow volume was 1.4 x 10⁶ m³. Considering about 8 hours duration for the paroxysmal phase, these values provide bulk eruption rates of 13 m³/s (air-fall tephra) and 41 m³/s (cone) and a mean lava effusion rate of 48 m³/s (lava). Physical parameters and volcanological data suggest that the 26 October paroxysm was relatively small in terms of intensity (i.e. low eruption rate), and that most of the magma erupted was emitted as lava flows and coarse-grained pyroclastic material deposited on the cone, with tephra fallout away from the cone representing only slightly less than 10 % of the total erupted volume. We conclude that, although the ash features indicate efficient magmatic fragmentation, most of the magma emitted during the lava fountaining phase was already degassed.