SOURCE PROCESS OF CYCLIC FIRE FOUNTAINING AT MT. ETNA IN 2000: A MULTIDISCIPLINARY STUDY OF THE JUNE 14 (63RD) EVENT

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From 26 January to 29 August 2000, Southeast crater of Etna (SEC, 3250 ma.s.l.) was the site of 66 paroxysmal fire fountaining events whose remarkable periodicity and reproducible eruptive pattern indicate a cyclic source mechanism operating in a magma feeding system of quite stable geometry. We have investigated this source mechanism in light of data for the whole series of events [1] and, in particular, of a detailed multi-disciplinary study of the 63rd (14 June) event [2]. Like previous ones, this event involved aseismic, precursory extrusion of degassed lava (10 hours), then growing Strombolian activity and lava effusion (1.5 h) and, finally, 40 minutes of 300 to 600 m high fire fountaining paroxysm that ended abruptly. The synchronous evolutions of volcanic tremor and eruptive activity evidences a main control of the seismic signal by the shallow conduit flow dynamics, even though a deepening of the tremor source (deeper magma effervescence and flow) is indicated during the eruption climax. Combining the erupted amounts of dense magma and gas, geochemical data for the erupted lavas, the chemistry of fountain gases measured for the first time on Etna using remote FTIR spectrometry, and the dynamics of the phenomena we show that periodical accumulation and collapse of a gas bubble foam layer at the base of SEC conduit was the most likely process responsible of the June 14 eruption and other fountaining events at SEC in 2000. The mean gas accumulation rate prior to the June 14 event is assessed at 35 kg.s⁻¹. The different data types allow us to provide quantitative constraints upon the geometry of SEC feeding system (conduit height and width, size of the magma reservoir) and its evolution with time. We propose that the 2000
fountain series was triggered by the input of primitive volatile-rich melt into a per-
manent reservoir of moderate size that contained more evolved and partly degassed magma left after the previous 1998-99 SEC activity. Turbulent plumes, magma mixing and bubble-melt separation generated by this input sustained gas accumulation on top of the reservoir, leading to bubble coalescence and periodical foam collapse at the origin of the successive eruptive events [3]. This process gradually declined in strength when the deep input stopped, resulting in a decreasing rate of gas accumula-
tion, increasing periodicity of the fountaining events (from mid-April onwards), and rapid magma crystallization when most of the initial gas load became evacuated.