Insights into the cyclic eruptive behavior of Mount Etna during 2011: geophysical and geochemical constraints

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Since the second half of the 1990s, the eruptive activity of Mt. Etna has provided evidence that both explosive and effusive eruptions display periodic variations in discharge and eruption style. In this work, a multiparametric approach, consisting of comparing volcanological, geophysical and geochemical data, was applied to explore the volcano's dynamics during 2009-2011. In particular, temporal and/or spatial variations of seismicity (volcano tectonic earthquakes, volcanic tremor, long period and very long period events), ground deformation (GPS and tiltmeter data) and geochemistry (SO2 flux, CO2 flux, CO2-SO2 ratio) were studied to understand the volcanic activity, as well as to investigate magma movement in both deep and shallow portions of the plumbing system, feeding the 2011 eruptive period. After the volcano deflation, accompanying the onset of the 2008-2009 eruption, a new recharging phase began in August 2008. This new volcanic cycle evolved from an initial recharge phase of the intermediate-shallower plumbing system and inflation, followed by (i) accelerated displacement in the volcano's eastern flank since April 2009 and (ii) renewal of summit volcanic activity during the second half of 2010, culminating in 2011 in a cyclic eruptive behavior with 18 lava fountains from New South East Crater (NSEC). Furthermore, supported by the geochemical data, the inversion of ground deformation GPS data and the locations of the tremor sources are used here to constrain both the area and the depth range of magma degassing, allowing reconstructing the intermediate and shallow storage zones feeding the 2011 cyclic fountaining NSEC activity.