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Degassing behavior of Mt. Etna volcano (Italy) before and during the 2008-2009 eruption, inferred from crater plume and soil gas measurements

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The evolution of magmatic degassing that preceded and accompanied the 2008-2009 Mt. Etna eruption was monitored by using a combination of: i) near-daily SO2 flux measurements; ii) calculated HCl and HF fluxes, obtained combining the daily SO2 flux values with discrete FTIR measurements of SO2/HCl and SO2/HF molar ratios; iii) periodic soil CO2 flux measurements. Thanks to the differential release of magmatic gas species from an ascending magma body we were able to track the magma transfer process in the volcano plumbing system from depth (< 5 km) to the surface. Our data suggest that the intermittent paroxysmal activity that mainly affected the South-East Crater (SEC) during 2007, displayed the efficient but complex nature of Mt. Etna's plumbing system, with gas-rich magma ascending and degassing via the central conduit system prior to eruption at the peripheral SEC. Conversely, the 15 month long 2008-09 eruption event was characterized by quasi steady state magma supply. The calculated volume of magma required to produce the observed SO2 flux during the 2008-2009 eruption closely matches the volume of erupted magma. This "eruptive" steady-state would indicate an almost perfect process of magma migration and eruption at the surface, without substantial storage within the volcano plumbing system.