Geophysical Research Abstracts,
Vol. 10, EGU2008-A-08100, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-08100
EGU General Assembly 2008

Short-term warning in Campi Flegrei active caldera inferred from magma chamber evolution and opening processes.

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Differentiation mechanisms and timescale controlling over-pressuring and opening of magma chambers are crucial issues for volcanic risk evaluation, particularly in densely populated areas. Campi Flegrei high-risk active caldera produced tens of eruptions with VEI ranging between 1 and 7. Here we analyze the chemical composition of minerals and glass-matrixes of most explosive and effusive eruptions in order to reconstruct pre-eruptive compositional, thermal and pressure gradients as well as mechanisms and timing of evolution towards critical conditions and eruption.

Our petrologic data indicate that a wide sill-like trachytic magma chamber was active under the Campanian Plain at 2.5 kbar since 39 ka. Thermal exchange between high liquidus trachytic sill and cool country rocks causes intense undercooling, driving a catastrophic and fast (100 years) in situ fractional crystallization and crustal assimilation that produces a water oversaturated phonolitic cap and an overpressure in the chamber that triggers eruptions. This process culminates in an abrupt reservoir opening and in a fast single-step high decompression. Sanidine phenocrysts crystal size distributions reveal high differentiation rate, thus suggesting that such a sill-like magmatic system is capable of evolving in a very short time and erupting suddenly with only short-term warning. Eruptions occur by sudden opening and withdrawal of magma chamber close to over-saturation conditions. Our textural data indicate that moderate to long magma rise times, calculated in the order of few days, produce open-

degassing responsible for moderately explosive to effusive activity. Short magma rise times, calculated in the order of few hours, result in closed–system degassing that allow explosive fragmentation when the volume of growing bubble reaches a fixed threshold. Vesicularity and water content measured on matrix glass of pumice indicate that this process occurs at pressure of 10-30 MPa. In these conditions, degassing, fragmentation and in turn the eruptive style is strongly influenced by initial conditions in the magma chamber (volatile content, temperature, pressure) instead of decompression rate. Our inferences on the rise processes timing retrieved from CSD data for CF rocks, allow us to make some speculation about a possible reliable forecast of magmatic activity in the order of tens of hours before eruptions.