Geophysical Research Abstracts,
Vol. 11, EGU2009-10150, 2009
EGU General Assembly 2009

Is vent location an important factor in the assessment of pyroclastic flow hazard from sub-Plinian events at Vesuvius?

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Reconstructions of vent location of past sub-Plinian (and Plinian) eruptions of Vesuvius show a significant spatial variability of the vent inside the caldera area. Moreover, it is likely that the exact location of the vent of a future explosive event of that type at Vesuvius will be unknown until the onset of the event itself. Nevertheless, to our knowledge, no studies exist that analyse the influence of vent location on the simulated eruptive scenarios. This omission could be particularly critical for the assessment of pyroclastic flow (or pyroclastic density current, PDC) hazard due to the specific morphology of the Somma-Vesuvius complex.

In this work, we present new numerical simulations of column collapse and pyroclastic density current scenarios at Vesuvius by using the transient 3D multiphase flow code PDAC (Esposti Ongaro et al., Parallel Computing, 33, 2007). Simulations have been carried out by assuming three different locations of the vent within the caldera area: the first is in Valle del Gigante, between Mt. Somma ridge and the present Gran Cono, the second is in Piano delle Ginestre, to the west of the Gran Cono, while the third one is in Valle dell'Inferno, in the south-eastern direction with respect to the Gran Cono. Source conditions for all cases refer to a sub-Plinian event and to both partial and nearly-total collapse of the eruptive column.

Simulation results clearly show the first-order effect of vent location on the propagation directions of PDCs and the areal distribution of pyroclasts, owing to the complex interaction of the flow with the proximal volcano morphology. Comparisons with simulations assuming a central vent located in the position of Gran Cono clearly show the different roles of Mt. Somma, Gran Cono, along with mean slope and channelling effects as a function of the assumed vent location. Estimates of the areas invaded by the flows are presented, although the definition of their runout is particularly difficult due to the sensitivity of the flow dynamics to the different ground boundary conditions assumed. Overall simulation results suggest considering the vent location variable in any future assessment of pyroclastic flow hazard at Vesuvius.