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The Campi Flegrei Deep Drilling Project: using borehole measurements to discriminate magmatic and geothermal effects in caldera unrest

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Large calderas are potentially the most risky volcanic areas in the world since they are capable of producing huge eruptions whose major effects can involve human life and activities from regional to global scale. Calderas worldwide are characterized by frequent episodes of unrest which, only in few cases, culminate with eruptions. This ambiguous behavior is generally explained in terms of magma intrusion or disturbance of geothermal fluids in the shallow crust, which are both source of ground deformations and seismicity. A major goal is to determine the relative contribution of each process, because the potential for eruptions significantly enhanced if magma movements emerge as the primary component. A very important case study is the active Campi Flegrei caldera, hosting part of the large city of Naples (Southern Italy). In the framework of the Campi Flegrei Deep Drilling Project new filed data from pilot borehole have been recorded (permeability and in situ stress) by using a novel procedure of Leak Off Test. These new data, particularly the actual permeability, are fundamental to calibrate the caldera unrest models at Campi Flegrei and, , to put constrains to forecast the maximum future eruptive scenario. We show here that these new data, integrated by fluid-dynamical modeling, allow to assess that only about a third of the maximum uplift recorded in 1982-1984 may be due to shallow aquifer perturbation, so that the remaining part should be due to magma inflow, corresponding to about 0.05 Km3 of new magma if we assume a sill-like reservoir located at 4 km of depth. Considering an almost equivalent magma inflow for the 1969-1972 unrest, which showed a similar uplift, we got a total magma inflow of 0.1 Km3. It is then very important to assess the times for cooling of such accumulated magma, in order to assess the eruption hazard.