The CFDDP project: first results from the 500 m pilot hole drilling at the Bagnoli Plain, eastern sector of the Campi Flegrei caldera

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SESSIONE 1

VOLCANOES

A 1. Volcanological research at Campi Flegrei: implications for possible future eruptive scenarios

Conveners:

PierFrancesco Dellino, Roberto Isaia

The Campi Flegrei are one of the active Italian volcanoes source of the largest eruption in the Mediterranean over the last 200,000 years, the Campanian Ignimbrite of about 40,000 years ago, and recently included in the list of super-volcanoes. Its evolution has been characterized by intense eruptive activity, mainly explosive with significant variability in both magnitude and time-space distribution. The volcano has been recently affected by phenomena of ground deformation, seismicity and intense hydrothermal activity that still show further signs of variation. The acquired knowledge shows how the Campi Flegrei volcanic field is a complex system that requires an additional effort by the geosciences community to help identify the current state of the volcano and suggest possible future scanarios. With this main aim the session will welcome contributions from each sector of volcanology and those with multidisciplinary approach, to open a debate on the CF volcano presently moved from DPC at the alert-level of attention.

The CFDDP project: first results from the 500 m pilot hole drilling at the Bagnoli Plain, eastern sector of the Campi Flegrei caldera

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KEYWORDS: Bagnoli Plain, drilling, mud cuttings

The drilling of a 500 m pilot-borehole in Bagnoli Plain, has been performed in advance of the Campi Flegrei Deep Drilling Project (CFDDP), which is funded and supported by International Continental Scientific Drilling Program and INGV. The site is located ~1 km to the west of the eastern margin of Campi Flegrei caldera, within ILVA large and desolate, dismantled industrial area of Bagnoli. Simultaneously with the drilling, we have performed continuous sampling of mud cuttings and associated gases, as well as monitoring of seismicity. Two short cores were collected at -438 m and -500 m depths, respectively. A geophysical logging has been later performed down to a depth of 438 m. The amount of formation gas in the returning drilling mud is low and never exceeded 0.2 vol.-%. The analyzed gas phases mainly consists of CO_2 with lower amounts of CH_4 and local outflow of H_2S. Highest gas concentrations were observed in the lowermost 30 m. The temperature at 410 m was ~60°C and the thermal gradient was ~0.08°C/m. The total gamma ray emission varies in the range of 80-220 gAPI, with an average at 162 gAPI. Mud samples were analyzed by optical and electron microscope, X-ray diffractometry and mass spectrometry. The drilled strata consist of a complex pyroclastic sequence emplaced during several episodes of explosive eruptions and through secondary sedimentation in both subaerial and submarine environments. The sequence includes (top downward) i) pyroclastic deposits composed of variably vesicular and porphyritic fragments, ii) a succession of pyroclastic and volcanoclastic beds made up of sub-rounded or rounded vesicular to dense, heterogeneous pyroclastic fragments containing a variable amount of fossils, carbon, wood fragments and peat; iv), iii) a ~60 m-thick level dominated by brown dense to vesicular glass fragments, iv) a low crystalline greenish tuffs between -270 to -470 m, and v) a basal gray pumice-bearing tuff. Dolomite, sulphur, albite, adularia, illite/montimorillonite, glauconite and chabazite constitute the main neoformation assemblage at >245 m depth. The drilling data will help to characterize with a greater detail the structure of the plain which houses part of the city of Naples. Preliminary results furthermore provide new information on the workings, evolution and present state of the volcanic system.

Probabilistic invasion maps of pyroclastic density current hazard by using long-term vent opening mapping and simplified invasion models: application to the Campi Flegrei caldera (Italy)

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KEYWORDS: Campi Flegrei caldera, pyroclastic density currents, vent opening map

Campi Flegrei is an example of active and densely populated caldera with a very high volcanic risk associated with the occurrence of Pyroclastic Density Currents (PDCs) produced by explosive events of variable scale and vent location. The mapping of PDC hazard in such caldera setting is particularly challenging due to the complex dynamics of the flow, the large uncertainty of future vent location and the complex topography affecting the flow propagation. Nevertheless, probabilistic mapping of PDC invasion, able to account for the intrinsic uncertainties affecting the system, is needed for hazard assessment. In this study, we show the results of new field work and statistical analysis of past eruptive activity aimed at producing long-term probabilistic maps of vent opening at Campi Flegrei. The field work was focused on the structural and morphological nature of the caldera and particularly on the reconstruction of the location of past eruptive vents as well as of main faults and fissures formed in the last 15 kyrs of activity. One objective of the analysis was to incorporate into the vent opening maps the main uncertainties affecting the system. This was done by adopting appropriate density distributions of the probability of vent opening of the different areas of the caldera and by relying on expert judgement. Then, we used these maps to produce a variety of probabilistic PDC hazard maps of the Campi Flegrei area based on different invasion models and accounting for the uncertainty in vent opening and event size. Invasion models were based on simple correlations derived from field reconstruction of past events, one-dimensional models based on a linear decay of the flow energy (e.g. energy line), and simple energy decay models tuned on transient and 2D numerical simulations of the flow dynamics.