

Sub-Project V3_5 - Vulcano

Responsibles:

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Vulcano lays along a NNW-SSE oriented regional strike-slip fault acting on a thinned continental crust (18-20 km). The island covers an area of about 22 km² and is entirely made up of volcanic rocks. The last eruption (1888-90 A.D.) gives name to a peculiar type of explosive activity, which is characterized by numerous closely timed eruptive pulses (vulcanian activity). At present, the island is site of intense fumarolic emissions, which are concentrated on the active crater of La Fossa cone, and of degassing activity on diverse areas of its northern sector.

The high temperature of gas emissions, their chemical and isotopic composition and the knowledge of the hydrothermal and magmatic systems, leave no doubt on the presence of magmatic melts under the volcano, which in the future should give way to new eruptions. Recent investigation that combine the geophysical information on the structure of the crust under the volcano and data deriving from the study of the fluid inclusions in crustal xenoliths, suggest the presence of various type of magmatic reservoirs at different depth, which were active in the recent past and likely represent the sites of preferential storage of present magmas. The eruptive activity of the subaerial part of the island dates back to more than 100 ka and has been characterized by the formation of various volcanic edifices that, over time, migrated from SSE toward NNW.

Recent eruptions, which were characterized by products of shoshonitic to rhyolitic composition, occurred inside a volcano-tectonic structure, La Fossa Caldera. The volcanic apparatus of Vulcanello (active between 183 B.C. and 1550 A.D.) formed along the continuation toward N of this structure. Inside this structure, in older times the most voluminous eruptions of Vulcano occurred, and later on La Fossa Cone formed, which has been the most active centre of the last 6 ka.

The eruptions of Vulcano were characterized by relatively small volumes of eruptive products (fractions of km³) when compared with those of other Italian active explosive volcanoes. Anyway, the particular type of activity, which has been characterized by phreatomagmatic explosions generating pyroclastic density currents (with subordinate amounts of fallout products and lava flows), poses stringent questions about the volcanic risk. This is due also to the peculiar distribution of the anthropic activities on the island (the majority of buildings is concentrated at the foot of the active cone of La Fossa) and to the fact that during summer time the population of the island grows up to many thousands people.

Studies on the eruptive mechanisms and on the volcanic hazard have been carried on in recent times at Vulcano, leading to the definition of quite coherent scenarios in the case of a renewal of the eruptive activity from the crater of La Fossa cone. However, eruptive scenarios for other areas of the island, in particular the northern sector of La Fossa Caldera, are lacking. In this area the ascent and eruption of new magma, both in subaerial and subaqueous conditions, needs to be taken into account. The distinct probability that at longer terms it can lead to explosive activity spreading the products both over Vulcano and Lipari, as occurred in the past and is testified by recent studies on the eruptions of Tufi di Grotte dei Rossi, needs to be assessed.

Also, hazard maps on which are drawn the contour lines of the probability of the impact parameters expected in a future eruption represent new results to reach in this project.

Furthermore, even though quite detailed studies on the structure of the volcano and on the hydrothermal-fumarolic system have been carried out in the recent past, synthetic elaboration of data leading to a clear picture of the levels of criticality of the volcano are lacking.

In the time-span of a two years project, a significant improvement of the knowledge on the superficial and deep magmatic alimentation systems, on the volcanic hazard, and on the levels of criticity of Vulcano, can be reached only with a high level of coordination between diverse volcanological, geochemical and geophysical competences.

The multidisciplinary approach that is needed for finalizing the project results to the Civil Protection requests, not only requires a tight integration and dissemination of results among tasks in the due course of the project (biannual workshops), but also that during the phase of project implementation each Research Unit is organized in a way to possess the knowledge and the competence for exhaustively answering, in a quantitative way and with clearly defined error ranges, one or more of the basic questions (work-packages) described in the following.

In the following we describe in more detail the structure of the Tasks and of the relative Work-packages.

Task 1. Eruptive products, eruptive scenarios and hazard

WP 1.1: What do we know from rock characteristics about the eruptions?

Deliverables:

1. Databases on the chemical-physical characters of eruptive products and melts
2. Energy release of explosive eruptions

WP 1.2: Which are the scale and the type of expected eruptive phenomenology?

Deliverables:

1. Graph and diagrams of expected scenarios based on probability density functions

WP 1.3: What are the impact parameters we expect in a future eruption and how it is expected will they be distributed over the territory?

Deliverables:

1. Codes for the calculation of impact parameters of explosive eruptions, and applications to the case of Vulcano
2. Hazard maps

Task 2. Structure of the volcano

WP 2.1: Which are the areas where it is expected that a renewal of the eruptive activity will take place?

Deliverables:

1. Combined elaboration of geological and geophysical data for the definition of probable areas of new vent opening

WP 2.2: Where are the magmatic reservoirs located, and which type of melts do they host?

Deliverables:

1. Synthetic elaboration of new and already available petrological, isotopic and geophysical data for the definition of depth and location of magmatic reservoirs and of the characteristics of host melts

Task 3: Levels of criticality of the volcano

WP 3.1: Which type and what intensity of signals do we expect from the volcano in the imminence of eruptive activity?

Deliverables:

1. Acquisition and elaboration of new and already available geochemical and geophysical data for the definition of the present state of the volcano and its criticality