

Sub-Project V3_7 - Pantelleria

Responsibles:

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The island of Pantelleria represents the top of a large active volcano developed on the Africa continental crust in front of the Sicilian-maghrebides thrust system. The volcano is located within NW-SE trending tectonic depressions related to the opening of a rift system developed during the Neogene –Quaternary in the Pelagian Block. The area is characterized in fact by a continental crust less than 20 km thick, a relatively high heatflow ($\cong 100 \text{ mw/m}^{-2}$) and by positive Bouguer anomalies ranging between +40 and + 80 mGal

The island is dominantly composed by volcanics showing compositional variations ranging from transitional basalts, hawaiites and mugearites, occurring in places only in the northwestern portion of the island, to peralkaline rhyolites (pantellerites) that constitute the prevalent outcropping lithotype of the island.

The volcanic activity of the island is mainly characterized by violent explosive eruptions characterized by the occurrence of large volcano-tectonic collapses producing huge volumes of ignimbrites and pyroclastics. Lava-domes and lava flows were also erupted by various centres.

The age of volcanic products on the island of Pantelleria ranges from 320 ka to the present. The last eruption occurred in 1891 about 5 km NW of the western coast. This event was accompanied by vigorous seismicity, by increasing of fumarolic activity on the island and by a significant uplift occurred at the NE coast.

The island is also characterized by a widespread occurrence of surface hydrothermal manifestations (fumarole discharges and thermal waters) which makes the fluid geochemistry an important tool for understanding the underground structure of the volcano. Recent studies highlighted a complex hydrological picture, where mixing between different fluid components (meteoric water-seawater-geothermal brines) takes place. Furthermore recent studies evidenced that Pantelleria island sustain an intense soil CO₂ degassing highlighting the need of a detailed study of the most exhaling areas aimed at the definition of the gas hazard risk.

The volcano-tectonic features of Pantelleria, where about 10.000 inhabitants live permanently, represent high risk characters involving distinct typical aspects related to the Civil Defence. Severe risks are in fact related to the effects of probable eruptions located both on-land and off.shore with possible development of large tidal waves, to the slopes active deformation, to the uprising and degassing processes of CO₂ related to fracturing processes, to the location of probable eruptive centres. The improvement of the knowledge on volcanology, geochemistry, structures, seismology and active deformations of the island thus represents a basic tool to define different hazard scenarios and to identify possible forerunners of unrest of volcano. The researches will be focused on the following tasks and workpackages.

Task 1. Volcano-tectonic features and feeding system

WP1.1: Active faulting and fracturing

Deliverables:

1. Database with geometry, kinematics and morphotectonic features of active faulting

2. Maps with pattern distribution of surface fractures, eruptive fractures and vent distribution
3. Database of historical and instrumental seismicity

WP1.2: Lithospheric structures

Deliverables:

1. Database of available reflection and refraction seismic data, gravimetric informations, crustal tomography, deep structures and modelling of feeding system
2. Structural model of the edifice

WP1.3: Volcanic products and eruptive evolution

Deliverables:

1. Reconstruction of the eruptive history on the basis of the geological records and historical chronicles
2. Maps of distribution of the major volcanic units and locations of major eruptive centres
3. Reconstruction of the eruptive mechanisms from the volcanic deposits for major eruptions

Task 2. Ground deformation

WP2.1: Long term deformation

Deliverables:

1. Distribution of Quaternary palaeo-shorelines and marine terraces
2. Quantification of Late Quaternary-Holocene uplift rates and deformation curves

WP2.2: Short term deformation

Deliverables:

1. Database of GPS measurements and radar interferometry
2. Reconstruction of the velocity field and deformation

WP2.3: Morphodynamic evolution

Deliverables:

1. Map of slope stability and landslides

Task 3. Hydrogeological setting and geothermal system

WP3.1: Definition of a baseline level for groundwater composition in the present quiescent state of activity

Deliverables:

1. Spatial distribution of major, minor and trace species and dissolved gases in the groundwater system
2. Assessment of the mass and energy budget of the groundwater system

3. Identification and quantification of hydrogeochemical precursors of volcanic unrests

WP3.2: Geochemical, petrological and geophysical assessment of physical-chemical properties of the hydrothermal system

Deliverables:

1. Geometry of deep-seated hydrothermal reservoirs
2. Estimate of the probability of pressurization events of the hydrothermal reservoir and consequent phreatic explosions
3. Identification and quantification of geochemical precursors for magmatic and/or phreatic eruptions

WP3.3: CO₂ outgassing

Deliverables:

1. Identification of relationships between tectonic and volcano-tectonic structures and soil-CO₂ outgassing
2. Map of spatial distribution of soil-CO₂ concentration and fluxes, and of anomalous degassing areas
3. Quantification of CO₂ outgassing of the island

Task 4. Hazard

WP4.1: Hazard mapping

Deliverables

1. Identification of major hazardous events and associated probability of occurrence
2. Medium and long-term thematic hazard maps including hazard from volcanic eruptions, CO₂ outgassing and slope instability