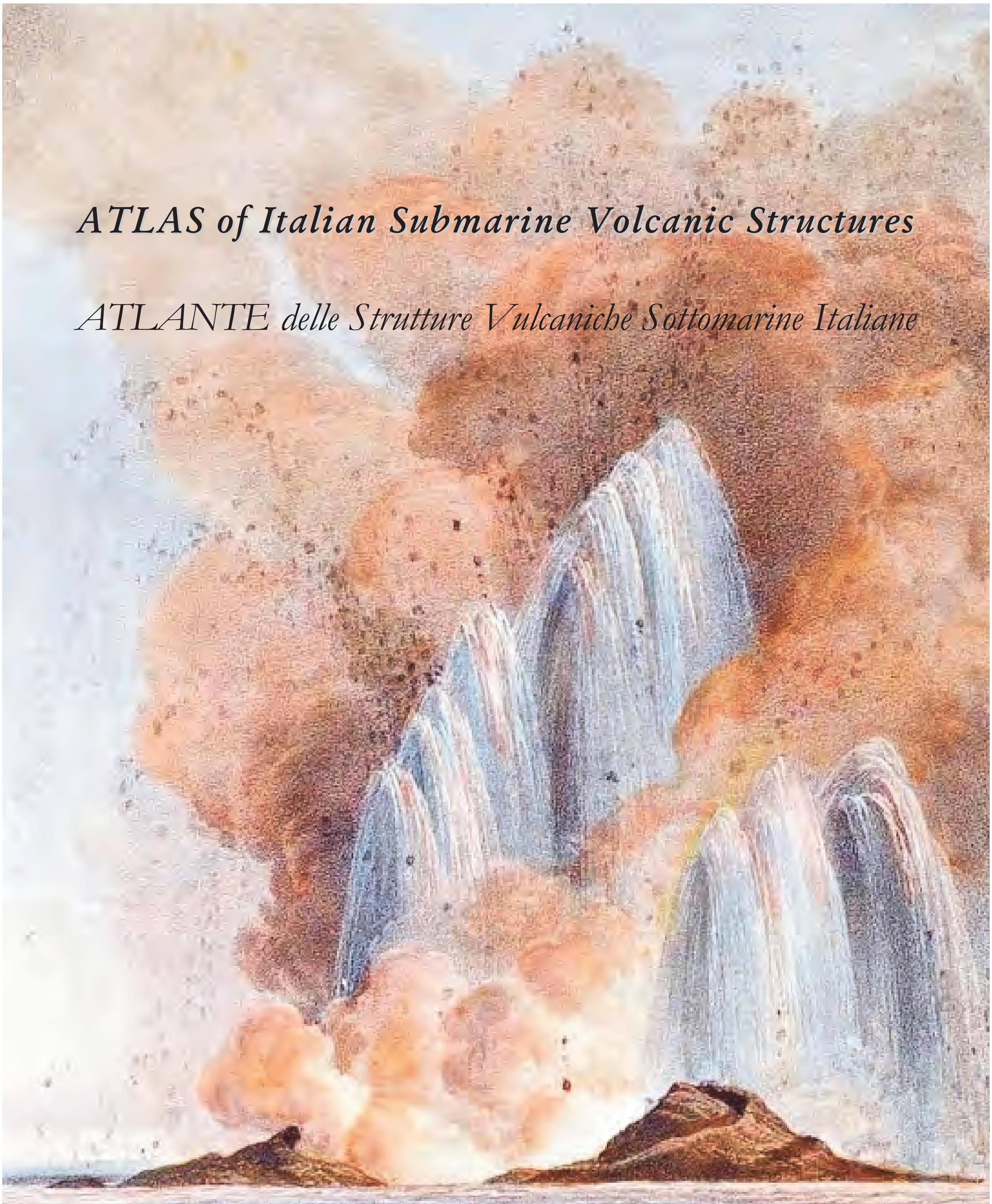
ATLAS of Italian Submarine Volcanic Structures

ATLANTE delle Strutture Vulcaniche Sottomarine Italiane



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New Volcanic Island, elevated by submarine eruption, on the south-west coast of Sicily, first observed July 12th, 1831. From a sketch sent August 6th by an officer of His Majesty's Flag Ship St. Vincent to H.R.H. the Duke of Sussex, K.G., President of the Royal Society. Published Septr. 9th by R. Ackermann, London.

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ATLAS of Italian Submarine Volcanic Structures

Atlante delle Strutture Vulcaniche Sottomarine Italiane

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ABSTRACT - During the last 30 years, many studies were carried out on submerged structures in the Italian seas, particularly in the Tyrrhenian area. Despite the increasing amount of information, available data are still far from complete even for the most studied seamounts; in many cases samples or data sources are not well described, often poorly- to un- georeferenced, or presented on schematic maps, in some cases on poorly detailed bathymetry. Within the framework of the EMODnet Geology Project (www.emodnet-geology.eu), more than 230 bibliographic references have been identified and analysed, with the aim of identifying and cataloguing the available data on the Italian volcanic seamounts. A significant original contribution has also been possible by processing the Italian bathymetric map extracted from the EMODnet Bathymetry Project (www.emodnet-bathymetry.eu). The slope maps derived from that bathymetry allowed to infer the areal extent and the volume of the identified seamounts.
Data collected during the compilation of the volcanic seamount database have been standardized, catalogued and summarized in the 57 ID Sheets that form this Atlas and organised in 7 Volcanic Seamount Sectors. Each Sector is briefly described in terms of geographical, geological and geochemical features. In each ID Sheet, all the information related to one or multiple seamounts (belonging to the same structure/group) has been classified in five different categories: Morphology, Volcanic structure, Chemical composition and age, Volcanic products and Brief volcanic evolution. Each volcanic seamount is illustrated in the related sheet by a figure that shows its morphology by the bathymetry slope map, the extent of its base and the top of the structure. The main features of each volcano are also summarised in a dedicated table and a schematic cross-section.
This work represents the first attempt of a systematic classification and cataloguing of the Italian submarine volcanoes, which aims to make all the information easily accessible to the researchers/users/public.

KEY WORD: Tyrrhenian Sea, atlas, seamounts, submerged volcanism, data bases, Geographic Information Systems.

RIASSUNTO - Negli ultimi 30 anni, sono stati condotti molti studi sulle strutture vulcaniche sottomarine presenti nei mari italiani; particolare attenzione è stata dedicata all'area tirrenica. Nonostante la grande quantità di dati presenti, le informazioni rinvenute in letteratura sono ancora lontane dal consentire una comprensione completa delle strutture vulcaniche sottomarine, ivi inclusi gli apparati più studiati. I dati inoltre sono spesso non omogenei nel format, di difficile localizzazione e georeferenziazione, a volte presentati su mappe disegnate a mano e con batimetria non dettagliata. Con lo scopo di identificare e catalogare i dati dei vulcani sottomarini nell'ambito del Progetto EMODnet Geology (www.emodnet-geology.eu), sono state individuate ed analizzate più di 230 fonti bibliografiche per l'estrazione delle relative informazioni. Dati originali sono inoltre stati ottenuti dalla elaborazione di una mappa batimetrica realizzata dai dati del progetto EMODnet Bathymetry (www.emodnet-bathymetry.eu), che ha consentito la stima dell'area, volume e pendenze dei seamount identificati.

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I dati raccolti durante la compilazione del database dei vulcani sottomarini sono stati standardizzati, catalogati e riassunti nelle 57 schede identificative di questo Atlante organizzate in 7 Settori di seamount vulcanici. Ogni Settore è brevemente descritto relativamente alle sue caratteristiche geografiche, geologiche e composizionali. In ogni scheda identificativa le informazioni relative al singolo seamount, o a più seamounts (appartenenti alla stessa struttura/gruppo), sono state classificate in cinque categorie differenti: "Morfologia", "Struttura vulcanica", "Composizione chimica ed età", "Prodotti vulcanici" e "Sintesi dell'evoluzione vulcanica". In ogni scheda identificativa è presente la mappa di pendenza che mostra l'ubicazione della struttura vulcanica, la sua linea di base ed il punto piu alto. Ciascuna scheda è corredata da una tabella riassuntiva delle principali caratteristiche della struttura vulcanica e un disegno schematico del suo profilo. Questo lavoro rappresenta il primo tentativo di una sistematica raccolta e catalogazione dei dati relativi ai vulcani sottomarini italiani; la sua realizzazione ha come scopo quello di rendere tutti i dati esistenti facilmente accessibili e fruibili ai ricercatori/uten-ti/pubblico.

Parole chiave: Mare Tirreno, atlante, seamounts, vulcanismo sommerso, banca dati, Sistema Informativo Geografico.

1. - INTRODUCTION AND METHODOLOGY

Within the framework of the EMODnet Geology 2 Project (http://www.emodnet.eu/), the collection of available data concerning the Italian submerged volcanic edifices allowed to build a complete database, which includes morphological, structural, stratigraphic, geochemical and age information.

The EMODnet Geology 2 Project aims at building a GIS cartography of submerged volcanic structures at the 1:250,000 scale. The volcanic structures dataset is built, according to EMODnet Geology WP6 architecture (http://www. emodnet-geology.eu/), as point, line and polygon shapefiles with associated attribute tables. The mandatory fields in this table are: a unique identifier code for each recognised volcanic structure, the volcanic edifice position and the bibliographic reference(s). The other fields in the table allow the collection of more specific information (*e.g.*, chemical composition, presence of collected samples, period of activity and dating of eruptive events, presence of gas emissions, morphological and volcanic activity type and a comment field for additional information). The attribute table represents therefore a brief, yet synthetic, characterization of the volcanic objects. In addition, attention was given to the eruptive history.
For many seamounts, much more information than required by EMODnet Geology is available in the literature, also thanks to several oceanographic surveys performed in the last decades in the Italian seas (*e.g.* CROP Project, Finetti, 2005; Ocean Drilling Program, Kastens & Mascle, 1990; ROV survey, Cruise VST02, Gamberi *et alii*, 2006; Progetto Magic, DPC-CNR 2007-2013). Therefore, a large dataset has been organized in a wider database. This Atlas is based not only on data collected but also on new elaborations made on purpose, such as for example the definition of the areal extent of the volcanic edifices, which was usually not indicated in the available literature and, as a result, the elaboration of slope maps and volume calculations. Consequently, our dataset contains both the data required by the EMODnet Geology 2 Project and other information, useful to better frame the Italian submerged volcanic structures into the geological setting of the area.

2. - DATA RECOVERY

With the purpose of cataloguing the volcanic seamounts, more than 230 bibliographic references of various formats (*e.g.* published and unpublished works among scientific articles, PhD theses, books, PowerPoint presentations, oceanographic and geothermal survey reports, conference papers, etc.) were identified for information extraction. This led as a first step to the validation of submerged structures as volcanic or non-volcanic seamounts (fig. 1).

Only the seamounts validated as volcanic structures have been selected for this Atlas and a critical reading of existing data was performed for information extraction and compilation of the database.

The shaded relief model of the Italian seafloor and the relative contour lines used in this volume have been obtained from the Italian bathymetric map (px spatial resolution: 190 m) built from the EMODnet Bathymetry portal (http://www.emodnet-bathymetry.eu/data-products). More detailed bathymetric maps (e.g. px spatial resolution: 50m - 10m for coastal areas - from the Progetto Magic, DPC-CNR 2007-2013) were also available for some areas of the Tyrrhenian Sea and were used for morphological descriptions.

All the collected information has been organized in attribute tables associated with polygon, line and point shapefiles identifying each volcanic structure. For each seamount, the basal area is defined by a polygonal shapefile, while a point shapefile indicates the highest culmination above the seafloor. The

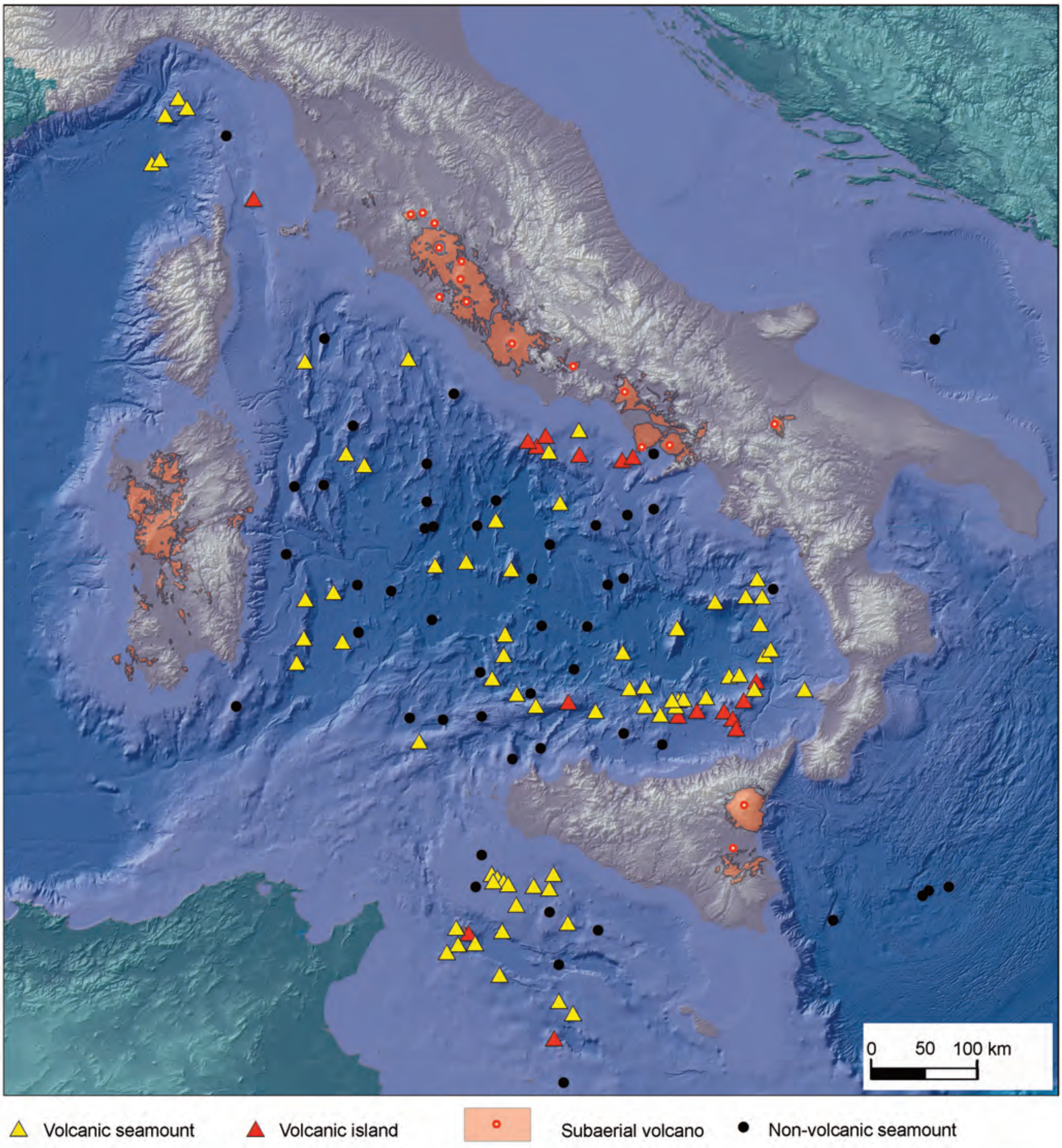


Fig. 1 - Map of volcanic islands and submerged seamounts, subdivided into volcanic and non-volcanic.
- *Mappa delle isole vulcaniche ed edifici sommersi, suddivisi in vulcanici e non-vulcanici.*

drawing of the basal contour line of each seamount is based on geological and physiographic boundaries, extending it to the main break in slope of the inferred base, making the extent of the edifices based on the volcanological interpretation of their morphology, and in the end significantly improved with respect to previous outlines (*e.g.* WÜRTZ *et alii*, 2014).

The shape and extent of the volcanic structures were also inferred from structural and geophysical map images extrapolated from published literature and georeferenced by means of a GIS software. Once defined the seamount area, the volume of the entire edifice was calculated using the reference Digital Elevation Model (DEM EMODnet) (fig. 2).

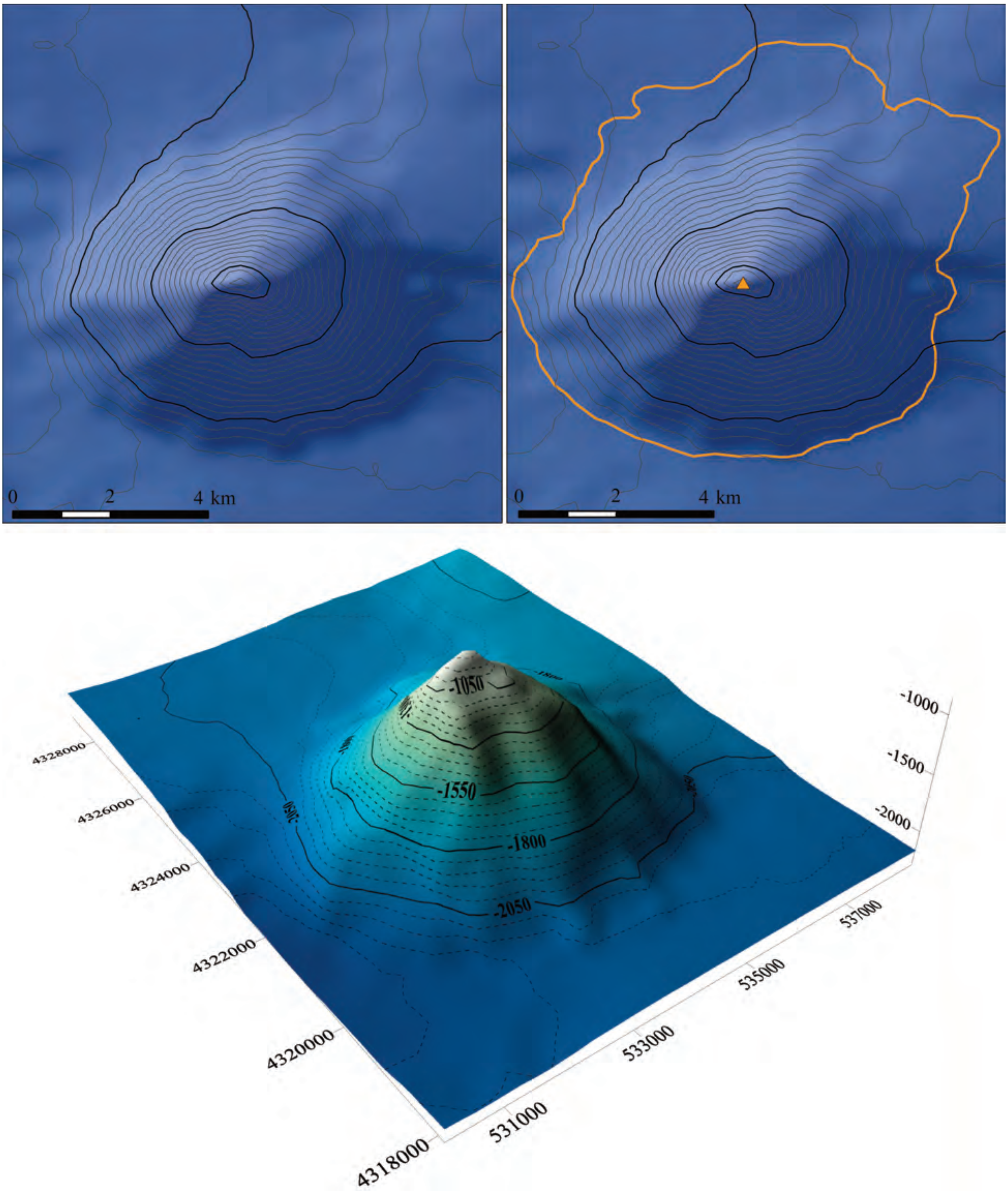


Fig. 2 - Example of representation of basal contour line and culmination point for the Lametini I volcanic seamount.
- *Esempio di rappresentazione della linea di contorno basale e del punto di culminazione per il seamount Lametini I.*

A total of 76 volcanic seamounts has been identified. Eighteen of these seamounts emerge above sea level as well-known volcanic islands (i.e. Capraia, Western Pontinian, Ventotene and S. Stefano, Ischia, Procida, Ustica, Pantelleria, Linosa and the Aeolian Islands), while three edifices are structures recognised as volcanic in nature from old studies, but previously un-named; so we have herein named them for the first time as Livia, Creusa and Tiro respectively (see § 5.11, 5.12 and 6.20). These names belong to famous women and nymphs of Greek mythology and Roman history and were chosen to be in agreement with the surrounding seamount names.

The identification of the 76 volcanic seamounts is the result of an intense process of skimming, merging and standardization of a vast amount of information accumulated during the last 30 years of research, which often proved to be discordant, not uniform and incomplete. Some of the main problems addressed during the process of data validation are listed below.

- The first discordance encountered was the presence of seamounts with multiple names (*i.e.* Ulysse/ Genova Gulf, Spinola/Tristanite, Occhiali/Doria, Albatros/Cicerone, Magnaghi/Vittorio Emanuele, Aceste/Tiberio, Marsili/Plinio, Palinuro/Strabo, Garibaldi/Glauco, Graham/Ferdinandea, Alfil/ Linosa III); the same edifice could be named differently in different articles. In this volume the most frequently recurring names are reported, in order to prevent further confusion in the edifice identification.

- Other problems were related to the chemical composition and reference coordinates of collected samples, which were missing in some cases, so that it was difficult to establish the volcanic nature or composition of the seamounts. Sometimes, the wrong attribution of a dredged sample to another seamount resulted in an incorrect evaluation of the chemical composition and in seamount relocation. This is the case of Etruschi seamount (§ 3.2), to which KELLER (1981) attributed a sample tholeiitic in composition. Actually, the geographic coordinates of this sample point to Columbus seamount (§ 5.2), located at about 100 km SE with respect to Etruschi seamount and characterised by a composition similar to the dredged sample. This erroneous attribution was subsequently taken up by PECCERILLO (2005, 2017), who corrected the sample to its rightful location, but also repositioned Etruschi seamount towards SE, where instead Columbus seamount is located. For such type of inconsistencies, in this volume it was considered more reasonable to keep the position of the seamounts and to attribute the error to the wrong geographic attribution of the dredged sample.

- The method of age determinations is not always specified in the literature; thus the soundness of these data many times remains uncertain.

3. - SEAMOUNT ORGANIZATION

The information related to each identified volcanic structure has been summarized into 57 sheets, organized in 7 Volcanic Seamount Sectors.

Each Volcanic Seamount Sector is introduced by a summary concerning its geographic position, volcanic evolution and relationship with the overall geodynamic framework of the area, overall chemical composition and radiometric dating, together with a representative bathymetric map and a TAS diagram of the available chemical analyses of samples from that sector.

Seamounts have been ascribed to sectors according to their location, age and chemical composition. Yet, it is important here to remark that the volcanic sectors, as herein defined, are not identical to geochemical and petrographic provinces, as indicated for example in PECCERILLO (2005, 2017), because, in the complex geodynamic framework of the Tyrrhenian Sea, the same location may become the site of diachronous pulses of volcanism with different geodynamic significance. For example, at Capraia Island older products show age and composition affinity with the Corsica-Sardinian Volcanic Seamount Sector, while the younger products emitted by Punta dello Zenobito display an age and composition comparable to the Etruscan Volcanic Seamount Sector (e.g. CONTICELLI *et alii*, 2010). Similarly, Ponza Island is almost entirely constituted by rhyolites, dated between 4.3 Ma and 2.5 Ma comparable to the characteristics of the Etruscan Volcanic Seamount Sector, while trachytic lavas emitted on the southeastern part of the island display ages of ≃1 Ma, comparable to Neapolitan Volcanic Seamount Sector features. In these cases, for the purposes of subdivision into sectors we referred to the age and composition of the oldest and/or more voluminous products.

Each seamount is described in a sheet containing, at the best of the available information, the following items:

- Morphological type: the morphology classification of the volcanic edifices is based on analyses of the available bathymetries (EMODnet, http://www.emodnet-bathymetry.eu/ and Progetto Magic, DPC-CNR 2007-2013) and, where available, on geophysical data such as the seismic profiles of the CROP project (FINETTI, 2005). Seamounts are classified as:

• Composite edifice: the morphology of a volcanic edifice formed by the aggregation of multiple structures not elongated on a preferential direction;

• Fissural edifice: the morphology displayed by a well-developed volcanic structure built along a preferential direction;

• Stratovolcano: volcanic edifices with a subaerial portion built by the alternation of effusive and explosive deposits (i.e. Aeolian Islands);

• Simple cone: the conical morphology of a volcanic edifice characterised only by a summit vent and regular slopes denoting a simple conduit structure.

- Magmatic series and chemical composition: the chemical compositions reported in the Atlas mostly refer to underwater deposits, although in some cases, where no or few submerged samples have been analysed, also a selection of subaerial data has been used to define the overall chemistry of the volcanic edifice. Where available, chemical analyses of samples dredged during Oceanic Cruises projects or extracted through Oceanic drilling programs are described and also plotted on a TAS diagram in the introductory paragraph of each Volcanic Sector. An important note is that we have decided not to recalculate the sample composition on a water free bases, so what the reader will see in the TAS diagrams are the raw compositions, referred to the original papers. This is because for submarine samples a lot of care needs to be taken in considering the effects of alteration, a type of study that is well beyond the purposes of the Atlas and that we therefore leave to the interested reader to evaluate.

- Activity type, Activity age range: the activity type nomenclature ranges from "Effusive" to "Explosive", and "Mixed" for the combination of both activity styles. The activity age range refers to the period of time between the oldest and the youngest dates available on dredged samples, generally based on radiometric dating. Due to their submerged nature and to the absence of information for some seamounts, these data are not always available, nor they represent necessarily the full extent of the volcanic history. On the other hand, the amount of data concerning volcanic islands (Pontinian Islands, Ischia, Procida, Aeolian Archipelago, Ustica, Pantelleria and Linosa) and the most studied seamounts (i.e. Marsili/Plinio, Palinuro/Strabo, Vavilov and Magnaghi/Vittorio Emanuele), is conspicuous. Regarding the volcanic islands, the activity range is largely based on the age determinations of the sub-aerial products.

- Volume: the volume of each seamount provided in this Atlas is calculated between a horizontal plane at the average depth of the base of the edifice and the bathymetric DEM above it. We estimate the error related to this procedure of calculation (including that related to the spatial resolution of the DEM) to ±10% of the indicated value. This is the first complete dataset about volumes of the Italian volcanic seamounts with an explicit method of calculation, and we think that this dataset is essential for any estimate or consideration about average eruption rates and volcanic evolution of the seamounts.

- Fluid emissions: this field reports the presence of degassing activity and the origin of the fluid (where data were available).

In addition to the information summarized in the table, each sheet shows, in the lateral column, the average base depth and the depth of the top from sea level. Each seamount is represented in a dedicated figure by its bathymetric map. The slope representation (in degree; color scale in legend) overlaps the shaded relief model, where the principal contour lines are plotted.

Each volcanic object is also described in more detail in each identification sheet with a text, providing information about its morphology (shape, dimensions, volume, slope), volcanic structure (faults, crater rim, dikes, scars, etc.), chemical composition and age (chemical analyses and samples dating); volcanic products (description of samples dredged and/or drilled) and a summary of the volcanic history and activity (brief volcanic evolution). The bibliographic references from which all information was extracted are reported at the end of the Atlas.

The list of volcanic sectors and relative seamounts presented in this Atlas is reported below:

1 - *Ligurian Volcanic Seamount Sector*: Spinola/Tristanite and Calypso smts, Ulysse/Genova Gulf Central Volcano smt, Occhiali/Doria smt, Genova smt;

2 - *Corsica-Sardinian Volcanic Seamount Sector*: Cornacya smt, Cornaglia smt, Capraia Island, Quirinus smt;

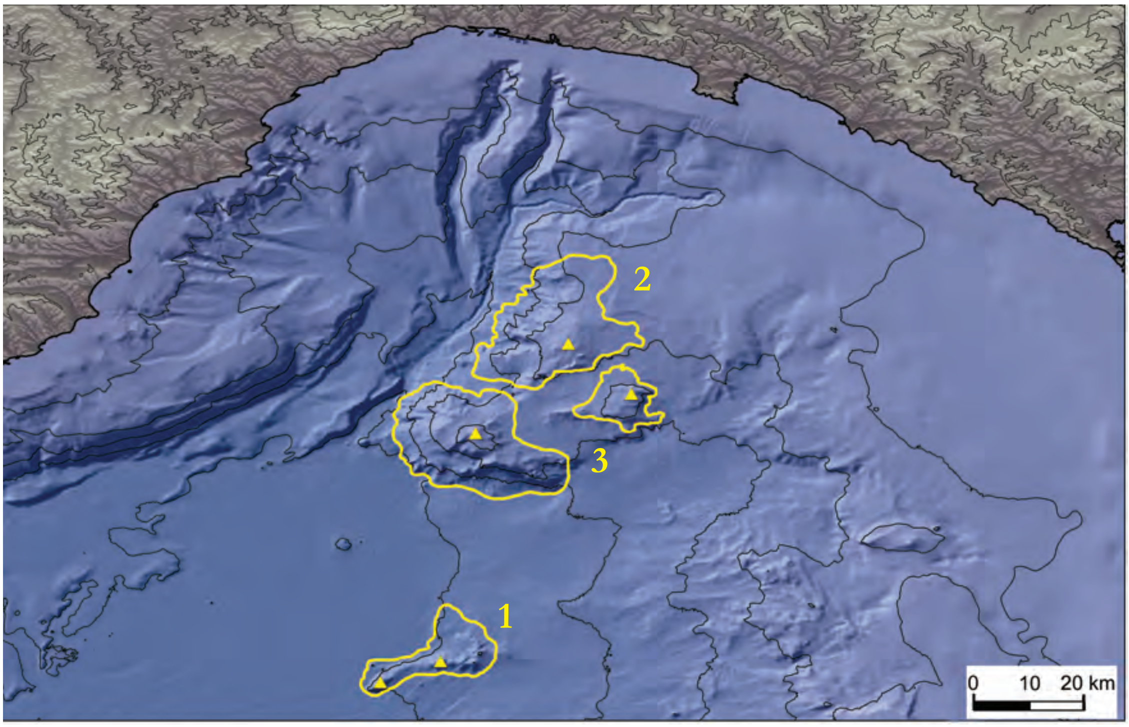
3 - *Etruscan Volcanic Seamount Sector*: Western Pontinian Islands (Ponza, Palmarola, Zannone), Etruschi smt, Tiberino smt;

4 - *Neapolitan Volcanic Seamount Sector*: Ventotene Island and La Botte smt, Ventotene Ridge, Albatros/Cicerone smt, Ischia and Procida Islands;

5 - *Central Tyrrhenian Volcanic Seamount Sector*: Marco Polo smt, Columbus smt, Gortani smt, Magnaghi/Vittorio Emanuele smt, D'Ancona smts, Vavilov smt, Virgilio smt, Augusto smt, Quirra smt, Virgilio II lava field, Livia smt, Creusa smt, Ustica Island, Prometeo smt, Aceste/Tiberio smt, Garibaldi/Glauco smt, Anchise smt;

6 - *Aeolian - E Tyrrhenian Volcanic Seamount Sector*: Marsili/Plinio smt, Palinuro/Strabo smt, Glabro smt, Enotrio smt, Diamante smt, Alcione smt, Lametini smts, Capo Vaticano smt, Stromboli Island, Strombolino I and Strombolino II smts, Panarea Island, Vulcano Island, Lipari Island, Salina Island, Filicudi Island, Alicudi Island, Eolo smt, Enarete smt, Sisisfo smt, Tiro smt;

7 - *Sicily Channel Volcanic Seamount Sector*: Tetide, Anfitrite, Galatea and Euridice smts, Empedocle smt (Ferdinandea/Graham, Terrible, Nerita), Nameless smt, Pantelleria Island, Linosa Island, Linosa II and Alfil/Linosa III smts.



1. Ligurian Volcanic Seamount Sector

Fig. 3 - Overview of the volcanic seamounts of the Ligurian Volcanic Seamount Sector.
- Panoramica degli edifici vulcanici sommersi del Settore vulcanico sottomarino Ligure.

The Ligurian Volcanic Seamount Sector lies in the northern portion of the Tyrrhenian Sea (fig. 3) and is comprised between the Corsica northern margin and the Ligurian coast. The volcanic sector is composed by several composite edifices named Spinola/Tristanite smt and Calypso smt, Ulysse/Genova Gulf Central Volcano smt, Occhiali/Doria smt and Genova smt.

This area has been active during Miocene and its evolution is linked to the Liguro-Provençal back-arc oceanic basin opening (20.5 Ma-15 Ma, GATTACCECA *et alii*, 2007), formed as a consequence of the rollback of the oceanic slab (from Middle to Late Miocene) that caused the thinning of the crust and a passive asthenospheric upwelling in a back-arc geodynamic setting.

The extensional regime dominated the northwestern part of the Ligurian basin from the Upper Miocene to the Plio-Quaternary (JOLIVET *et alii*, 1998) leading to the emplacement of numerous magmatic bodies (SERRI *et alii*, 1993) and to a high thermal flux in this area (DELLA VEDOVA *et alii*, 1984; JEMSEK *et alii*, 1985; RÉHAULT *et alii*, 2012). The principal volcanic products erupted are lavas with composition ranging from HK calc-alkaline magmas to more alkaline products (fig. 4).

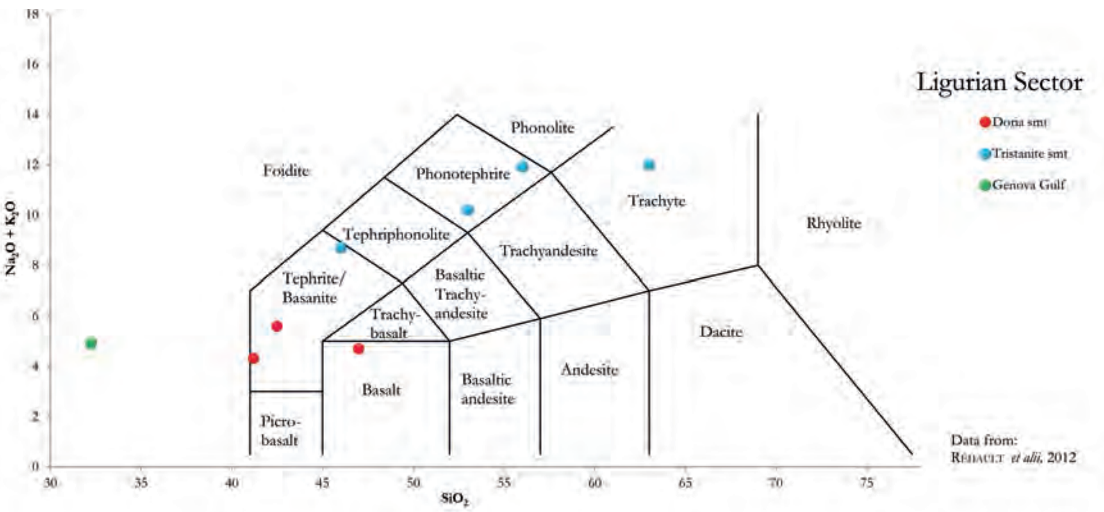
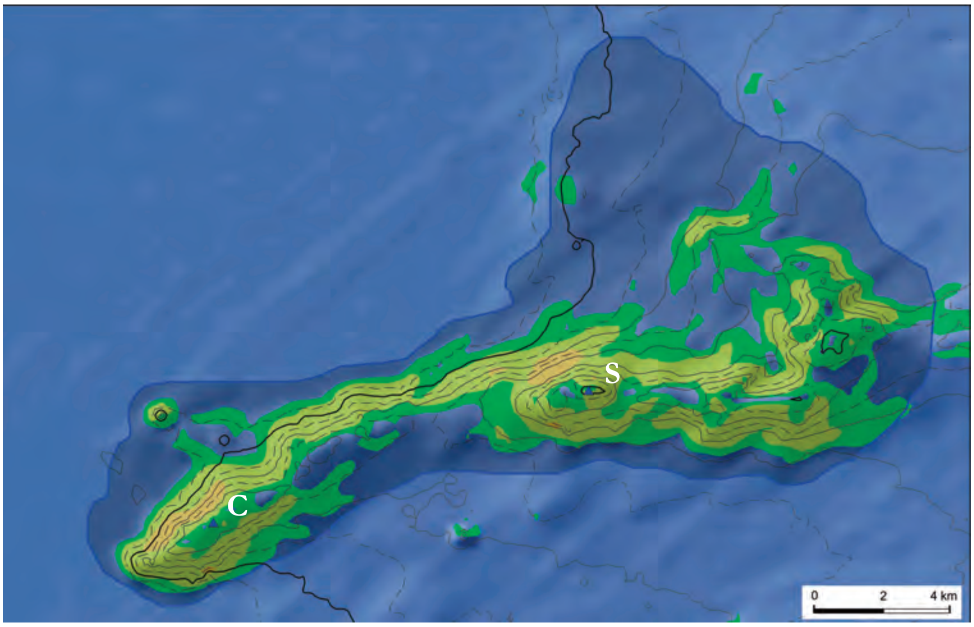
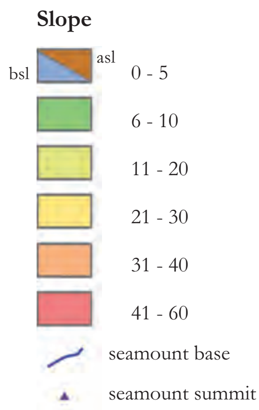


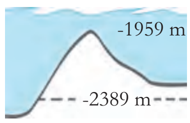
Fig. 4 - TAS diagram of composition of samples dredged along Occhiali/Doria smt, Spinola/Tristanite smt and Genova Gulf smt. Data are plotted raw from cited sources and may include LOI up to >20%. The reader is referred to the original papers for an evaluation of the data and for the nomenclature adopted in this text.
- Diagramma TAS della composizione di campioni dragati lungo Occhiali/Doria smt, Spinola/Tristanite smt e Genova Gulf smt. I dati sono tracciati dalle fonti citate e possono includere LOI fino a >20%. Si rimanda il lettore agli articoli originali per una valutazione dei dati e per la nomenclatura adottata in questo testo.

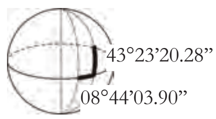
1.1 *Spinola/Tristanite, Calypso Seamounts*



Morph. ty.	Composite edifice
Serie	Alkaline to calc-alkaline
Chem. com.	Andesite, trachyte, phono-tephrite, tephriphonolite
Act. ty.	Mixed
Act. age r.	18-12.4 Ma
Vol. [km^3±10%]	10
Flu. ems.	/







Morphology

The Spinola/Tristanite (S) and the Calypso (C) seamounts are here considered as a composite structure located south of Genova Gulf. To the east, a horseshoe-like shaped (NW-looking concavity) seamount is known as Spinola spur or Tristanite ridge. To the west, a NE-SW elongated ridge, 7.5 km-long, is known as Calypso hills (Réhault *et alii*, 2012; Würtz *et alii*, 2014; Würtz & Rovere, 2015).

The base of the Spinola/Tristanite and Calipso smts is comprised between -2602 m and -2108 m, averaging at -2389 m. The highest summit is at -1959 m, for an average height of ~430 m.

The flank slopes reach 20° to 30° only in the vicinity of the Calypso hills summit and following its NW-facing flank, and on both sides of the Tristanite horseshoe southern branch. Elsewhere, the slope is comprised between 3° and 17°. No sharp changes in slope are detected around these seamounts.

The calculated total volume is 10 km^3.

Volcanic structure

The Calypso smt and the Spinola/Tristanite smt form a composite edifice. Structurally, this edifice lies along the external border of the Corsica thinned margin, towards the central part of the basin. Magnetic studies revealed that the seamount also extends south-westwards with other buried seamounts (Réhault *et alii*, 2012).

No detailed information about the volcanic structures could be found in the available literature.

Chemical composition and age

Existing chemical analyses of lava samples indicate mainly alkaline compositions; analysed pyroxenes from Spinola/Tristanite smt plot in both the sub-alkalic and alkalic fields (Réhault *et alii*, 2012).

Available ages (K-Ar) are 18.0 ± 1.0 Ma, 12.8 ± 0.6 Ma and 12.4 ± 0.6 Ma (Réhault *et alii*, 2012).

Volcanic products

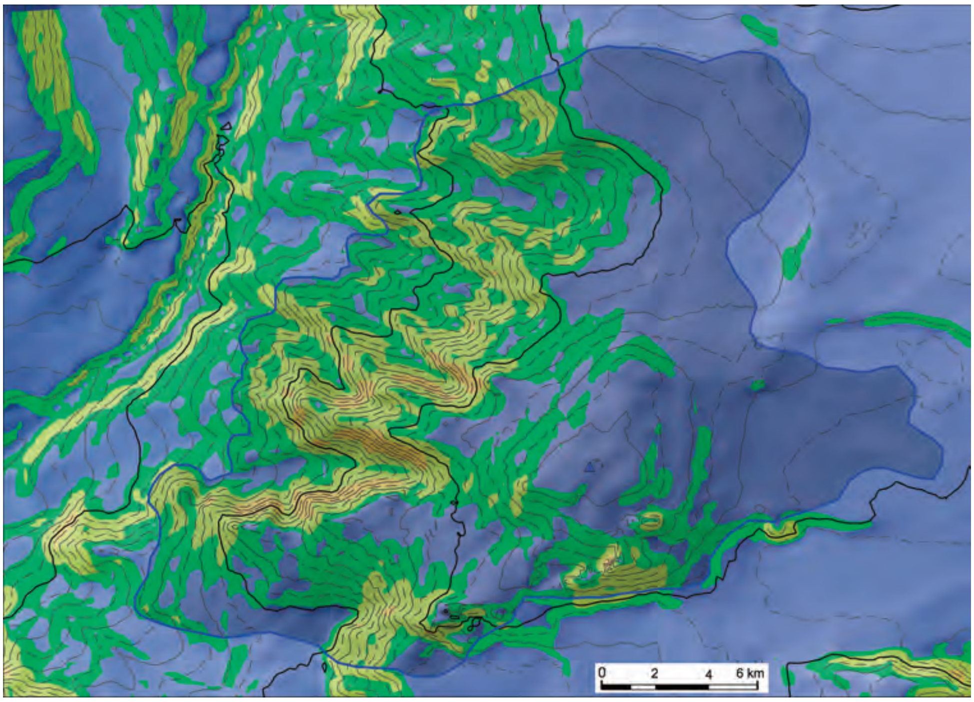
Samples from the Spinola/Tristanite smt are from light green lava dredged on the southern flank; samples from the Calypso smt are white and laminated tuffs and porphyritic lavas andesitic in composition. (Réhault *et alii*, 2012).

Brief volcanic evolution

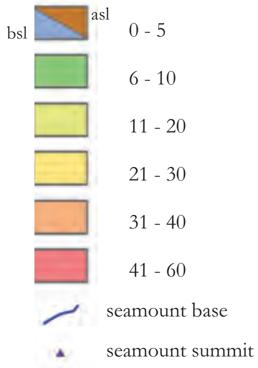
The Spinola/Tristanite and Calypso smts are located on a thinned continental crust, which is also affected by major NE-trending fault systems. According to Réhault *et alii*, (2012), volcanism in this area, after the end of the oceanic spreading (21-18 Ma), was favoured by a process of slab roll-back that affected the oceanic plate in subduction beneath the European margin. This led to asthenospheric upwelling, associated with the fast opening of the Liguro-Provençal back-arc basin and the concurrent Corsica-Sardinia block rotation.

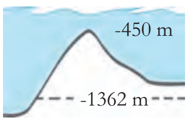
Ulysse/Genova Gulf Central Volcano Seamount 1.2

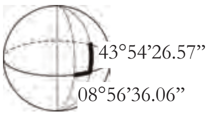
Morph. ty.	Composite edifice
Serie	HK-calc-alkaline
Chem. com.	Shoshonite
Act. ty.	Effusive
Act. age r.	14.8 Ma
Vol. [km³±10%]	89
Flu. ems.	/



Slope







Morphology

The Ulysse/Genova Gulf seamount is located in the central area of the Genova Gulf, on the eastern flank of the Bisagno river submarine canyon (Würtz *et alii*, 2014; Würtz & Rovere, 2015). Recently, it has also been indicated as Genova Gulf Central Volcano (Réhault *et alii*, 2012).

It appears as a central edifice, with several canyons that stretch to the NW, towards the Bisagno canyon. Its maximum elongation stretches NE-SW for 25 km, while it extends for 16 km along the perpendicular NW-SE direction. The edifice summit is at about -450 m, while the base lies above a NW-sloping substrate, with a maximum depth of -1907 m and a minimum depth of -825 m, averaging at -1362 m, for a mean height of 912 m (according to the edifice extent presented in Réhault et *et alii*, 2012).

The steepest flanks (20° to 35° of slope) are located along the most carved canyons, while the top of the edifice presents a 3° to 10° maximum slope.

The approximate volume of the structure is 89 km^3.

Volcanic structure

No detailed information on this edifice could be found in the scientific literature. Dredged samples are lavas (Réhault *et alii*, 2012), and the seamount, given its morphology and volume, can be considered a composite edifice.

Chemical composition and age

The composition of a basalt dredged near the top of the seamount showed a K-rich shoshonitic affinity and an age (K-Ar) of 14.8 ± 2.8 Ma (Réhault *et alii*, 2012).

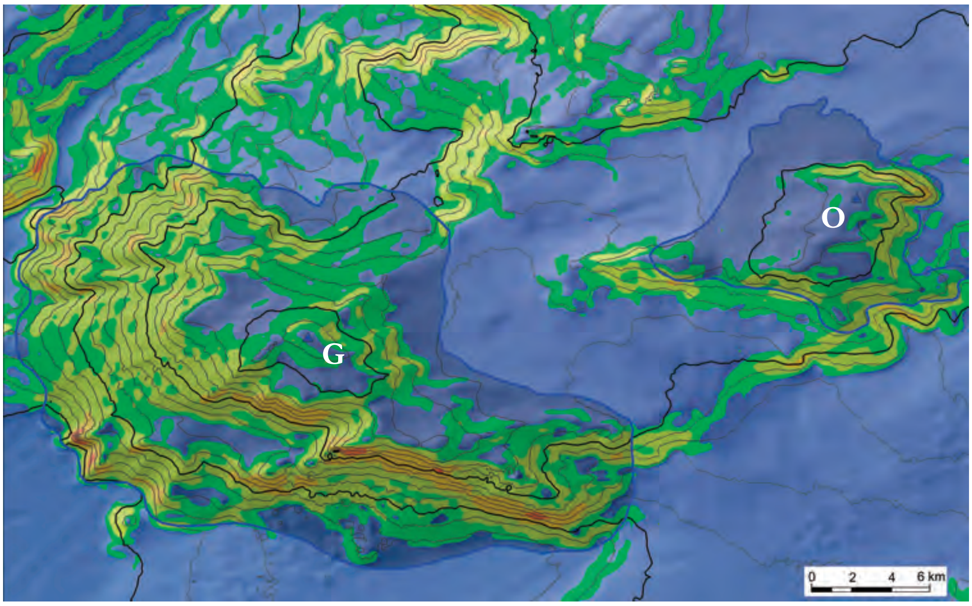
Volcanic products

No detailed information could be found in the scientific literature on the volcanic products of the Ulysse/Genova Gulf smt. The only dredged sample of a basalt lava accounts for an effusive activity.

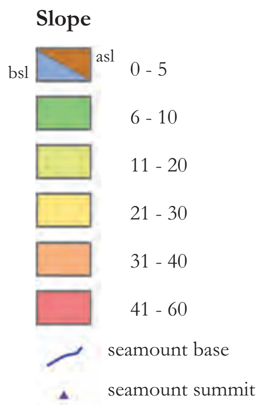
Brief volcanic evolution

There is no enough information about this seamount to derive its volcanic evolution. Based on the available age and magma composition Réhault *et alii* (2012) suggested that this edifice is contemporaneous to crustal thinning associated with the onset of an intra-arc rifting process, and both the opening of the Corsica-Ligurian basin and the counter-clockwise rotation of Corsica-Sardinia block to its present position (Réhault *et alii*, 2012). These processes are attributed to the slab-roll back of the oceanic lithosphere subducting between 15 and 13 Ma.

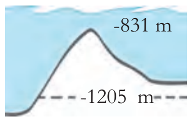
1.3 *Occhiali/Doria and Genova Seamounts*

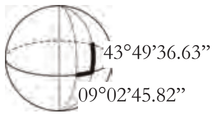


Morph. ty.	Composite edifice
Serie	HK-calc-alkaline
Chem. com.	Shoshonite
Act. ty.	Effusive
Act. age r.	11.4-7.3 Ma
Vol. [km^3±10%]	149 (G); 13 (O)
Flu. ems.	/

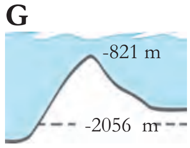


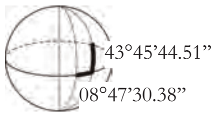
O





G





Morphology

The Occhiali/Doria (O) and Genova (G) seamounts are located in the central area of the Genova Gulf. The Genova smt is listed in Würtz & Rovere (2015) as a nameless seamount, while in Réhault *et alii* (2012) it is considered as part of the Monte Doria Volcanic Complex, together with the nearby Occhiali/Doria smt. In another compilation of the Mediterranean seamounts, Genova and Occhiali/Doria smts are listed separately (Würtz *et alii*, 2014).

The Genova smt is a 25 km-long edifice, WNW-ESE trending, with the steepest slopes (20° to 35°) along its southern flank. The Occhiali/Doria smt, on the other hand, has an irregular shape. As in the Genova smt, the steepest slopes (10° to 20°) are located along the southern flank, with an E-W orientation. The Occhiali/Doria smt has a top depth of -831 m. The base ranges between -1422 m and -1030 m, with an average of -1205 m. The mean semount height is 374 m. The Genova smt has its base between -2558 m and -1269 m, with an average of -2056 m. The top of the edifice is at -821 m, for a mean height of 1235 m.

The volume of Occhiali/Doria smt can be estimated at around 13 km^3 and that for Genova smt at 149 km^3.

Volcanic structure

The Occhiali/Doria and Genova smts are composite structures. The summit of Genova smt represents its main volcanic edifice; smaller parasitic cones can be recognised close to the summit and along the eastern elongated flank. The Occhiali/Doria smt is a separate edifice 10 km apart from Genova smt (Réhault *et alii*, 2012).

Chemical composition and age

Avaliable ages and chemical compositions derive from samples collected on the Genova smt (Réhault *et alii*, 2012). Dredged products collected range from shoshonitic to porphyritic Ol-basalts lavas phenocrysts of plagioclase and diopside. Most analyses of the clinopyroxenes plot within the alkalic field (Réhault *et alii*, 2012).

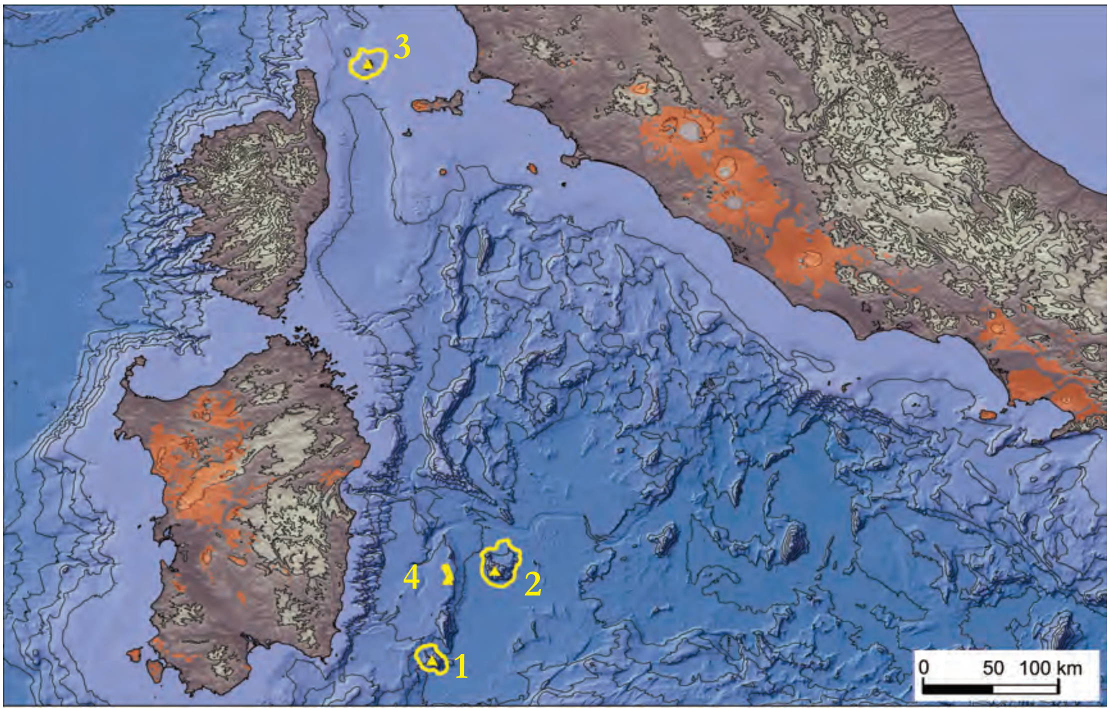
Available ages (K-Ar) range between 11.4 ± 1.4 Ma and 7.3 ± 1.4 Ma, with other ages between 9.2 and 7.5 Ma (within the error bars) (Réhault *et alii*, 2012).

Volcanic products

The Genova smt is made of a pile of pillow-lava flows, with individual thicknesses decreasing upward. The high vesicularity of these lavas suggests that effusive activity occurred at low to moderate depths (Réhault *et alii*, 2012).

Brief volcanic evolution

These volcanoes formed around 11-7 Ma ago, when eruption of K-rich shoshonitic lavas is interpreted as a consequence of the evolution of the collision zone (the subduction of the oceanic crust underneath the European margin), involving the opening of a slab window (Réhault *et alii*, 2012). This window was formed by the tearing, breaking and sinking of the subducting oceanic lithosphere, which allowed a subsequent asthenospheric uprise.



2. Corsica-Sardinian Volcanic Seamount Sector

Fig. 5 - Overview of the volcanic seamounts of the Corsica-Sardinian Volcanic Seamount Sector.
- Panoramica degli edifici vulcanici sommersi del Settore vulcanico sottomarino Sardo-Corso.

The Corsica-Sardinian Volcanic Seamount Sector lies in the western portion of Tyrrhenian Sea (fig. 5) and is located along the Corsica and Sardinia eastern margin. The sector is formed by composite edifices (Cornacya smt, Cornaglia smt, Capraia Island, Quirinus smt).

High-K calc-alkaline, shoshonitic and ultrapotassic rocks (fig. 6), Miocene-Pliocene in age, relate to the overlap of collisional and post-collisional back-arc processes, with involvement of partial melting of a heterogeneous sub-continental metasomatized mantle source (AVANZINELLI *et alii*, 2009; CONTICELLI *et alii*, 2010; PECCERILLO, 2017).

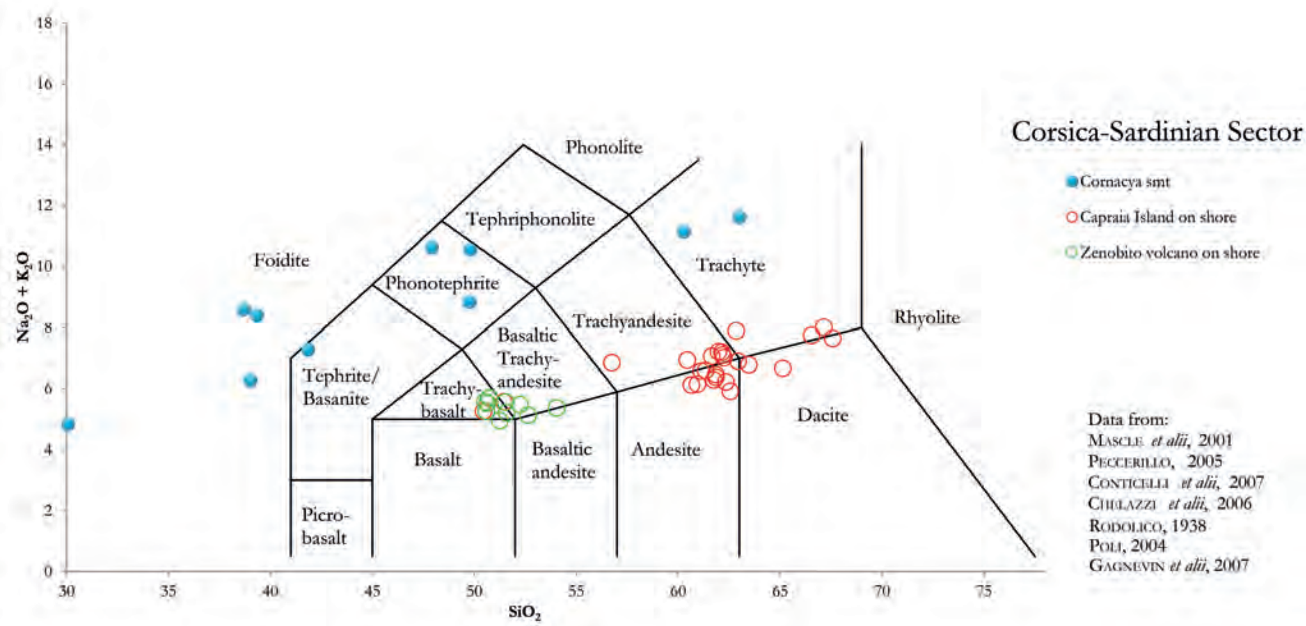
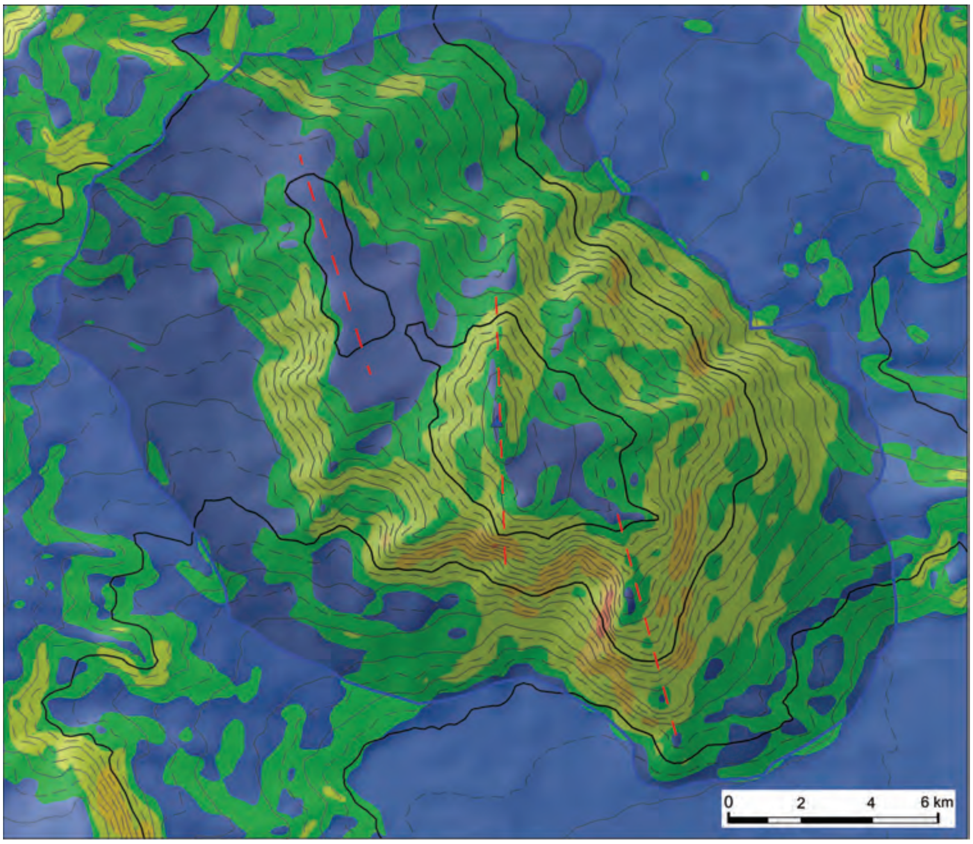


Fig. 6 - TAS diagram of composition of the Corsica-Sardinian Volcanic Seamount Sector products. Data are plotted raw from cited sources and may include LOI up to >20%. The reader is referred to the original papers for an evaluation of the data and for the nomenclature adopted in this text.
- Diagramma TAS della composizione dei prodotti del Settore vulcanico sottomarino Sardo-Corso. I dati sono tracciati dalle fonti citate e possono includere LOI fino a >20%. Si rimanda il lettore agli articoli originali per una valutazione dei dati e per la nomenclatura adottata in questo testo.

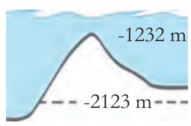
2.1 *Cornacya Seamount*



Morph. ty.	Composite edifice
Serie	Shoshonitic to HK-calc-alkaline
Chem. com.	Shoshonites with lamproitic enclaves
Act. ty.	Effusive
Act. age r.	12.6 Ma
Vol. [km^3±10%]	70
Flu. ems.	/

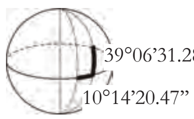
Morphology

This seamount was discovered and named during the French submersible "Sarcya" cruise in 1994 (Mascle *et alii*, 2001; Würtz & Rovere, 2015). It mainly elongates NW-SE, although it shows NNW-SSE oriented ridges within the edifice. It is 22 km-long and 14 km-wide. The base ranges between -2667 m and -1499 m, averaging at -2123. The shallowest peak is at -1232 m of depth for a mean height of the edifice of 891 m. Slopes mainly range between 6° and 20°, mostly on the SE flank, with sporadic steeper cliffs whose slope reach 26° to 35°. Calculations indicate a total volume of 70 km^3.



Volcanic structure

During the Sarcya cruise in the Sardinia Channel, Mascle *et alii* (2001) report that from the depth of -2385 m and above, volcanic rocks are exposed and form a succession of sub-vertical cliffs separated by steep dipping talus. The intense fracturation corresponds to a N-S to N20/N40-trending normal fault system, with E-W to N120 tear faults, which is consistent with a horst and graben, and tilted blocks structure, related to the opening of the deep Sardinia channel. A very detailed description of this seamount's fracturing is given in Mascle *et alii* (2001).



Chemical composition and age

Conticelli *et alii* (2010) report the presence of shoshonitic to high-K calc-alkaline rocks. These rocks show a wide compositional range from mafic to felsic products: in general, Cornacya shows a majority of trachy-andesitic lavas (Mascle *et alii*, 2001). Lamprophyres are often included in the K-rich andesites and are geochemically similar to Ti-poor lamproites. Mica compositions reflect chemical exchanges between the lamprophyre and its host rock suggesting that both rocks were emplaced simultaneously (Mascle *et alii*, 2001).

Mascle *et alii* (2001) also report a ^{40}Ar-^{39}Ar total age of 12.6 ± 0.3 Ma (± 1σ) for a dredged andesitic pebble from Cornacya. This age was calculated from 15 in-situ ^{40}Ar-^{39}Ar analyses performed on a single automorph crystal of biotite; a weighted average calculation on the same data points, carried out in this paper, gives an age of 13.07 ± 0.5 Ma (95% conf. lev., MSWD=1.5), slightly older but equal within error to the total age.

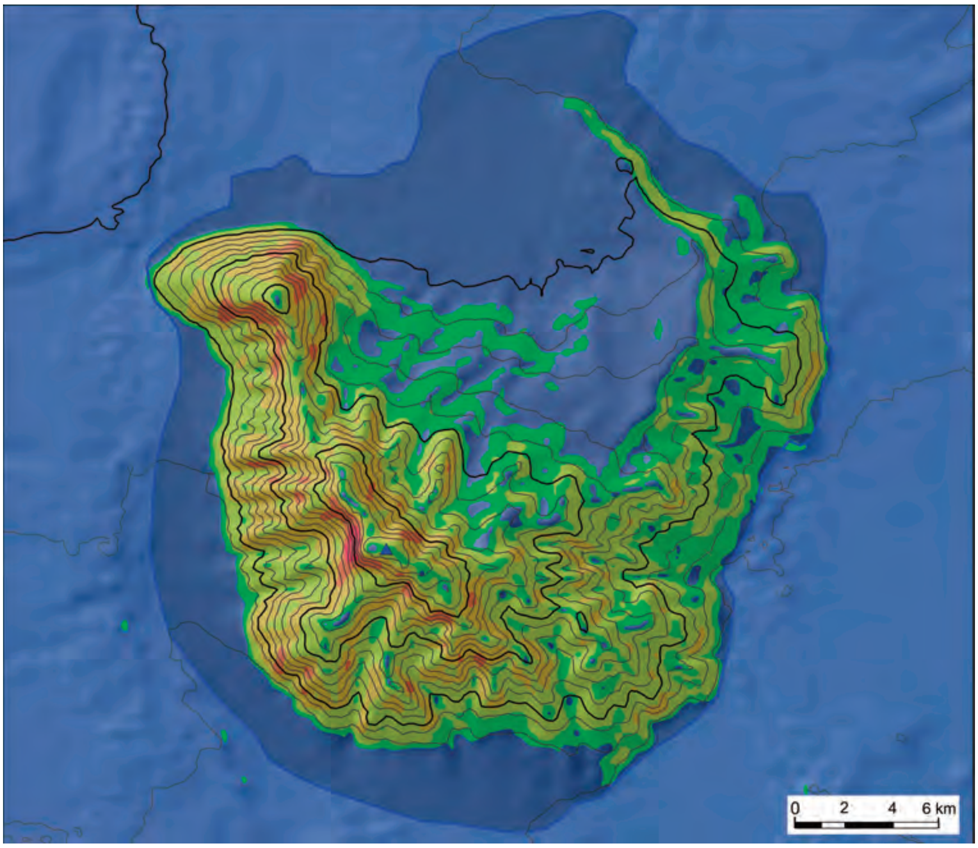
Volcanic products

The main volcanic products are shoshonitic lavas of intermediate compositions with lamproitic enclaves (MASCLE *et alii*, 2001).

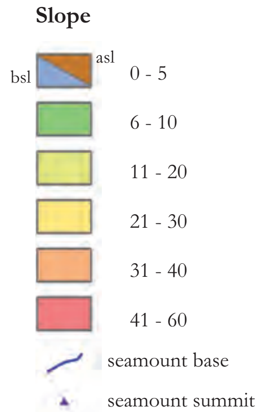
Brief volcanic evolution

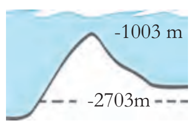
The Cornacya shoshonitic suite has been dated at 12.6±0.3 Ma, which is contemporaneous with the Sisco lamproite emplacement (Cape Corsica). In fact, the Cornacya volcanic products show petrological and geochemical similarities with the K-rich rocks and lamproites from Tuscany. However, Tuscany rocks are younger than the Cornacya ones and, thus, do not belong to the same magmatic episode. On the other hand, Cornacya is compatible with Sisco lamproites: although the igneous suites are 500 km apart, they show a similar structural location on the Western Tyrrhenian margin. They were emplaced during the post-collisional lithospheric extension of the Corsica-Sardinia block, just after its rotation and before the Thyrrenian Sea opening. This means that lithospheric thinning began in northern and southern Tyrrhenian at the same time, around 13 Ma ago. The differentiation between the geodynamic evolution of the northern and southern Tyrrhenian basins occurred later, due to the southward retreat of the Tyrrhenian subduction (MASCLE *et alii*, 2001).

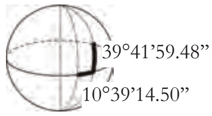
2.2 *Cornaglia Seamount*



Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	/
Act. age r.	10 Ma
Vol. [km^3±10%]	188
Flu. ems.	/







Morphology

This seamount presents a horseshoe-like relief with a N-looking concavity, which is far better developed (in height and width) on its western side. The base of the edifice lies between -2841 m and -2530 m, averaging at -2703 m. Cornaglia smt is 1700 m high, since its shallowest peak is located at -1003 m of depth, on the western flank of the structure.

The flank slopes exceed 10° mainly along the western flank, with sporadic peaks of slope's values that reach 57°.

The Cornaglia seamount total volume is 188 km^3.

Volcanic structure

The volcanic structure is scarcely known, but CROP project seismic profiles (Finetti, 2005; Gaullier *et alii*, 2014) indicate the presence of two N-S-oriented normal faults located to the W and to the E of the seamount.

Chemical composition and age

No information is available on Cornaglia products' chemical composition. Because of the presence of pre-Messinian sediments (i.e. > 7.2 Ma) in the sedimentary succession, this seamount has been dated around 10 Ma (Würtz & Rovere, 2015).

Volcanic products

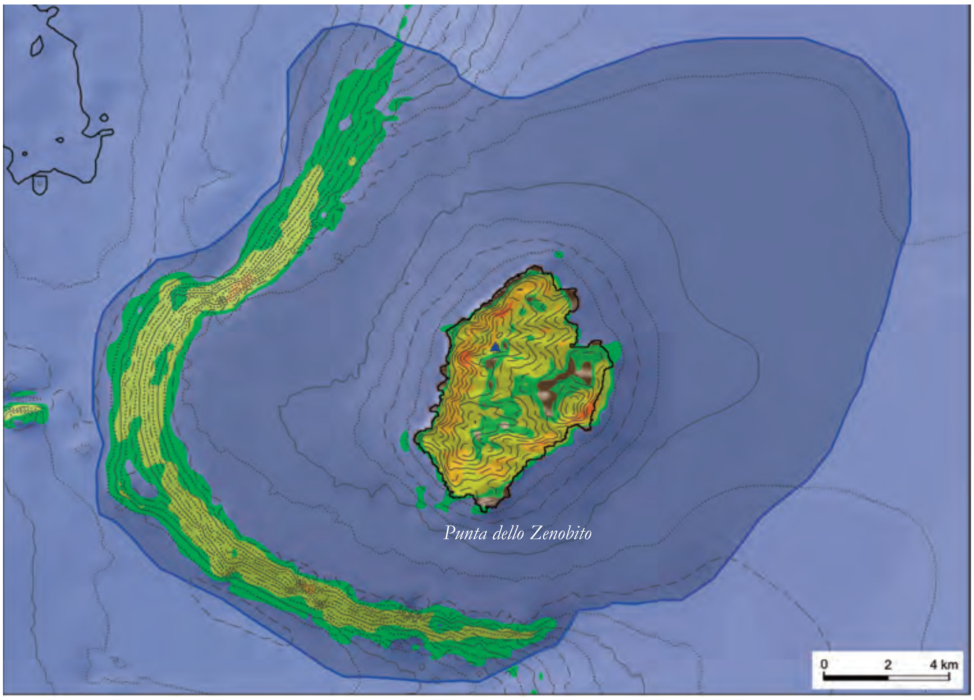
There is no direct information on Cornaglia seamount volcanic products or activity type.

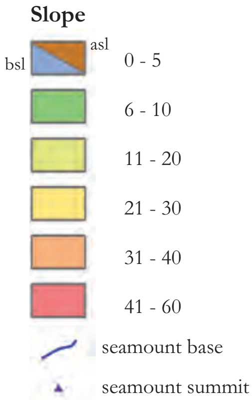
Brief volcanic evolution

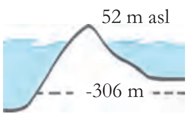
It can be noted from literature, that the Cornaglia smt is associated with a gravity anomaly (De Ritis *et alii*, 2010a). Also, available seismic reflection profiles from the CROP project (Finetti, 2005) show a very thin Plio-Quaternary sedimentary cover and no Messinian sediments on top of the Cornaglia smt (Gaullier *et alii*, 2014). This seamount is closely tied to the Cornaglia Terrace evolution, which lies directly to the S of the seamount: this terrace was the earliest center of extension of the Tyrrhenian Sea about 10 Ma (Würtz & Rovere, 2015).

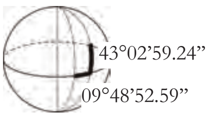
Capraia Island 2.3

Morph. ty.	Stratovolcano
Serie	HK-calc-alkaline
Chem. com.	Andesites dacites, rare rhyolites. Late pulse of trachy-basalts
Act. ty.	Mixed
Act. age r.	7.8 - 2.72 Ma
Vol. [$km^3 \pm 10\%$]	54
Flu. ems.	/









Morphology

Capraia Island is the emergent part of a submarine edifice. The island shows a 7 km-long NNE-SSW elongation, 3.5 km wide. Its extension under sea level has never been fully defined. In our morphological reconstruction, the submerged edifice elongates along the same trend as the island for 29 km (and 22 km of width). The edifice base reaches the maximum depths of -463 m on its western flank, while the eastern sector is shallower (-106 m). The average submerged height is around 306 m.

The main scarps border the southern-western flank, reaching 10°-15° of slope. The remaining flanks are less steep, never exceeding 2°. Slopes along the island coast are steep (25°-30°), as coasts are mainly characterized by high cliffs (300 m).

The total volume of the Capraia Island including its submerged part is 54 $km^{3.}$

Volcanic structure

The entire edifice (above and under sea level) has been interpreted as a stratovolcano. As indicated in Aldighieri *et alii* (2004), the present perimeter of the island represents only a small part of the original volcano, that was partially submerged because of both tectonic activity and sea level variation. Presently, only the volcanic evolution of Capraia Island is well known (e.g. Ferrara & Tonarini, 1985; Aldighieri *et alii*, 2004; Chelazzi *et alii*, 2006), while little is known for the submerged part of the edifice.

Capraia Island is the result of the overlap of two volcanoes: Capraia and Punta dello Zenobito. The Capraia volcano is a large composite apparatus dominated by lava flows and lava domes with a high-K calc-alkaline affinity, while the Zenobito volcano is a small monogenetic apparatus that produced a cinder cone associated to a very small plateau-like lava structure, overlapping the south-westernmost edge of the Capraia volcano (Chelazzi *et alii*, 2006; Conticelli *et alii*, 2010, Peccerillo, 2017).

Chemical composition and age

Capraia Island formed during two separate stages. The first and most voluminous stage produced mainly andesite, dacite and rhyolite calc-alkaline lavas and domes (Aldighieri *et alii*, 2004; Gasparon *et alii*, 2009). Ar-Ar datings of these products range between 7.8 and 7.2 Ma (Gasparon *et alii*, 2009). K-Ar datings indicate older ages of 9.8 Ma (Borsi *et alii*, 1967; Pierattini, 1978).

After a hyatus in the volcanic activity (and a flank collapse), activity resumed erupting trachybasalts with shoshonitic affinity from a monogenetic centre (Punta dello Zenobito) in the southern tip of the island (Ferrara & Tonarini, 1985; Aldighieri *et alii*, 2004). The ages of this younger activity are debated and range depending on the dating method between 4.93 and 2.72 Ma (Conticelli *et alii*, 2010; Peccerillo, 2017 and references therein).

Volcanic products

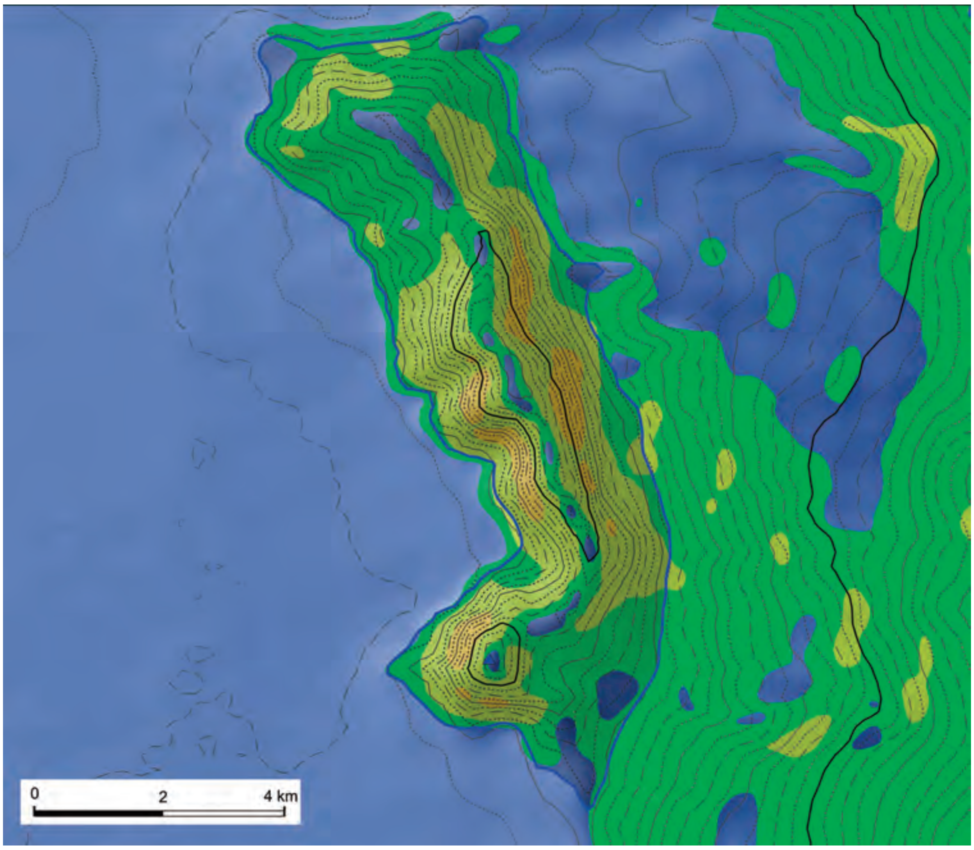
Above the island, volcanic products are mainly shoshonitic/calc-alkaline lavas, andesitic intrusions and block and ash/pyroclastic flow deposits. This testifies the occurrence of both explosive and effusive activity.

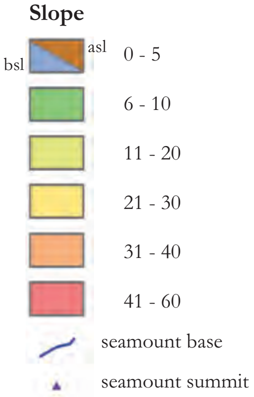
Brief volcanic evolution

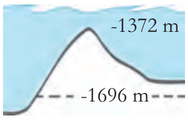
The geological evolution of the island is summarized in Conticelli *et alii* (2010) and in Peccerillo (2017). The oldest volcanic centre that forms the island is a stratovolcano, which produced a 50 m-thick lava flow sequence, with associated scoria and breccia deposits. These lavas are followed by the formation of andesitic domes and associates to block and ash and pyroclastic flows deposits. During the same period of activity, multiple intrusive bodies emplaced along the NNE-SSW structural trend, producing lava flows and breccia deposits Then, a hiatus it followed in the volcanic activity. A sector collapse occurred likely either towards the end or after of this early stage of activity. The restart of the activity is related to the emplacement of a small monogenetic scoria cone at Punta dello Zenobito (southern area of Capraia Island), associated with thin lava flows and with a final intrusion.

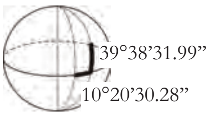
Quirinus Seamount 2.4

Morph. ty.	Fissural edifice
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	/
Vol. [km³±10%]	3
Flu. ems.	/









Morphology

This seamount lies along a N-S trending structure. The edifice is elongated parallel to this regional structure and is 10 km long and 2 km wide. The base lies between -1725m and -1657m averaging at -1696m. The shallowest peak is at a depth of -1372 m, for a mean height of 324 m.

The Quirinus seamount edifice is characterized by the presence of a small cone (1.5 km of diameter) on its southern tip and a NW-SE elongated structure in the remaining northern area. Slopes are steep (16° to 30°) only along the north-western and the south-eastern elongated flanks, and on the western flank of the southern cone. The other areas' slopes rarely exceed 15°.

The estimated total volume is only 3 km^3.

Volcanic structure

According to the available seismic sections from the CROP project (section M-28B; Finetti, 2005), Quirinus does not appear to be a polygenetic volcanic edifice. It is interpreted as a draping lava layer, lying on the top of the submarine elongated structure. The lava source may be located in correspondence of the conical-shaped edifice in the southern part of the seamount area.

Chemical composition and age

No data on the age or chemical composition of Quirinus seamount are available. The association of Quirinus smt with the Corsica-Sardinian Volcanic Seamount Sector is therefore purely tentative, based on its geographic location relative to the Cornaglia and Cornacya smts which are arc-related seamounts.

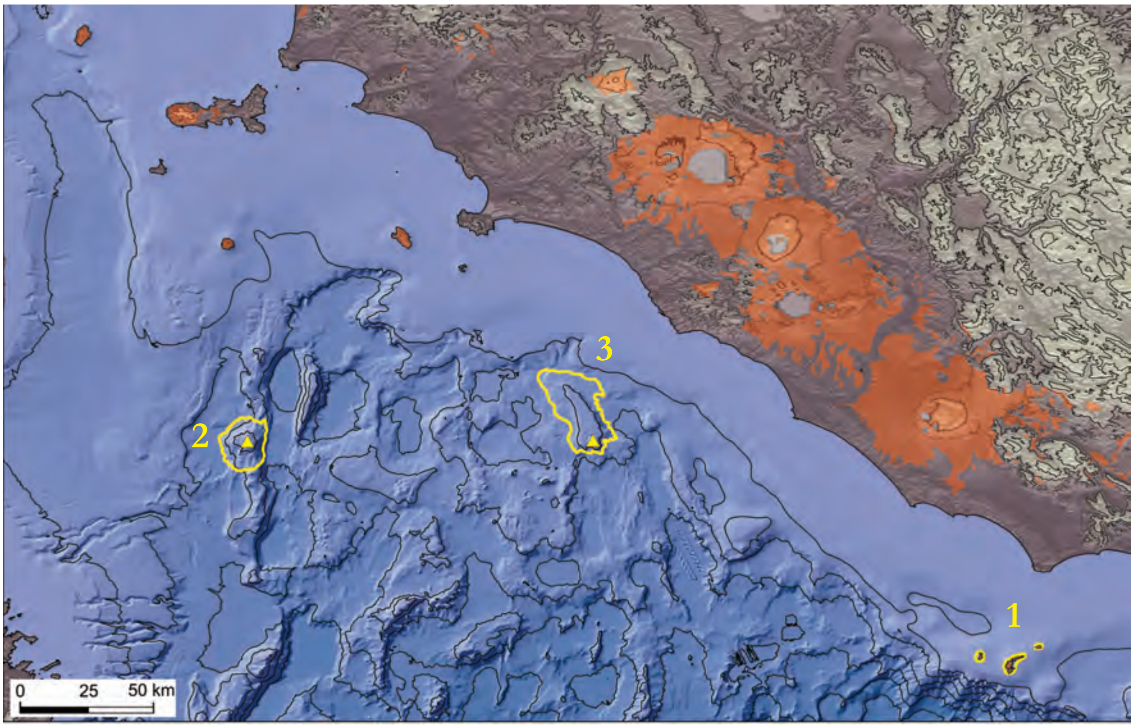
Volcanic products

Volcanic products from this seamount have not yet been sampled or described. No information is available.

Brief volcanic evolution

The origin and emplacement of Quirinus lava flow field are related to the Tyrrhenian basin opening stage, when previous thrust faults partially inverted their direction of displacement

(FINETTI, 2005). Extensional faults, active since the Middle Miocene, produce sharp scarps stage on the Sardinian slope and in the Sardinian basin, where they truncate previous thrust faults. The main feeder-conduits for the Quirinus smt have been inferred as connected with the extensional fault EF-6 shown on the CROP section M-28B (FINETTI, 2005; also indicated as East Sardinian Line). This fault separates a sharply thinned and delaminated eastern crust from a western one, which also stretched, but remained much thicker (FINETTI, 2005).



3. Etruscan Volcanic Seamount Sector

Fig. 7 - Overview of the volcanic seamounts of the Etruscan Volcanic Seamount Sector.
- Panoramica degli edifici vulcanici sommersi del Settore vulcanico sottomarino Etrusco.

The Etruscan Volcanic Seamount Sector lies in the north-central portion of the Tyrrhenian Sea (fig. 7) facing the southern Tuscany-northern Latium shores. The volcanic sector is formed by different lava domes (Ponza, Palmarola and Zannone Islands) and composite edifices (Etruschi smt, Tiberino smt). This area includes also various intrusive islands (Elba, Montecristo, Giglio). Volcanic products are Pliocene-Pleistocene in age and bi-modal in signature, with co-existing crustal-derived, anatectic magmas and high-K calc-alkaline hybrid magmas with intermediate characteristics of crustal-derived and mantle-derived magmas. On-land this magmatism is associated with the Tuscan Magmatic Province and includes the sub-alkaline products of Torre Alfina, Radicofani, Cimini, Tolfa and Ceriti volcanic centres (Avanzinelli *et alii*, 2009).

Taken together, the Corsica-Sardinian magmatism and the Tuscan magmatism (fig. 8) relate to the overlap of collisional and post-collisional back-arc processes, with involvement of partial melting of a heterogeneous sub-continental metasomatized mantle source, and show an age polarity that reflects the migration from west to east of back-arc extension (Avanzinelli *et alii*, 2009; Conticelli *et alii*, 2010; Peccerillo, 2017).

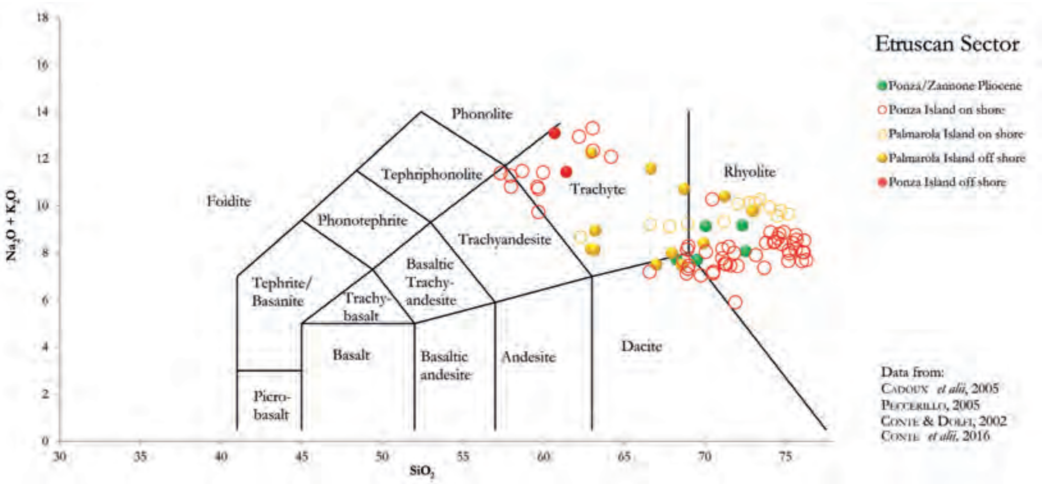
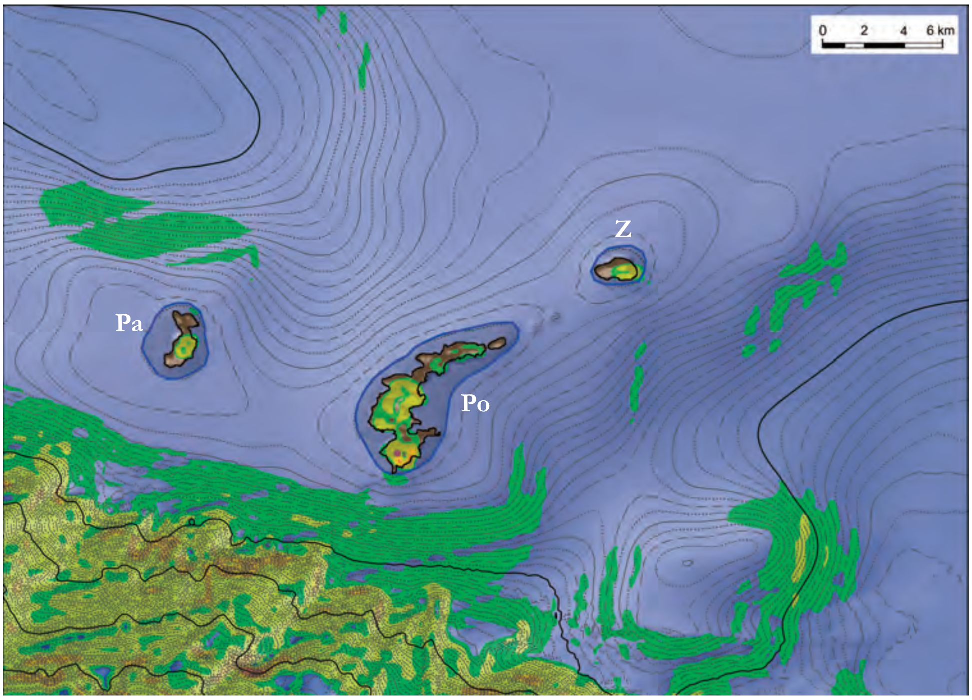
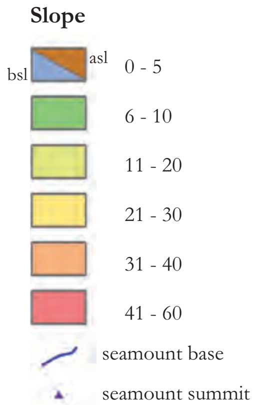


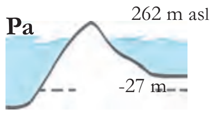
Fig. 8 - TAS diagram of composition of the Etruscan Volcanic Seamount Sector products. Data are plotted raw from cited sources and may include LOI up to >20%. The reader is referred to the original papers for an evaluation of the data and for the nomenclature adopted in this text.
- Diagramma TAS della composizione dei prodotti vulcanici relativi al Settore vulcanico sottomarino Etrusco. I dati sono tracciati dalle fonti citate e possono includere LOI fino a >20%. Si rimanda il lettore agli articoli originali per una valutazione dei dati e per la nomenclatura adottata in questo testo.

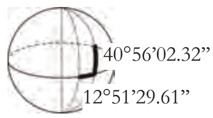
3.1 *Western Pontinian Islands: Ponza, Palmarola and Zannone*

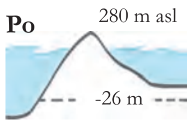


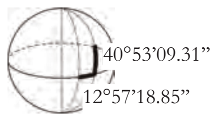
Morph. ty.	Lava dome
Serie	HK-calc-alkaline
Chem. com.	Mainly rhyolites and trachytes
Act. ty.	Mixed (Po), effusive (Pa, Z)
Act. age r.	4.2 - 1 Ma
Vol. [km^3±10%]	0.8 (Po); 0.1 (Pa); 0.1 (Z)
Flu. ems.	Volcanic origin (Z)











Morphology

The Western Pontinian archipelago is composed by three islands: from W to E, Palmarola (Pa), Ponza (Po) and Zannone (Z). The islands are mostly made of volcanic deposits extending underwater for only for 20-30 m, while they mainly develop above sea level with total heights of 289 m (Pa; top height 262 m), 306 m (Po; top height 280 m) and 220 m (Z; top height 194 m).

Palmarola shows a N-S elongation and extends for less than 3.5 km of length and 1 km of width. Ponza is the largest of the three islands, mainly elongating NE-SW, for 8 km of length and a maximum width of 2 km. Zannone, the easternmost island, is the smallest; it does not show a particular elongation and extends for approximately 1 km of radius.

The slope map shows that the three islands develop in the offshore shallow sharp rises, reaching slope values of 20° to 35° (especially in the southern part of Ponza Island). Elsewhere, slopes are gentler, not exceeding 15°.

The sheet F05 of the Progetto Magic (DPC-CNR 2007-2013) shows that the coarse fabric of the bathymetry that can be related to the volcanic products extends down to depths of maximum -100 m, below which the morphology becomes smoother. A break in slope occurs at depths around -200m, connecting the structural high onto which the volcanic islands are built to the surrounding bathyal plains. Three areas with pockmarks characterized by fluid emissions are identified to the west and to the east of Zannone Island, at depths shallower than -150 m. Other degassing areas have been documented also to the north.

Palmarola Island has an indicative volume of 0.1 km^3, while Ponza Island has 0.8 km^3 and Zannone Island 0.1 km^3.

Volcanic structure

The islands of the archipelago lie, as a relatively thin volcanic cover, onto a structural high of the continental shelf, bounded by NE-SW normal faults that separate Ventotene and Palmarola basins (Bellucci *et alii*, 1999; De Rita *et alii*, 2001; Cadoux *et alii*, 2005). The volcanic activity that built those structures were mainly effusive and intrusive, and took place both in a submarine (Ponza, Palmarola, Zannone) and in a subaerial environment (Ponza, Zannone) (De Rita *et alii*, 2001; http://www.isprambiente.gov.it/Media/carg/413_BORGO_GRAPPA/Foglio.html). The overall volcanic structure is a monogenetic field, made mostly of individual lava domes partly coalesced.

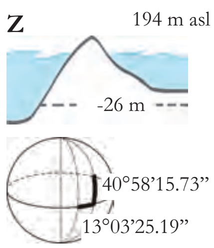
Chemical composition and age

The chemical compositions of the Pontinian Islands rocks belong to three series having HK calc-alkaline, transitional and shoshonitic affinities. The differentiation of parental melts ultimately led to different evolved products, mainly rhyolites and trachytes (Conte *et alii*, 2016).

The volcanic activity developed in two cycles: the first cycle occurred during the Pliocene with the emplacement of subalkaline rhyolites, which constitute the dominant products in Ponza and Zannone Islands. Ar-Ar age determinations suggest ages between 4.2-3.7 Ma and 3.2-3.0 Ma (Cadoux *et alii*, 2005; Conte *et alii*, 2016), although Palmarola Island has been described to rest on Gelasian marine clays suggesting a much younger age around 2.5 Ma (De Rita *et alii*, 2001), which is now referred to the basal part of the Lower Pleistocene. The second cycle developed during the upper part of the Lower Pleistocene with the emplacement of more alkaline products (trachytes) in the southeastern part of Ponza (around 1 Ma; Cadoux *et alii*, 2005; Conte *et alii*, 2016).

Volcanic products

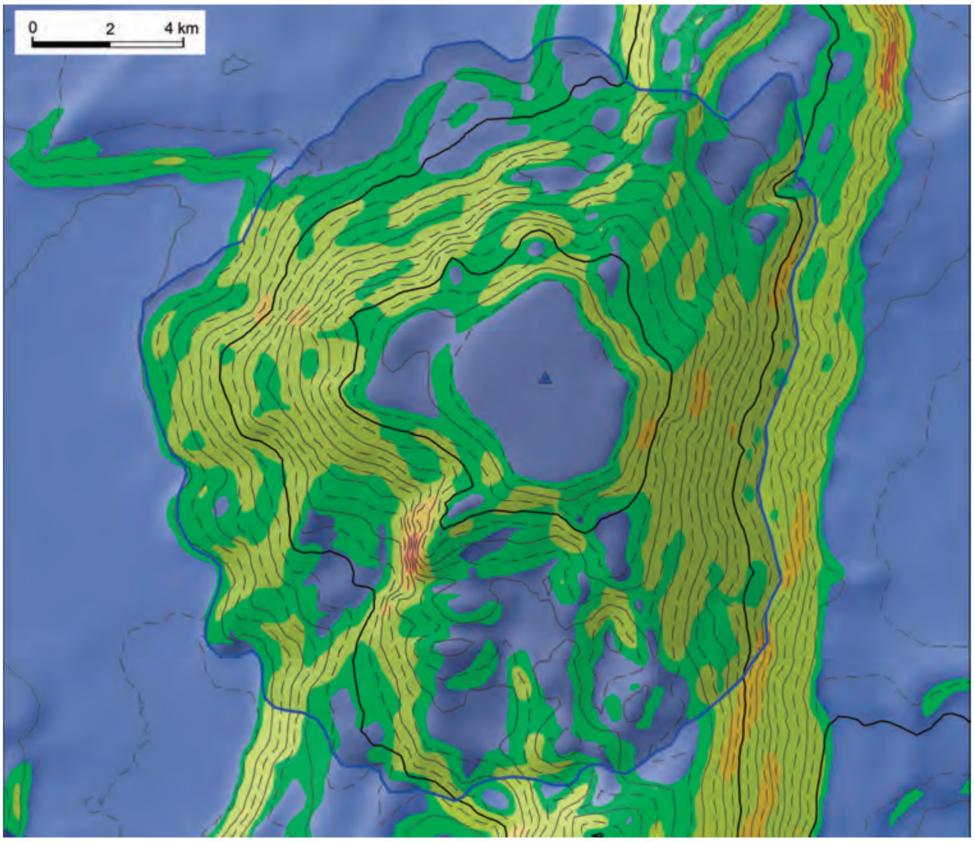
Submarine effusive activity is responsible for the emplacement of rhyolite lava domes and flows, dykes and hyaloclastites in Ponza and Palmarola (De Rita *et alii*, 2001; Scutter *et alii*, 1998). Rhyolite dykes are wavy and show obsidianaceous margins as a consequence of their emplacement in soft and water saturated hyaloclastite, therefore demonstrating a synchronous origin with the embedding rhyolite hyaloclastite (De Rita *et alii*, 2001), ruling out the huge time span supposedly separating the formation of the hyaloclastite and the domes, as un-accurately indicated by available absolute ages (Cadoux *et alii*, 2005). Zannone is similarly characterized by rhyolite domes and lava flows emplaced both in submarine and in subaerial environment. Ponza Island shows the transition to subaerial environment and a change to explosive activity with the emplacement of stratified lapilli tuffs. After a prolonged hiatus and the complete emersion the islands, the final products are massive trachyte lavas forming the Monte Guardia dome and associated feeder dyke in the southern part of the Ponza Island (Conte *et alii*, 2016).



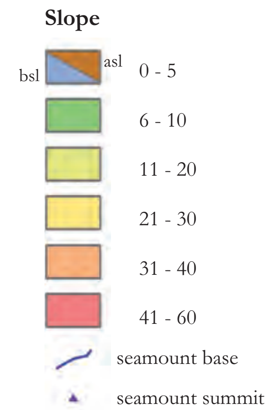
Brief volcanic evolution

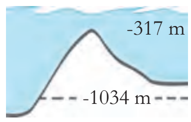
The Pontinian Islands represent the southernmost outcrops of the Tuscan Magmatic Province (Conticelli *et alii*, 2010). Similarly to the onshore dome complexes of Tolfa and Ceriti Mts, they represent a cluster of solitary rhyolitic domes largely emplaced in a shallow submarine environment, and built on a structural high of the continental shelf made up of sedimentary and metamorphic units. The age of the Pontinian rhyolites is around 2.5 Ma (defined by ages of the underlying sediments, which we prefer to older absolute ages proposed in literature) and is also similar to those of the Tolfa and Ceriti rhyolite dome complexes, indicating that a potassic-calc-alkaline magmatic event affected the Latium Tyrrhenian margin at that time. At ca. 1 Ma the volcanic activity resumed with a change to alkali character (K-trachytes of the Monte Guardia dome; Conte *et alii*, 2016). These chemical compositions are transitional to the K- and HK-series of the Roman Magmatic Province (Avanzinelli *et alii*, 2009) and also have an on-shore analogue in the Cimini dome complex (Conticelli *et alii*, 2013).

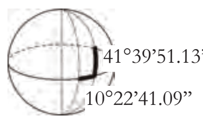
3.2 *Etruschi Seamount*



Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	/
Act. age r.	/
Vol. [km^3±10%]	53
Flu. ems.	/







Morphology

The shape of the Etruschi seamount is rather conical, although its slopes become rectified to a broad N-S direction along the eastern flank, where the edifice overlies the edge of a N-trending ridge of the basement. The edifice has 15 to 20 km of maximum diameters and shows a rather constant slope of 6° to 20° along all its flanks. Etruschi smt presents a flat top at -317 m of depth, which extends for roughly 4 km of diameter. The base has a maximum depth of -1347 m, a minimum depth of -669 m, averaging at -1034 m. The average total height of the edifice is 717 m.

The estimated volume for this seamount is 53 km^3.

Volcanic structure

There is no detailed information on this seamount, but MOELLER *et alii* (2013) based on the interpretation of a seismic profile, suggest the presence of two buried normal faults, defining a NNE-trending horst onto which the edifice is built. One of the inferred faults is located along and at the base of the eastern flank, with a 50° E dip; the other one is located along and at the base of the western flank, with a 40° W dip.

Based on morphology, the Etruschi smt appears as a stratovolcano/composite edifice.

Chemical composition and age

According to KELLER (1981), the Etruschi smt shows basaltic fragments, hawaiitic in composition and 0.1 Ma old, relative to sample RC9-195. This information is then taken in almost all later publications (e.g. PECCERILLO, 2005, 2017). However, the geographic coordinates of sample RC9-195 do not correspond to the location of Etruschi smt, but plot on the Columbus smt some 120 km to the SE of Etruschi smt. There are two possible options to be considered: one is that the geographic coordinates of sample RC9-195 are wrong and then Etruschi smt is really made of hawaiitic lavas; the alternative is that they are correct and then this composition applies to Columbus smt. We therefore believe that the coordinates of sample RC9-195 are correct and refer to Columbus smt. Therefore, though with no composition and age available, we place the Etruschi smt within the Etruscan Volcanic Seamount Sector, based on its geographic position.

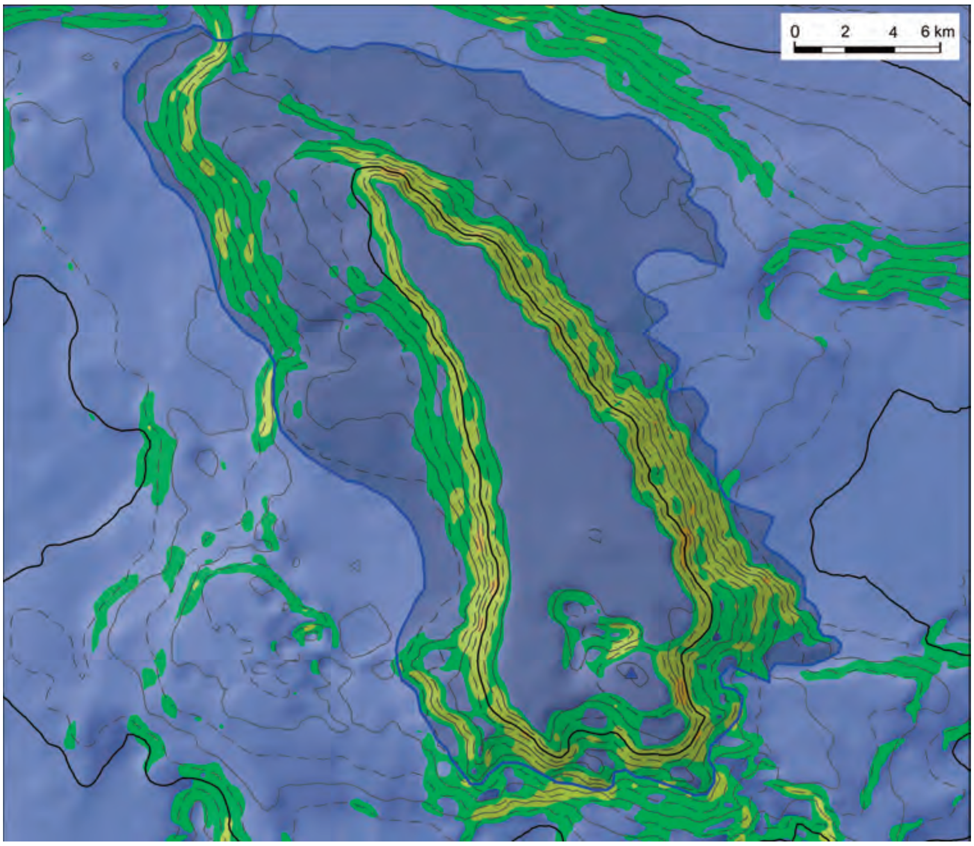
Volcanic products

Currently, no information on volcanic products is available.

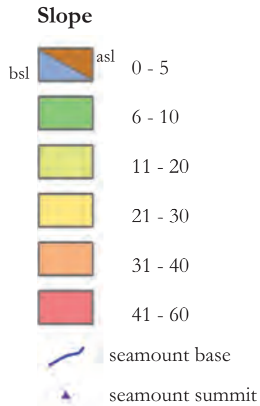
Brief volcanic evolution

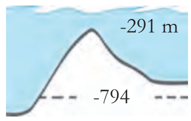
Currently, no detailed information on the volcanic evolution of this seamount is available. Yet, according to Moeller *et alii* (2013), this northern Tyrrhenian area evolved homogeneously by stretching and by a block rotation of the brittle upper crust, with a ductile deformation of the lower crust. This may have led to the formation of a half-graben structure with normal faults and a homogeneous crustal thinning (Moeller *et alii*, 2013), that may have favoured the rising of magma in the area.

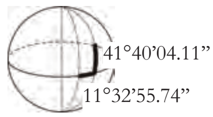
3.3 *Tiberino Seamount*



Morph. ty.	Fissural edifice
Serie	/
Chem. com.	/
Act. ty.	/
Act. age r.	/
Vol. [km^3±10%]	69
Flu. ems.	/







Morphology

This seamount shows a clear NW-SE elongation: it is roughly 35 km-long and 12 km-wide. Given the lack of detailed information on this edifice, this seamount has been included doubtfully in the volcanic seamount collection. The base reaches a maximum depth of -994 m and a minimum of -651 m, averaging at -794 m. It has an average height of 503 m and has a nearly flat, elongated, triangular top at -400/-300 m depth, with the shallowest area located in the southern part of the seamount at -291 m. The slope variation shows almost constant values ranging between 6° and 20°, locally reaching 21°-25°. The highest values are localized around the southern and south-eastern flanks.

The volume of this edifice is about 69 km^3.

Volcanic structure

There is no available information on the volcanic structure of this seamount.

Chemical composition and age

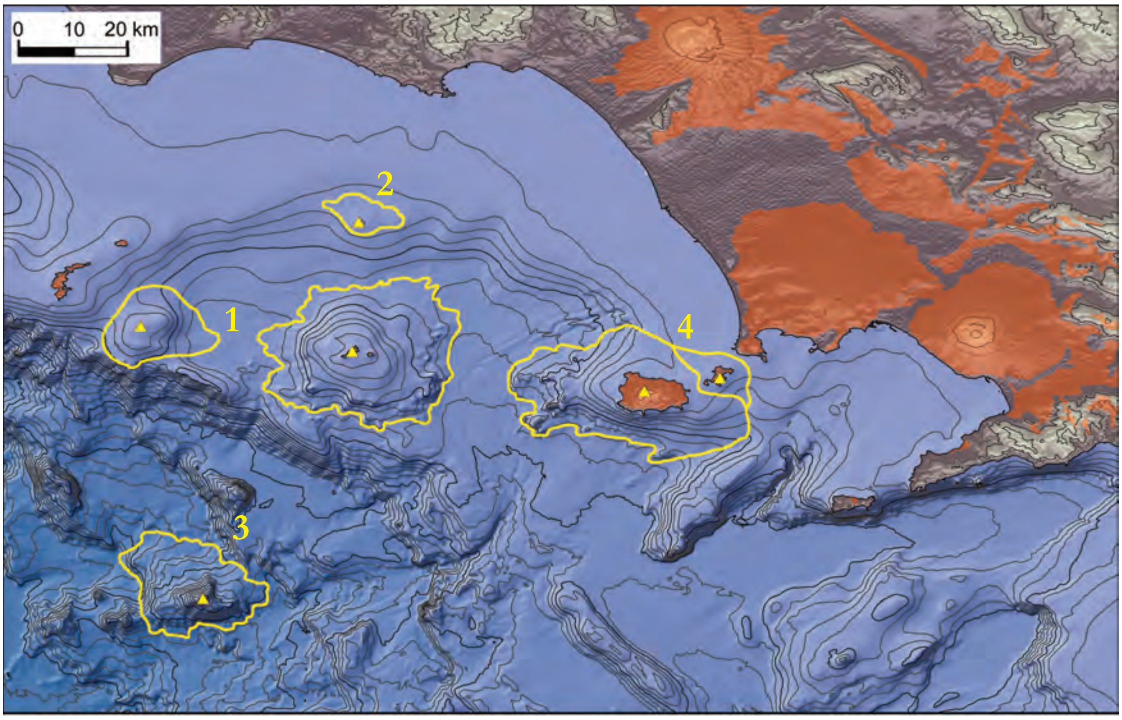
No information on the rock composition of this seamount is available. The association of Tiberino smt with the Etruscan Volcanic Seamount Sector is therefore purely tentative, based on its geographic location.

Volcanic products

No information on Tiberino volcanic products could be retrieved from literature.

Brief volcanic evolution

Through the analysis of the aeromagnetic field analytic signal, the boundaries of magnetic shallow sources indicated Tiberino seamount as a "fragment" of crystalline continental crust that locally presents magmatic effusions (CELLA *et alii*, 1998).



4. Neapolitan Volcanic Seamount Sector

Fig. 9 - Overview of the volcanic seamounts of the Neapolitan Volcanic Seamount Sector.
- Panoramica degli edifici vulcanici sommersi del Settore vulcanico Napoletano.

The Neapolitan Volcanic Seamount Sector encloses the central area of the Tyrrhenian Sea directly in front of southern Latium and Campanian coasts (fig. 9). This sector is composed by composite edifices and stratovolcanoes (Ventotene Island and Scoglio la Botte, Ventotene Ridge, Albatros/Cicerone smt, Ischia and Procida Islands). The area also includes a submarine hydrothermal field in the shallow offshore of Napoli, named Banco della Montagna (PASSARO *et alii*, 2016).

A volcanic edifice buried by the Volturno delta sediments has also been identified by geophysical surveys (DE ALTERIIS *et alii*, 2006).

The volcanic activity of this area is Pleistocene-Holocene in age (from ≃ 2 Ma to present day) and is connected with the opening of the Tyrrhenian

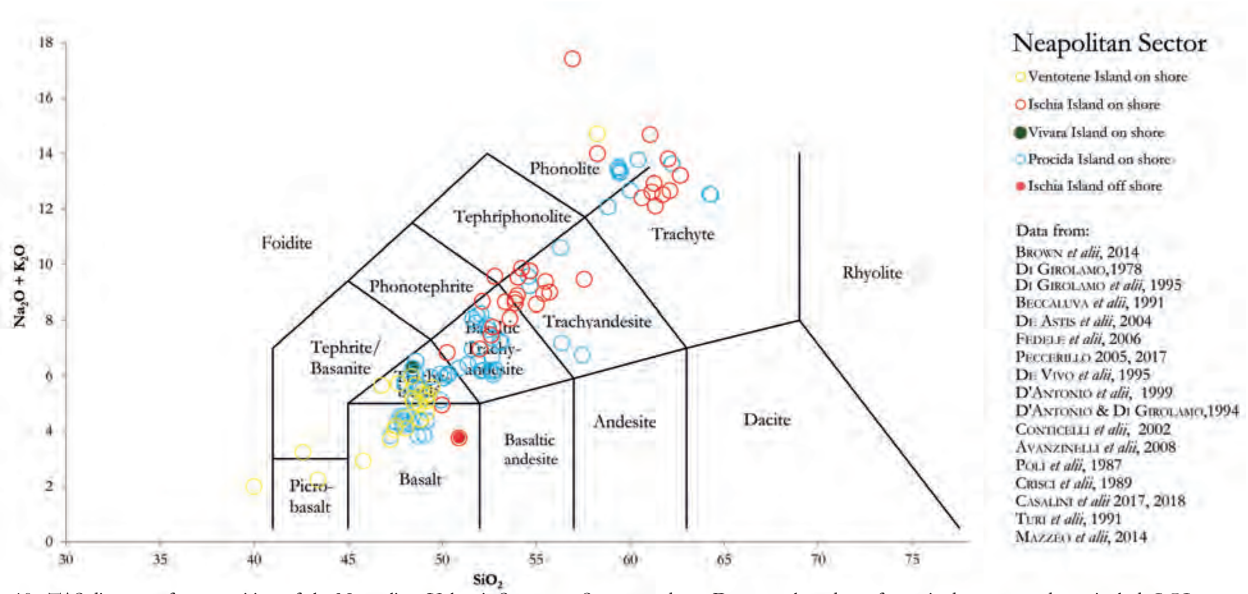
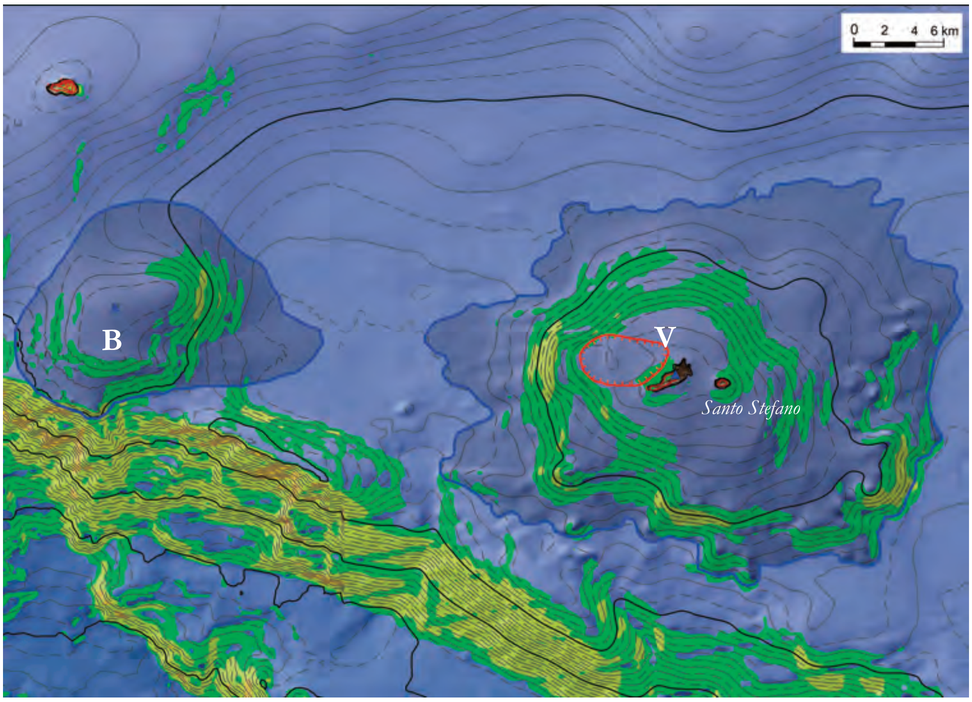


Fig. 10 - TAS diagram of composition of the Neapolitan Volcanic Seamount Sector products. Data are plotted raw from cited sources and may include LOI up to >20%. The reader is referred to the original papers for an evaluation of the data and for the nomenclature adopted in this text.
- Diagramma TAS della composizione dei prodotti vulcanici relativi al Settore vulcanico sottomarino Napoletano. I dati sono tracciati dalle fonti citate e possono includere LOI fino a >20%. Si rimanda il lettore agli articoli originali per una valutazione dei dati e per la nomenclatura adottata in questo testo.

basin (CONTICELLI *et alii*, 2010; PECCERILLO, 2017). The lithospheric extension contributed to the uprise of differentiated magmas from a metasomatized mantle source, with important role of recycled sediments (AVANZINELLI *et alii*, 2009). The magmas erupted in the Neapolitan Volcanic Seamount Sector (fig. 10) show high potassium contents. The most evolved compositions are mainly phonolitic and trachytic (i.e. Ischia and Procida Islands). Mafic trachybasalts magmas are also present (i.e. Ventotene and Santo Stefano Islands). The eastern portion of the sector is active (Ischia Island) and characterized by areas of strong hydrothermal gas discharge (Banco della Montagna). On-land this magmatism is associated with the Roman Magmatic Province and includes potassic and ultrapotassic products of Vulsini, Vico, Sabatini, Colli Albani, Ernici, Roccamonfina volcanic centres in the Latium region and with Campi Flegrei and Vesuvius in the Neapolitan region (CONTICELLI *et alii*, 2010).

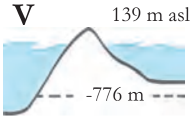
Ventotene Island and La Botte Seamount 4.1

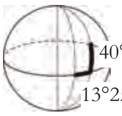
Morph. ty.	Stratovolcano
Serie	K-alkaline
Chem. com.	Basic to intermediate alkali-potassic (V) shoshonite to phonolite (B)
Act. ty.	Explosive
Act. age r.	0.81 - <0.13 Ma
Vol. [km^3±10%]	145 (V) 20 (B)
Flu. ems.	/

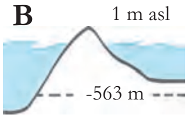


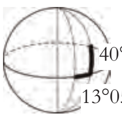
Slope

bsl asl 0 - 5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 60
seamount base
seamount summit
inferred caldera rim









Morphology

Ventotene Island (V) and La Botte Seamount (B) are part of the eastern Pontinian archipelago, and are located in a sedimentary basin on the continental shelf (Cadoux *et alii*, 2005).

Ventotene Island is about 2.8 km long and between 250 and 800 m wide, NE-SW-oriented. Its maximum height reaches 139 m asl. Santo Stefano is a smaller islet, less than a km (~600 m) in diameter. The islands only represent the emerged part of a much larger, rather conical volcanic edifice. The base extends for 25 km in diameter, has a maximum depth of -880 m, a minimum depth of -622 m, averaging at -776 m that make the total height of the edifice 915 m. The slopes of the edifice range between 6° and 15°. Sporadically (along the western, southern and south-eastern flanks) slopes reach 21° to 30°.

The sheet F06 of the Progetto Magic (DPC-CNR 2007-2013) shows a more detailed bathymetry and proposes the presence of various parasitic cones mostly along the northern and eastern slopes of the main edifice, at depths comprised between -400 and -500 m. At similar depths, fields of pockmarks are instead present mainly along the western slopes.

The total volume of Ventotene edifice is about 145 km^3.

To the West, a small volcanic body located approximately 12 km SE from Ponza Island named La Botte Stack represents the neck of an eroded volcanic vent and is the emergent part of a larger submerged volcanic edifice (Conte *et alii*, 2016). The base of this edifice is on average at -563 m, which is also its height, for a volume of 20 km^3.

Volcanic structure

Bathymetric data indicate that Ventotene is cut by a 2 km-wide, circular summit caldera located to the west of the main island, which reaches more than -150 m at its floor (De Vivo *et alii*, 1995; Perrotta *et alii*, 1996), formed during the last eruptive ignimbritic event (Perrotta *et alii*, 1996), occurred at ca. 330 ka (Bellucci *et alii*, 1999).

Chemical composition and age

Ventotene Island is dominated by basic to intermediate alkali-potassic subaerial deposits (Cadoux *et alii*, 2005). The most recent K-Ar age determinations indicate an age range between 0.81 and <0.13 Ma for the effusive and explosive products (Metrich *et alii*, 1988; Bellucci *et alii*, 1999). Composition of the La Botte stack range from shoshonite to phonolite (Conte *et alii*, 2016).

All volcanic rocks cropping out in Ventotene, S.Stefano and La Botte correlate both in age and composition with the potassic association of the Roman Magmatic Province (De Vivo *et alii*, 1995; Perrotta *et alii*, 1996; Bellucci *et alii*, 1999; Conticelli *et alii*, 2010).

Volcanic products

The stratigraphy of Ventotene and S. Stefano indicate the presence of a basal complex of lavas and associated scoria cones, followed by fall and surge deposits and interbedded palaeosoils and by an ignimbrite (De Vivo *et alii*, 1995). Based on the available stratigraphy, the subaerial activity had been mostly explosive (Perrotta *et alii*, 1996; Bellucci *et alii*, 1999).

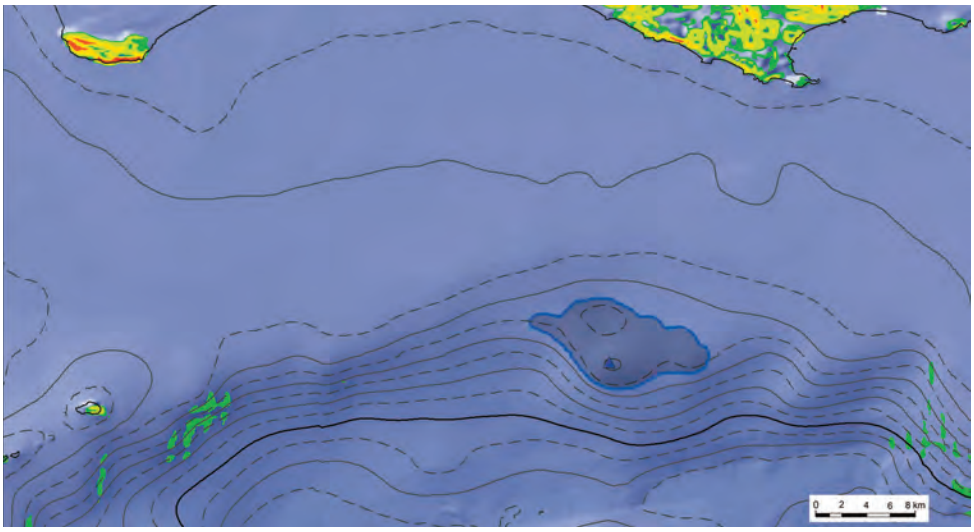
Zones of degassing have been detected around La Botte edifice (DPC-CNR 2007-2013).

Brief volcanic evolution

The subaerial stratigraphic sequence and the submerged volcanic morphology support the idea that Ventotene Island is a relict stratovolcano which had undergone a period of caldera-forming eruptions following the deposition of the Parata Grande ignimbrite. The caldera-forming processes probably started with a sector collapse (De Vivo *et alii*, 1995).

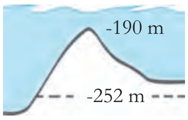
Ventotene Ridge 4.2

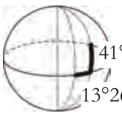
Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	Explosive (?)
Act. age r.	> 0.19 - 0.13 Ma
Vol. [km^3±10%]	0.11
Flu. ems.	Present



Slope

bsl asl 0 - 5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 60
seamount base
seamount summit





Morphology

The Ventotene ridge is an 11-km-long, NW-SE elongated structure located off Gaeta bay, 20 km to the north of Ventotene Island. The base of the Ventotene Ridge reaches depths ranging between -225 m and -279 m, averaging at -252 m. Its highest point is located at -190 m for an average height of 62 m. Cuffaro *et alii* (2016) described it as composed by four morphological highs separated by deep channels. The EMODnet bathymetry shows the presence of a fifth cone to the north, which makes the group of cones appearing more like a cluster, rather than a ridge.

The flanks have high slope gradients on average (12-20°), decreasing to a few degrees at the base of the cones. The summit of the two main edifices, as evidenced by the high resolution bathymetry in Cuffaro *et alii* (2016), is flat and sub-circular or slightly elongated. The westernmost edifice was named A by Cuffaro *et alii* (2016) who reported the following characteristics: it has a subconical shape, with a basal diameter of 3.5 km and a flat top with a diameter of 1.5 km, and a summit at 171 m depth. The highest edifice was named B in Cuffaro *et alii* (2016) and described as follows: it is elongated 6.3 km in a NW-SE direction and is 4 km wide. Its summit is flat and lies at -165 m depth. It also has a sub-conical shape, with a quasi-bilateral symmetry with respect to a NW-SE axis. Two minor edifices are located on the eastern sector, bounded to the SE by a steep escarpment. Several pockmarks are present along the NE-SW escarpment, including a wide depression.

The estimated volume is ca. 0.11 km^3.

Volcanic structure

The Ventotene Volcanic Ridge represents an independent volcanic system; its sub-conical truncated shape with steep slopes is typical of volcanic edifices located in shallow-intermediate water depths. The flat morphologies were probably caused by surficial erosion during Quaternary glacial sea level lowstands; if that is true they should testify a significant post-glacial subsidence of the area as the lowest known level of the sea during glaciations was at -120 m. According to (Cuffaro *et alii*, 2016) all the separated cones are not monogenetic, but originated through multiple eruption episodes that produced composite edifices.

Chemical composition and age

Petrological and geochemical data from Ventotene ridge rock samples are not available.

Seismic stratigraphy together with magnetic data suggest that the volcanic activity in this area is older than 190-135 ka and may be coeval with that of Ventotene Island (Cuffaro *et alii*, 2016).

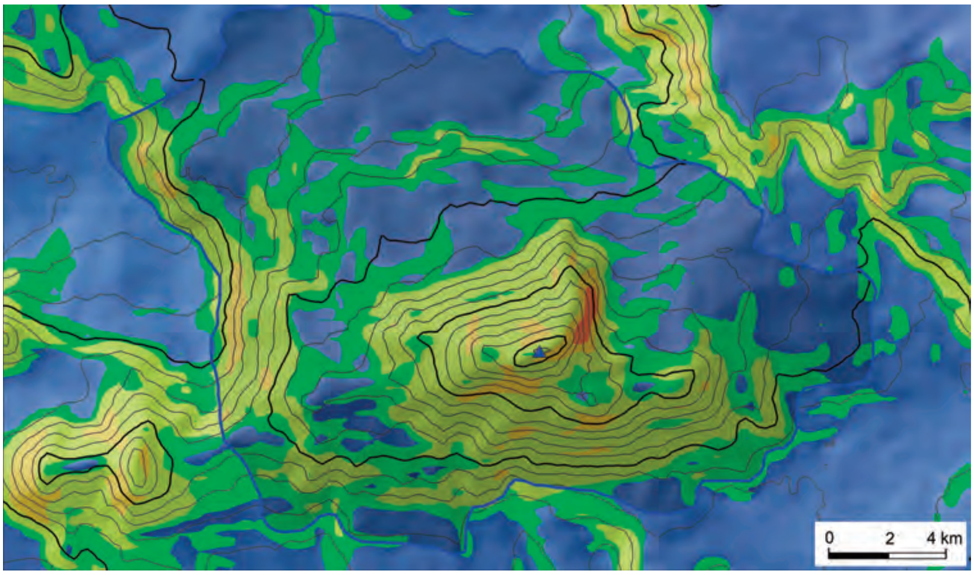
Volcanic products

The shallow depth of the ridge may have allowed explosive activity, although no direct information is available on the deposits.

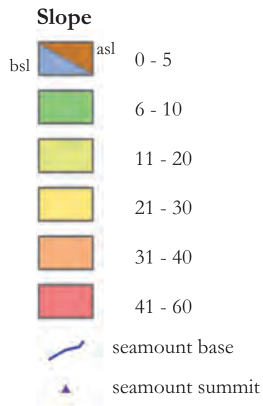
Brief volcanic evolution

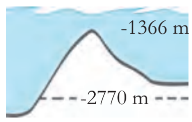
The Ventotene ridge lies in between a major NE-SW trending escarpment east of Ponza and a NE-SW trending graben southwest of the Roccamonfina volcano. This area could be a NE-SW transfer zone that accommodates the extension along this segmented portion of the margin (Cuffaro *et alii*, 2016) suggesting that the location of eruptive centers is structurally controlled.

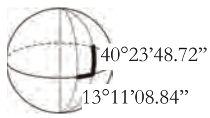
4.3 *Albatros/Cicerone Seamount*



Morph. ty.	Composite edifice
Serie	K-alkaline ?
Chem. com.	Potassic rocks
Act. ty.	Effusive
Act. age r.	/
Vol. [km^3±10%]	71
Flu. ems.	/







Morphology

The Albatros seamount was first reported by Bigi *et alii* (1990), but it has also been indicated as Cicerone Seamount in Finetti & Del Ben (1986).

The Albatros/Cicerone smt shows a triangular shape and has a maximum length and width of roughly 21 km x 17 km. Its top lies at -1366 m. The base lies between -3292 m and -2306 m, averaging at -2770 m. The average height of the edifice is 1404 m. The most elevated area of this seamount shows a horseshoe-like shape, with steepest flanks (11° to 40° of slope, especially along the southern flank) with respect to the rest of the structure where slopes rarely exceed 20°.

The estimated volume for this structure is 71 km^3.

Volcanic structure

There is no available information on the volcanic structure of this edifice. The Albatros seamount was recognized as a positive magnetic anomaly in Cella *et alii* (1998) and is now interpreted to be composed of Island Arc-type basalts, like those sampled at Ocean Drilling Program Site 651 (Trua *et alii*, 2004a,b).

Chemical composition and age

The presence of potassic rocks has been suggested (Trua & Marani, 2007), but no sample has been collected from the area. Therefore, the association of Albatros/Cicerone smt with the Neapolitan Volcanic Seamount Sector is tentative, based on its geographic location and possible magma composition.

Volcanic products

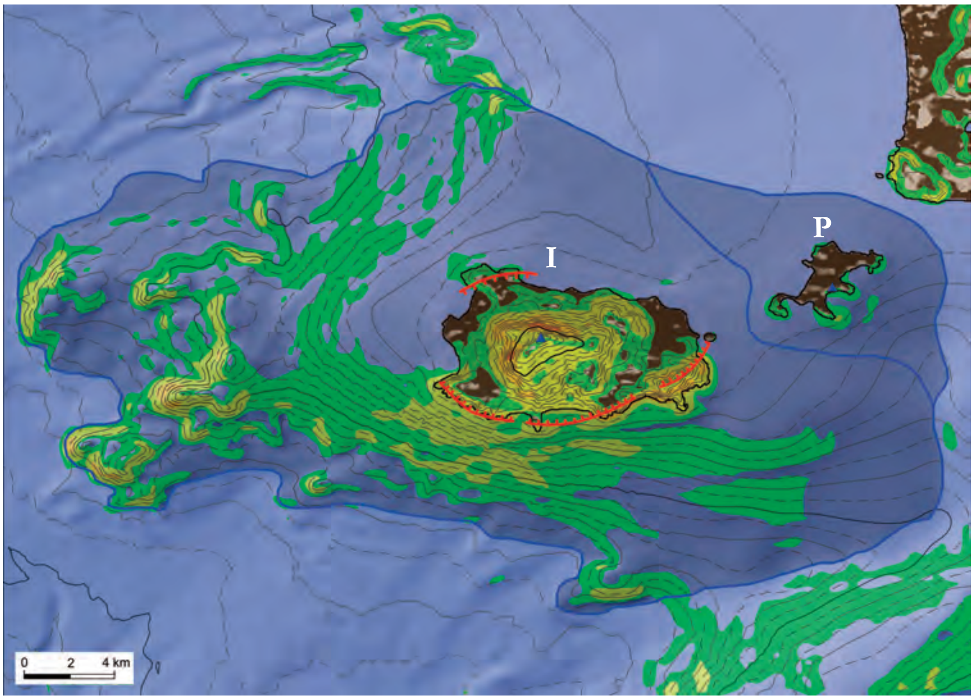
There is no information on Albatros seamount's volcanic products.

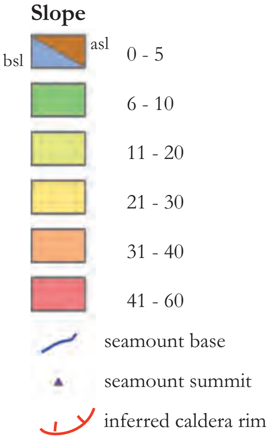
Brief volcanic evolution

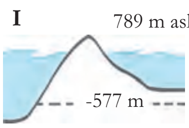
No data on the possible volcanic evolution of this edifice are available.

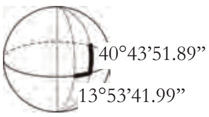
Ischia and Procida Islands 4.4

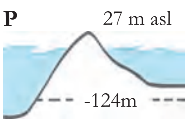
Morph. ty.	Stratovolcano
Serie	K-alkaline
Chem. com.	Trachy-phonolitic, trachytic, alkalitrachytic and latitic composition (I); Shoshonitic basalts and latites to trachytes and phonolites (P)
Act. ty.	Mixed
Act. age r.	0.15 Ma - 1302 AD (I) 0.07 - 0.014 Ma (P);
Vol. [km^3±10%]	125 (I); 4 (P)
Flu. ems.	/

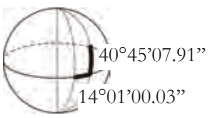












Morphology

Ischia (I) and Procida (P) Islands are located to the SW of Campi Flegrei volcano. Ischia is the main island and shows a nearly rectangular shape E-W oriented, 8 km x 7 km, while Procida has a highly irregular shape and its NE-SW length is about 4.5 km, with a width of roughly 2 km.

Ischia reaches its maximum height of 789 m asl at Mt Epomeo, which is an intracaldera, resurgent dome active since <30 ka ago (De Vita *et alii*, 2010). Procida is flat and reaches a maximum height of 27 m asl. By including the subaqueous extension, Ischia is 1366 m in average height, while Procida is only 151 m. Just 1 km to the ESE of Ischia, a shallow flat, 3 km x 3 km is named Banco di Ischia. The morphology of the submerged part of Ischia and Procida Islands is controlled by their location across the edge of the continental shelf. Slopes reach high values (20 to 35°) only around Ischia especially to the south, while the rest of the area shows inclinations of 6 to 20°.

The upper catchment of a prominent canyon is visible to the south of Procida, while the steep southern flank of the Ischia edifice is rather rectilinear and shows a prominent box-shaped scar. Sheet F07 of the Progetto Magic (DPC-CNR, 2007-2013) indicates a series of domains that are characterized by scattered blocks, interpreted by various authors as evidence of being the deposits of large volume landslides and sector collapses of both the subaerial and subaqueous portion of the edifice (De Alteriis *et alii*, 2010 and references therein). The largest of these domains extends for several kilometers to the south in the bathyal plain to depths of more than -1000 m.

Volumes are about 125 km^3 for Ischia, and 4 km^3 for Procida Island.

Volcanic structure

Procida and Ischia Islands are stratovolcanoes, both showing a complex central structure. Ischia is dominated by the 8 km x 7 km central caldera, presently largely occupied by the Epomeo Mt resurgent dome, and is site of intense post-caldera activity scattered around Mt Epomeo (De Vita *et alii*, 2010).

In the offshore of the island several centres can be recognized especially to the west, where their coalescence defines a W-trending ridge. To the ESE of Ischia, a prominent flat and rather circular shallow rise is named Banco di Ischia and is related to the erosion of a volcanic centre likely during the last low stand of the sea level. The morphology of the much smaller Procida Island also suggests the presence of 8 different eruptive craters, three of which located offshore, between the islands, at the intersection of different regional normal faults (De Astis *et alii*, 2004).

Many of the off-shore centres identified to the west of Ischia and between Procida and Ischia have been documented by submarine seismic reflection data (Aiello *et alii*, 2012). These centers appear to be generally located along faults or intersection of faults, mainly E-W, NE-SW and NW-SE oriented.

Chemical composition and age

Volcanic rocks from Ischia Island range from trachy-phonolitic, alkalitrachytic to shoshonitic in composition (DE VITA *et alii*, 2010; BROWN *et alii*, 2014); Procida Island products are mainly shoshonitic basalts and latites to trachytes and phonolites (ROSI *et alii*, 1988a,b; DE ASTIS *et alii*, 2004).

Procida volcanic activity developed between about 70 and 14 ka BP (DE ASTIS *et alii*, 2004). Ischia, based on subaerial products, has experienced volcanic activity since 150 ka BP and until 1302 AD (DE VITA *et alii*, 2010 and references therein).

Volcanic products

In Ischia Island, a large variety of volcanic products can be found: from lava flows, to lava domes and pyroclastic rocks, pumice fall deposits, block-and-ash flow deposits and ignimbrites (BROWN *et alii*, 2014).

Procida Island is characterized by pyroclastic deposits, pumice falls and ash-flow tuffs and a lava dome (DE ASTIS *et alii*, 2004). The subaerial part of Ischia Island and its shallow underwater continuation have been characterized by repeated large mass movements, producing sector collapses and debris avalanches, some of which catastrophic along the steeper southern slope (AIELLO *et alii*, 2012), likely related to volcano-tectonism in the resurgent caldera (DE VITA *et alii*, 2006).

The survey of the shallow submerged platform of Ischia (http://www.isprambiente.gov.it/Media/carg/464_ISOLA_DISCHIA/Foglio.html) and Procida (Servizio Geologico d'Italia, 2016).

Brief volcanic evolution

Ischia Island is an active resurgent caldera. The main volcanic event at Ischia is the caldera-forming eruption of the Tufo Verde dell'Epomeo ignimbrite at 55 ka BP, likely made of at least two main eruptive events (BROWN *et alii*, 2014). The post-caldera activity is discontinuous with alternation of pulses and quiescences of volcanic activity and caldera resurgence. The last main period of volcanic activity began at 10 ka BP and had a climax between 3ka BP and 1302 AD, when 36 eruptions occurred, both effusive and explosive (DE VITA *et alii*, 2010). This makes Ischia one of the most active volcanoes in Italy, presently quiescent but characterized by high volcanic hazard. The resurgence of Mt Epomeo is the main cause of flanks gravity instability and catastrophic events (huge submarine landslides) in the island's history (DE ALTERIIS *et alii*, 2010; BROWN *et alii*, 2014). Detailed accounts of Ischia Island's volcanic evolution can be found in DE VITA *et alii* (2010), SBRANA & TOCCACELI (2011) and in BROWN *et alii* (2014), which contain information from all the scientific literature concerning the island's volcanic activity.

A detailed stratigraphic study of Procida Island is available in ROSI *et alii* (1988b), together with new insights on its relation with the Campi Flegrei caldera evolution (DE ASTIS *et alii*, 2004).

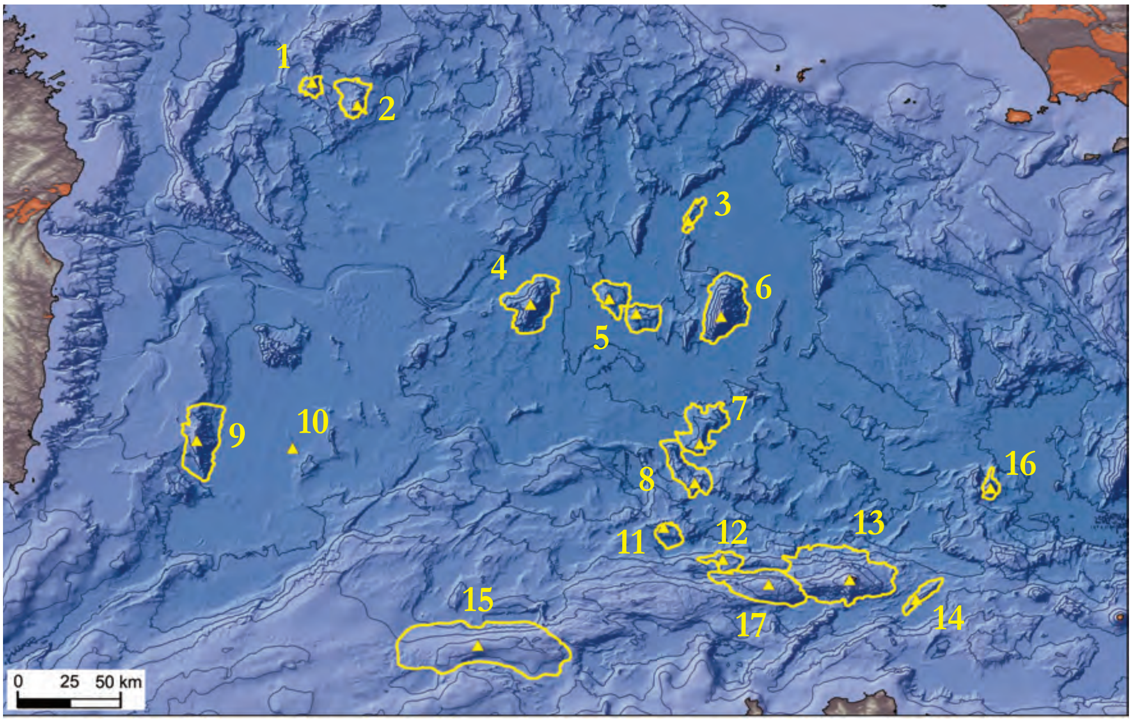


Fig. 11 - Overview of the volcanic seamounts of the Central Tyrrhenian Volcanic Seamount Sector.
- Panoramica degli edifici vulcanici sommersi del Settore vulcanico sottomarino del Tirreno Centrale.

The Central Tyrrhenian Volcanic Seamount Sector comprises numerous volcanoes that lie below the 41st parallel (fig. 11), indicated in many papers as a major lithospheric lineament. Different volcanic morphologies are present: fissural edifices and composite edifices (Marco Polo smt, Columbus smt, Gortani smt, Magnaghi/Vittorio Emanuele smt, D'Ancona smts, Vavilov smt, Virgilio smt, Augusto smt, Quirra smt, Livia smt, Creusa smt, Prometeo smt, Aceste/Tiberio smt, Garibaldi/Glauco smt, Anchise smt), stratovolcanoes (Ustica Island) and hypothetic lava fields (Virgilio II).

The Central Tyrrhenian activity is predominantly characterised by the spreading of the Vavilov Basin

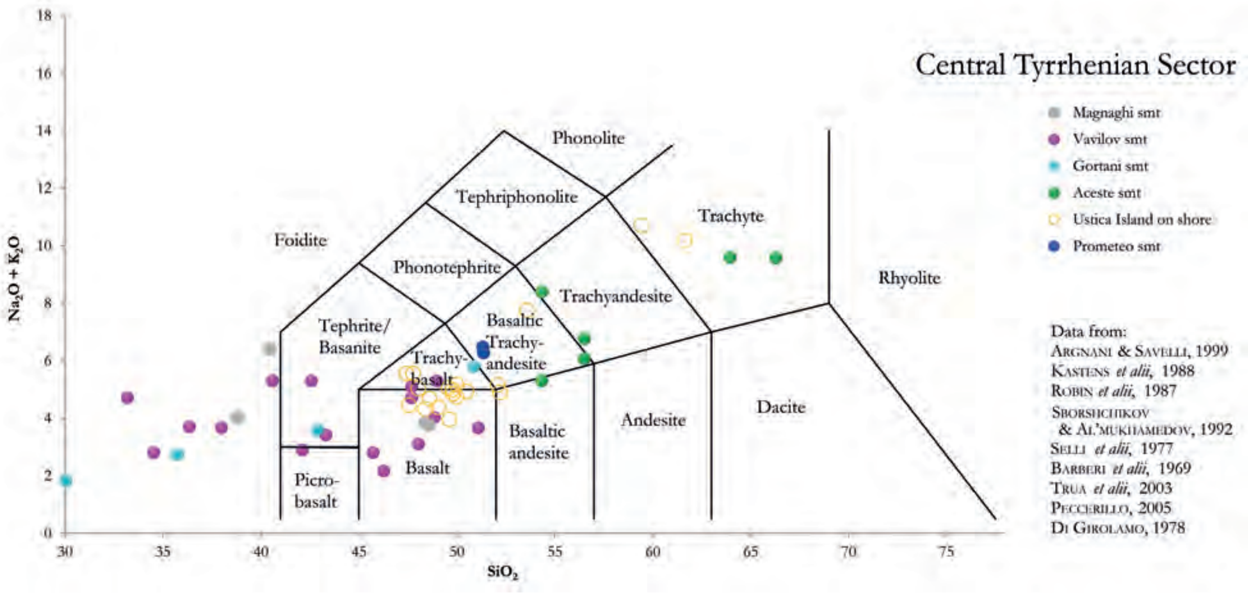
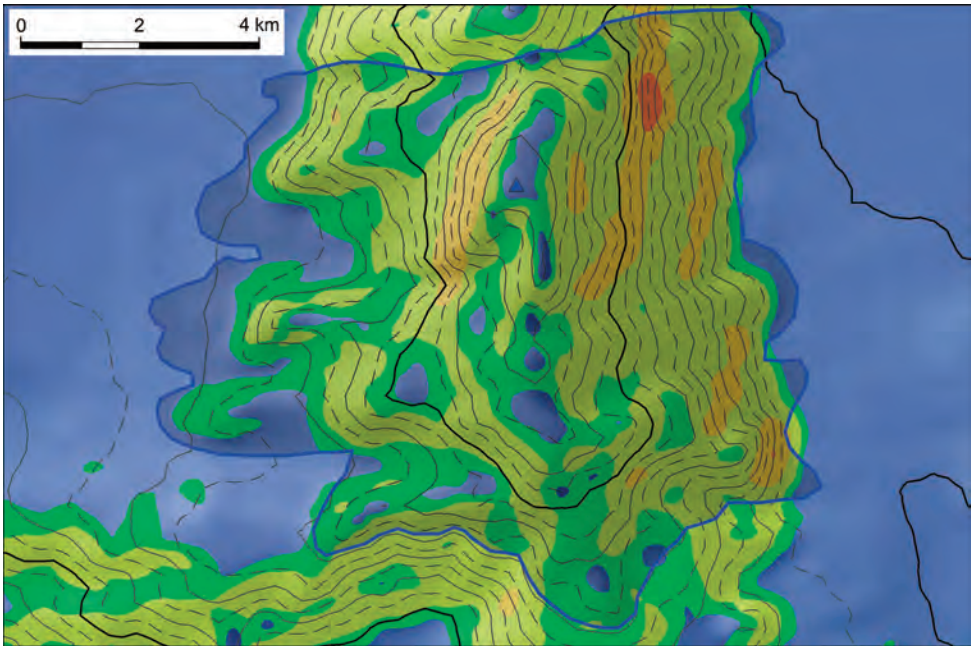


Fig. 12 - TAS diagram of composition of the Central Tyrrhenian Volcanic Seamount Sector products. Data are plotted raw from cited sources and may include LOI up to >20%. The reader is referred to the original papers for an evaluation of the data and for the nomenclature adopted in this text.
- Diagramma TAS della composizione dei prodotti vulcanici relativi al Settore vulcanico sottomarino Tirreno Centrale. I dati sono tracciati dalle fonti citate e possono includere LOI fino a >20%. Si rimanda il lettore agli articoli originali per una valutazione dei dati e per la nomenclatura adottata in questo testo.

(begun at > 4.3 Ma) that constitutes the first step of the progression towards southeast of the Tyrrhenian extension after the end of the Corsica-Sardinia block rotation. Ages inferred by sampled deposits range from Upper Miocene to Quaternary during which a large variety of magmas were emitted (fig. 12). Rocks compositions range from MORB-type to OIB-type and arc-type (PECCERILLO, 2017). The reason behind this wide range of magma compositions is still debated, but there is a general agreement in considering this portion of the Tyrrhenian Sea a back-arc basin, where the high heterogeneity of the upper part of the mantle is the result of the melting of ancient lithosphere and release of fluids by the Ionian subduction systems. In particular Garibaldi/Glauco and Anchise seamounts are considered parts of a Pliocene volcanic arc (PECCERILLO, 2017).

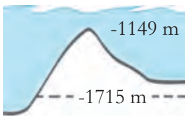
Marco Polo Seamount 5.1

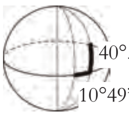
Morph. ty.	Composite/ Fissural edifice
Serie	Tholeitic ?
Chem. com.	Basalts
Act. ty.	/
Act. age r.	/
Vol. [km^3±10%]	9
Flu. ems.	/



Slope

bsl asl 0 - 5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 60
seamount base
seamount summit





Morphology

The summit structure of Marco Polo seamount shows a preferential N-S elongation, which is 10 km long. Although it is only 566 m high, this seamount presents a quite steep eastern flank, where slopes frequently exceed 15°, reaching 36°. The western flank, on the other hand, shows a gentler slope, not exceeding 15° (excluding a small cliff in the northern area of the seamount, where slope reaches 36°). The shallower peak of the edifice is at -1149 m of depth. The base ranges between -2008 m and -1343 m, averaging at -1715 m.

The total estimated volume for this structure is 9 km^3.

Volcanic structure

This volcanic edifice has been identified thanks to the CROP project section M-2A/I (Finetti, 2005). It is represented as the first edifice to the E of the Baronie Trough, fed by a N-S-oriented strike-slip normal fault. This may explain its N-S development.

Since no other data are available, the edifice has been catalogued as a composite edifice. The N-S elongation of its crest suggests a tectonic control on the eruptive vents.

Chemical composition and age

No samples are available from this seamount. The indication of its basaltic nature has been inferred by the location of the edifice and the available CROP section (Finetti, 2005). No information on the age of formation of this edifice is available.

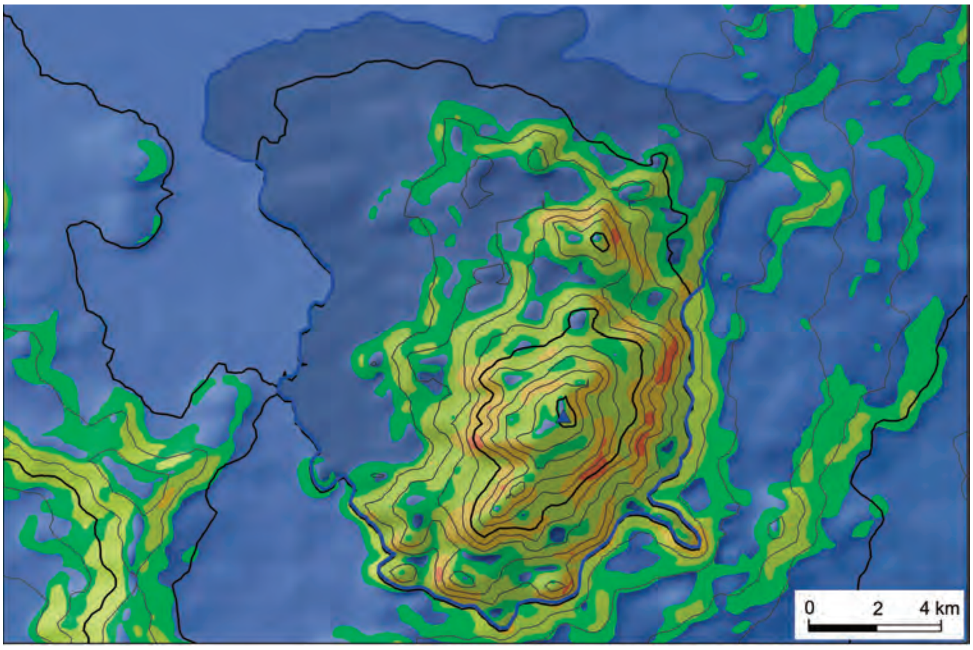
Volcanic products

No information is available on Marco Polo smt volcanic products.

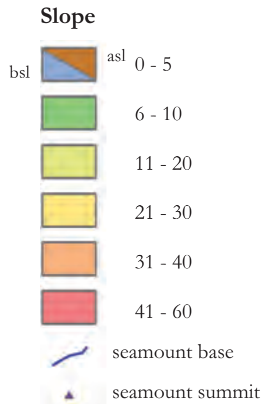
Brief volcanic evolution

There is no knowledge on the volcanic evolution of this edifice.

5.2 *Columbus Seamount*



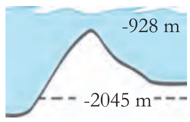
Morph. ty.	Composite edifice
Serie	Na-Alkaline
Chem. com.	Alkali-basalts
Act. ty.	Effusive
Act. age r.	/
Vol. [km³±10%]	35
Flu. ems.	/



Morphology

The morphology of Columbus seamount is quite irregular. The steepest and most elevated area of the edifice is eccentric to the SE: here slopes frequently reach 35° and the structure is 1117 m high, with its shallowest peak at -928 m. The summit area of the structure is elongated in a NE-SW direction, whereas to the N, the structure turns to a NW-SE trend. Along this trend, slopes are less steep, rarely exceeding 15°: here flanks gently lower down to the base of the seamount without cliffs. The base of the edifice lies between -2196 m and -1965 m, averaging at -2045 m.

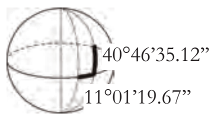
The estimated volume for this edifice is 35 km^3.



Volcanic structure

As for Marco Polo seamount, this volcanic edifice has also been identified on the base of CROP project section M-2A/I (Finetti, 2005). In this case, it is represented as the second and wider edifice to the E of the Baronie Trough, fed by a strike-slip normal fault.

Since no other data are available, the edifice has been catalogued as a composite edifice.



Chemical composition and age

The sample RC9-195 reported in Keller (1981) and later literature (Peccerillo, 2005, 2017) on the Etruschi smt is herein relocated based on its geographic coordinates to Columbus smt. This sample is made of OIB-type hawaiite lavas. The effusive nature of Columbus has been also inferred by the CROP project (Finetti, 2005). The age is constrained based on stratigraphic considerations at ca 100 ka (Keller, 1981).

Volcanic products

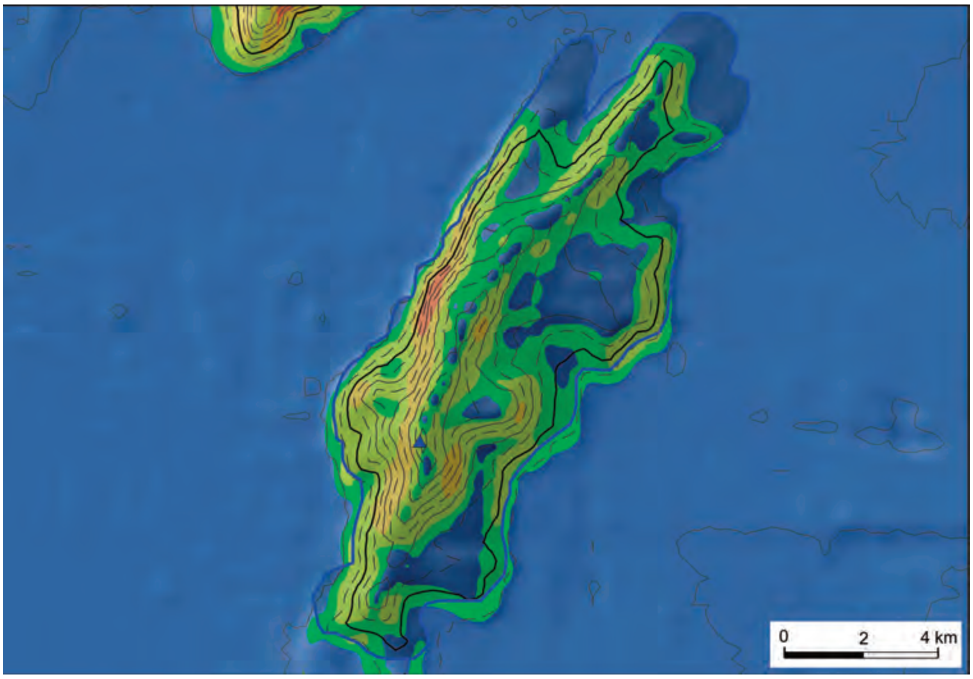
The sample RC9-195 described in Keller (1981) is made of vesicular lava, suggesting that the effusive event might have occurred at much shallower depths.

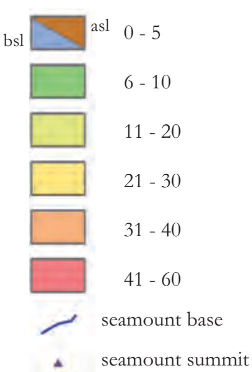
Brief volcanic evolution

Giving the lack of information, it is not possible to describe the volcanic history of Columbus seamount.

Gortani Seamount 5.3

Morph. ty.	Fissural edifice
Serie	MORB-type Tholeitic
Chem. com.	Basalts
Act. ty.	Effusive
Act. age r.	4.3 Ma
Vol. [km³±10%]	8
Flu. ems.	Volcanic origin

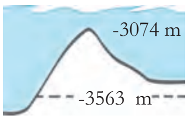




Morphology

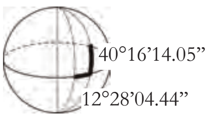
This seamount is named after the Italian geomorphologist Michele Gortani (Würtz & Rovere, 2015). It presents a narrow NNE-SSW-elongated structure, 18 km-long and 4 km wide. The westernmost steeper flanks reach slope values of 37°, while the eastern flanks are less straight and more gently dipping, with slope values ranging between 5° and 25°. The structure is nearly 500 m high and its top is at -3074 m. Its base lies between -3603 m and -3506 m averaging at -3563 m.

The volume of Gortani seamount is approximately 8 km³.



Volcanic structure

The Gortani smt is a narrow and elongated edifice that indicates a strong structural control on the location of vents. This structure is typical of a fissural edifice. Würtz & Rovere (2015) suggest that it may also continue to the north, maintaining the same NNE-SSW trending for a total length of 40 km. Vertically elongated velocity anomalies in a recent seismic tomographic model have been interpreted as basaltic bodies with an oceanic crustal affinity that intrude the mantle and are the root of the Magnaghi/Vittorio Emanuele, Vavilov, Gortani and D'Ancona Seamounts (Prada *et alii*, 2014).



Chemical composition and age

Basalts from the ridge crest (drillsite 655 of ODP Leg 107) have MORB-like composition and K/Ar age of 4.3 ± 0.3 Ma (Kastens *et alii*, 1988). The radiometric dating of the lavas indicates an eruption during the Gilbert polarity epoch (Kastens & Mascle, 1990); if the radiometric age of site 655 lavas is exact, the inversely magnetized rocks were erupted between the Cochiti and Nunivak events (4.23-4.37 Ma BP; Faggion *et alii*, 1995).

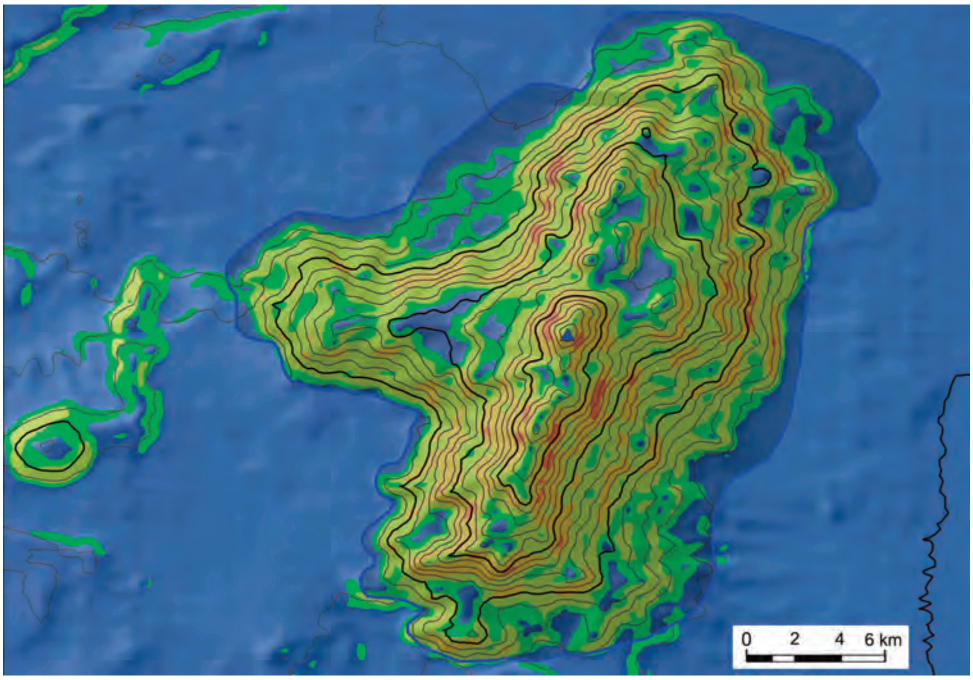
Volcanic products

Gortani smt presents pillow lava deposits, with abundant carbonate sediment and hydrothermal cement filling the cracks (Würtz & Rovere, 2015). The presence of pillow lavas is indicative of an effusive activity.

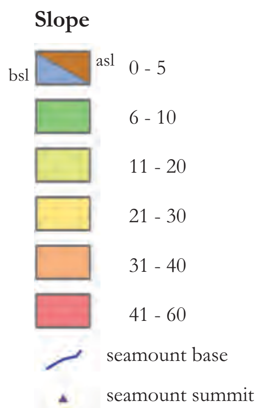
Brief volcanic evolution

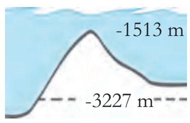
The volcanic evolution of this seamount is not yet available.

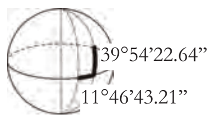
5.4 *Magnaghi/Vittorio Emanuele Seamount*



Morph. ty.	Composite / fissural edifice
Serie	OIB-type, Na-alkaline
Chem. com.	Alkaline basalt, tholeiitic to transitional basalts
Act. ty.	Effusive
Act. age r.	3.0 - 2.7 Ma
Vol. [km^3±10%]	144
Flu. ems.	Volcanic origin







Morphology

The Magnaghi seamount, also indicated as Vittorio Emanuele seamount, occupies an isolated position in the western part of the Vavilov abyssal basin (SBORSHCHIKOV & AL'MUKHAMEDOV, 1992; WÜRTZ & ROVERE, 2015); it stands out from this plain with 1714 m of height and its shallower peak reaches -1513 m. Its base lies at depths between -3468 and -2908 m, averaging at -3227 m. It displays a NNE-SSW elongation, 30 km long and about 10 km wide, and presents a E-W-oriented ramification on its western flank, which elongates for another 10 km from the main structure. Flanks are generally steep from top to base, with slope values ranging between 6° and 37°.

The total volume of the edifice reaches 144 km^3.

Volcanic structure

The Magnaghi/Vittorio Emanuele smt is a large volcanic edifice and, although some minor conical features are present on its top, it can be classified also as a fissural edifice (SARTORI *et alii*, 2004).

A side-scan sonar survey carried out by SBORSHCHIKOV & AL'MUKHAMEDOV (1992) revealed NW-SE and NE-SW trends that dominate the formation of deep gullies and steep escarpments.

Chemical composition and age

The Magnaghi/Vittorio Emanuele seamount deposits composition displays Na-alkaline affinity (SERRI, 1991).

This seamount has been dated at 3.0 - 2.7 Ma, according to SELLI *et alii* (1977) and PECCERILLO (2017).

Volcanic products

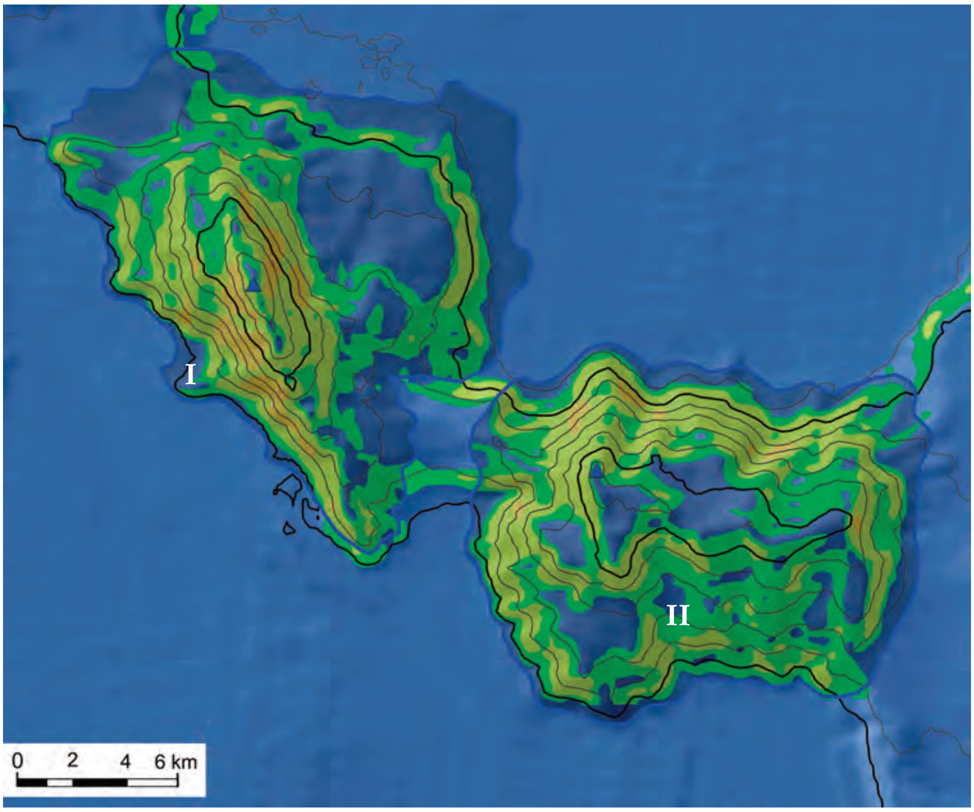
In general, lava flows and pillow lava deposits (along the vertical scarps) were identified (SBORSHCHIKOV & AL'MUKHAMEDOV, 1992).

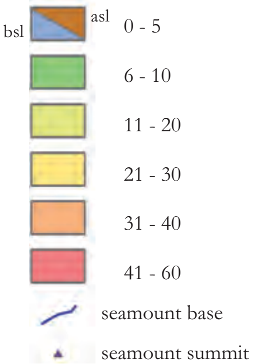
Brief volcanic evolution

Both the large central volcanoes of the Vavilov basin, the Magnaghi/Vittorio Emanuele and Vavilov seamounts, were built after cessation of the seafloor-spreading tectonic regime (TRUA *et alii*, 2004a,b).

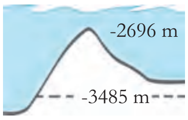
D'Ancona Seamounts 5.5

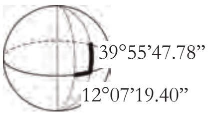
Morph. ty.	Composite edifice
Serie	Tholeitic ?
Chem. com.	Basalts
Act. ty.	Effusive
Act. age r.	/
Vol. [km^3±10%]	23 (I) 33 (II)
Flu. ems.	/



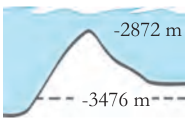


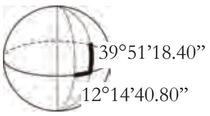
I





II





Morphology

D'Ancona seamounts are named after the CNR research ship "Umberto d'Ancona" (Würtz & Rovere, 2015). It is located between the Magnaghi/Vittorio Emanuele and Vavilov seamounts and it is not clear whether it should be considered as a seamount composed by multiple edifices (organized in an arcuate high-standing feature; Marani *et alii*, 2004; Würtz & Rovere, 2015), or by a single one (the westernmost one; Würtz *et alii*, 2014). We here consider two edifices indicated as I and II in figure.

Edifice I elongates on a NNW-SSE orientation, being 19 km long and 12 km wide, with a steep flank from top to base on its western side (up to 31°), and 400 m (from the top) of steep flanks along its eastern side (up to 31°, which then decrease to maximum 20° until the base of the edifice). This side also presents a deviation from the general orientation of the edifice, pointing towards a NNE-SSW trend. The top of edifice I is at -2696 m; the base lies on average at -3485 m for an average height of the edifice of 789 m. The volume of the edifice is 23 km^3.

Edifice II is 13 km long and 11 km wide, with a broad E-W orientation. Its steeper flanks, where slopes reach 31°, are north-facing, while the southern flanks are gentler, and slopes rarely exceed 20°. The top of the edifice is at -2872 m, while its base is on average at -3476 m, for an height of 604 m. Edifice II volume reaches 33 km^3.

Volcanic structure

The D'Ancona smts have been generally interpreted as a faulted continental block, although a possible magmatic origin has also been suggested (Marani *et alii*, 2004; Sartori *et alii*, 2004). On the basis of their location and given that the velocity gradient below is rather high in comparison to that of a continental block, Prada *et alii* (2014) suggest that they might also correspond to a basaltic intrusion into the mantle basement forming the root of a volcanic edifice.

Chemical composition and age

No information on the chemical composition or on the age of these seamounts is available. The possible basaltic nature of these volcanic edifices has only been attributed in consideration of their geodynamic location.

Volcanic products

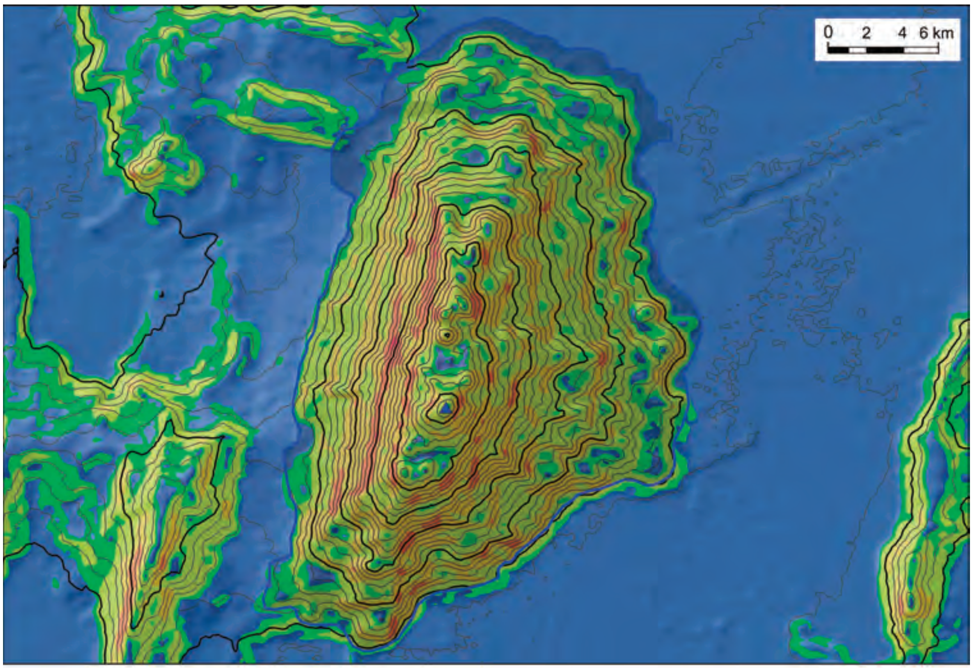
No samples have yet been collected from this area, although its activity is likely effusive based on the inferred chemistry and depths.

Brief volcanic evolution

The volcanic history of these seamounts has not been studied yet.

Vavilov Seamount 5.6

Morph. ty.	Fissural edifice
Serie	Tholeiitic to Na-alkaline
Chem. com.	Tholeiitic to alkaline basalts
Act. ty.	Effusive
Act. age r.	First pulse ca. 3 Ma Second pulse 0.37 - 0.09 Ma
Vol. [km^3±10%]	309
Flu. ems.	Volcanic origin



Slope

bsl asl 0 - 5

6 - 10

11 - 20

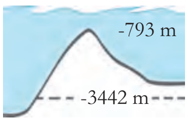
21 - 30

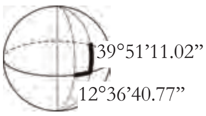
31 - 40

41 - 60

seamount base

seamount summit





Morphology

Vavilov seamount is more than 2600 m in height. Its base lies in the abyssal Vavilov basin between -3599 m and -3132 m, at an average depth of -3442 m; its shallowest peak is at -793 m of depth. It is 30 km-long in the NNE-SSW direction and 14 km wide, showing an asymmetry between its flanks; the western one is straighter and steeper (11° to 42°) and it is possible that this side was affected by flank collapses or faulting that caused the removal of part of the pre-existing edifice (as suggested by the presence of an arcuate scar, Marani *et alii*, 2004). On the other hand, the eastern flank is gentler (6° to 35°) and with an irregular topography likely related to the presence of constructional features such as small parasitic cones and fissural vents. The sheet F22 of the Progetto Magic (DPC-CNR 2007-2013) identifies a large number of cones on the summit crest and along the flanks, including the western slopes, suggesting that parasitic activity may have occurred also after the sector collapses in this area.

The volume of this structure is 309 km^3.

Volcanic structure

Vavilov is a huge fissural edifice largely made - from the -3600 m deep bathyal plain up to the foot of the terminal cone at about -1000 m - of a thick series of basaltic pillow lava flows (Marani *et alii*, 2004). The summit of the edifice is a quite articulated ridge where two cones stand out approximately 250 m high along with a series of smaller cones.

The alignment of cones forming the summit ridge can be projected on the narrow southern and northern flanks of the volcano, where 100 to 150 m high ridges can be well identified, also characterised by the presence of small cones. In the northern flank, steep transverse scarps give rise to terrace-like morphologies (Marani & Gamberi, 2004). Apart from the summit cones, Vavilov hosts several circular based cones that, however, are located for the major part, on the lower slope portions, between 2500 m and 3500 m depth (Marani & Gamberi, 2004).

Chemical composition and age

Vavilov smt lavas are tholeiitic to mildly Na-alkaline basalts (Peccerillo, 2017) and show incompatible trace element patterns very similar to those of Magnaghi/Vittorio Emanuele basalts (Trua *et alii*, 2007).

The beginning of the Vavilov activity is placed at 3 Ma during the spreading of the Vavilov basin. The age of the summit lavas is much younger and ranges between 0.37 and 0.09 Ma (K-Ar; Robin *et alii*, 1987), indicating possibly the occurrence of different magmatic pulses.

Volcanic products

The Vavilov volcano consists of a thick series of basaltic pillow lava flows. The base consists of thick submarine lava flows. The intermediate volcano shows a typical stratovolcano succession, with radial lava flows. The summit area is characterized by thinner lava flows with a scoriaceous surface (ROBIN *et alii*, 1987).

Recent explosive activity is documented for this seamount, where fresh scoriae were found in numerous sampling sites, located preferentially along the top of the volcano. Also, the recovery of fresh hydrothermal Mn precipitates indicates that hydrothermal activity is still occurring. (GAMBERI *et alii*, 2006).

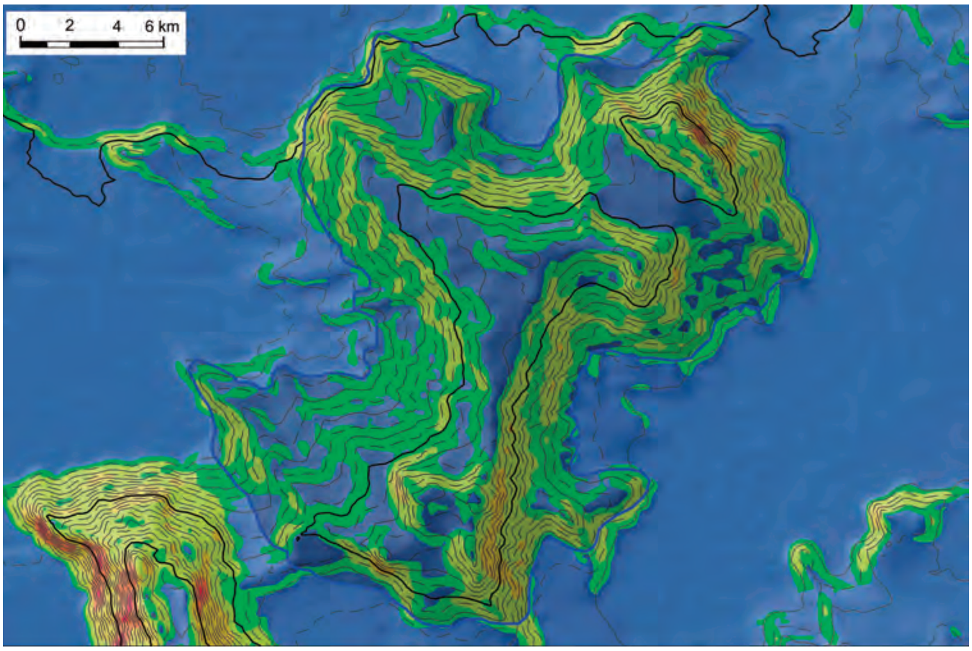
Brief volcanic evolution

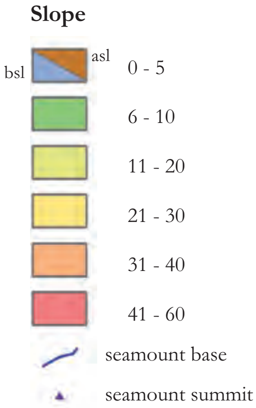
According to ROBIN *et alii* (1987), Vavilov edifice can be subdivided in two portions. The lower part, from the abyssal plain to a depth of approximately -1500 m deep, is constituted by basalts likely erupted from N-S oriented fissures. The morphology of the summit region, above -1500 m of depth, suggests the contemporaneous activity of two main eruptive centres, aligned along the same meridian direction of the basal part of the edifice. This upper part of the volcano is of a much younger age (0.37-0.09 Ma; ROBIN *et alii*, 1987). The lower series observed on the eastern flank dip towards the centre of the volcano, indicating that the massif tilted towards the west. Normal faults responsible of the tilting affect preferentially the base of the edifice and suggest that the major movements occurred during Late Pliocene or Early Quaternary.

It is located in the Vavilov basin and its formation is related to the latest phase of the Vavilov magmatism (TRUA *et alii*, 2007). It is believed that the eruption of Vavilov lavas occurred after the end of the northwest Tyrrhenian basin expansion (ROBIN *et alii*, 1987); they show an OIB type of magmas (PECCERILLO, 2017).

Virgilio Seamount 5.7

Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	/
Vol. [km^3±10%]	70
Flu. ems.	/



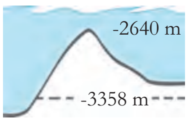


Morphology

Virgilio seamount is located to the north of the Augusto smt. It only appears on early maps (Finetti & Del Ben, 1986), in the central part of the southern Tyrrhenian Sea. Its shape is irregular, and its shallowest peak is located on its north-eastern ramification, with a depth of -2640 m. The base lies between -3548 m and -3037 m, averaging at -3358 m. The average height of the edifice is 718 m. The edifice has a maximum length of 26 km in its NNE-SSW direction, and 15 km in width along the perpendicular direction.

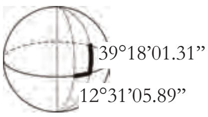
Slopes are moderate, ranging between 5° and 20°. Only a steeper cliff in the north-eastern area reaches up to 44° of slope.

The volume of the structure is about 70 km^3.



Volcanic structure

The volcanic nature of this seamount is indicated on the CROP project sections that cross the area (Finetti, 2005). The shape of the volcano suggests a composite structure made by the coalescence of a series of centres.



Chemical composition and age

No information on chemical composition and age is available for Virgilio smt. The association of the Virgilio smt with the Central Tyrrhenian Volcanic Seamount Sector is therefore tentative, based on its geographic location.

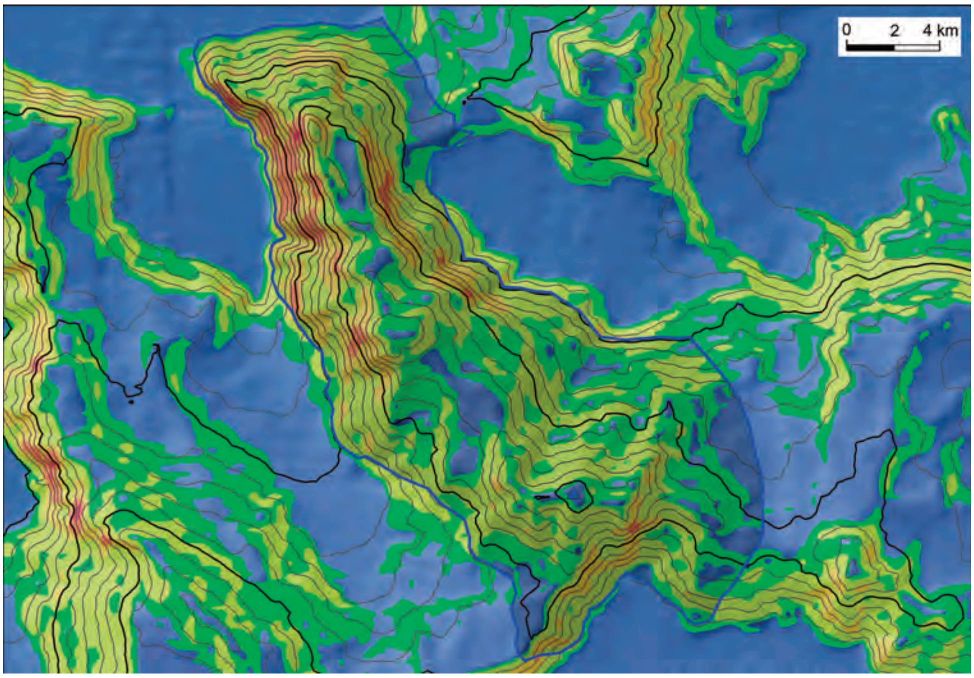
Volcanic products

No analyses were focused on this seamount. Given the depth of the edifice, the style of activity is inferred as mainly effusive.

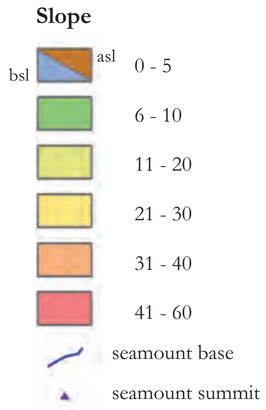
Brief volcanic evolution

The volcanic history for this seamount is not yet known.

5.8 *Augusto Seamount*



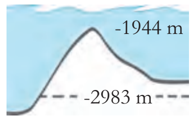
Morph. ty.	Fissural edifice
Serie	/
Chem. com.	/
Act. ty.	/
Act. age r.	/
Vol. [km^3±10%]	97
Flu. ems.	/



Morphology

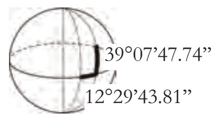
Augusto seamount is located southwest of Virgilio smt and represents the western tip of an arc-shaped structure. It is about 30 km-long and 10 km-wide, with a NW-SE orientation. The base lies between -3483 m and -2455 m, averaging at -2983 m. The shallowest peak is at -1944 m of depth, for an average height of the edifice of 1039 m. The edifice widens from NW to SE and its flanks become less steep. In the northwestern tip, slope frequently reaches 30° to 45°, especially along the western-facing flank, while the southern area presents more gentle slopes, ranging between 5° and 20°.

The calculated volume for this edifice is 97 km^3.



Volcanic structure

The real extension of this possible volcanic structure is controversial: Würtz *et alii* (2014) locate the main edifice to the north, but in a later article (Würtz & Rovere, 2015) the seamount is much longer forming a 55 km-long structure. Also, Cella *et alii* (1998) account for a small lateral volcanic center near Augusto smt, but the location of this center is not indicated.



Chemical composition and age

Chemical composition and age information for this seamount are not available. The association of the Augusto smt with the Central Tyrrhenian Volcanic Seamount Sector is therefore tentative, based on its geographic location.

Volcanic products

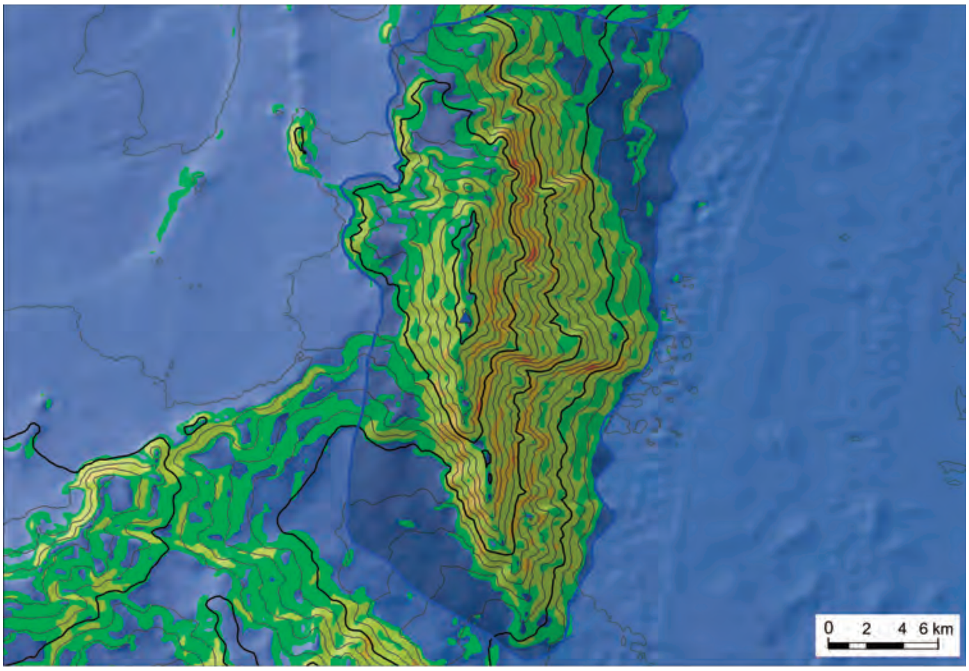
Augusto smt is indicated as composed of fragments of continental crust and magmatic effusions or as a submarine crystalline outcrop (Cella *et alii*, 1998; Finetti, 2005).

Brief volcanic history

The volcanic evolution of this seamount is not known.

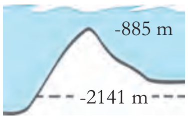
Quirra Seamount 5.9

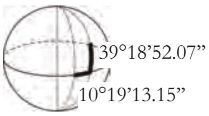
Morph. ty.	Fissural edifice
Serie	Na-alkaline; OIB-type
Chem. com.	Alkali-olivine basalts, hawaiites
Act. ty.	Effusive
Act. age r.	3 Ma
Vol. [km^3±10%]	117
Flu. ems.	/



Slope

bsl asl 0 - 5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 60
seamount base
seamount summit





Morphology

Quirra seamount is located directly to the N of Cornacya smt. Its name comes from a historical region in Sardinia (Würtz & Rovere, 2015). It is a huge 37 km-long, N-S-elongated structure, parallel to the Sardinia margin. The base lies between -2806 m and -1495 m, averaging at -2141 m. The summit is a N-S-trending ridge with minimum depth of -885 m, which makes the average height of the edifice 1256 m. The western flank, lying on the edge of the continental shelf, appears to be slightly less developed than the eastern one that reaches the abyssal plain (500 m of height against the nearly 1500 m of the eastern flank). The more developed flank exceeds the constant slope values that characterize the rest of the edifice (5° to 20°), reaching 36°.

The estimated volume for Quirra seamount is ca. 117 km^3.

Volcanic structure

Quirra smt lies along a regional master fault, N-S oriented located along the continental slope in that area (Finetti, 2005; De Ritis *et alii*, 2010a). The edifice shape is controlled by an elongated fissure-system parallel to the regional fault system.

Chemical composition and age

Na-alkaline rocks (mostly hawaiites) have been dredged on this seamount (Carminati *et alii*, 2010), interpreted as OIB-type (Serri *et alii*, 2001; Peccerillo, 2017).

Quirra alkaline seamount formed at around 3 Ma (Sartori *et alii*, 2004).

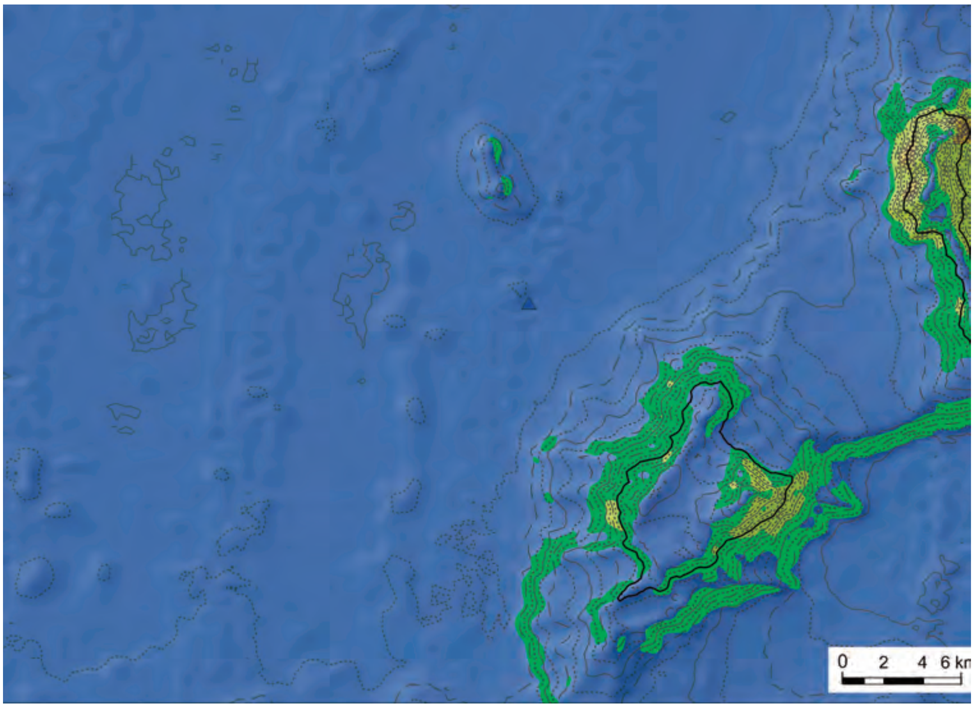
Volcanic products

A detailed description of the dredged products is not available, but hawaiitic lavas may be associated to a predominantly effusive activity.

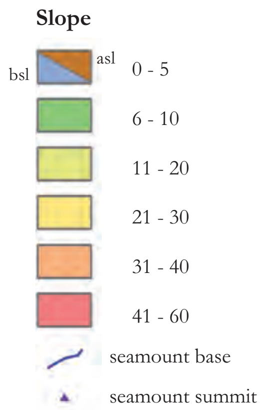
Brief volcanic history

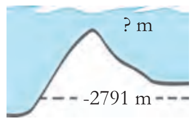
Quirra smt appears as a composite edifice fed by a N-S fissure system. The dimension of the edifice, also put in evidence by magnetic and gravity anomalies (De Ritis *et alii*, 2010a), accounts for a prolonged, polygenetic activity likely dominantly effusive in style.

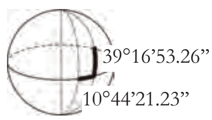
5.10 *Virgilio II Lava Field*



Morph. ty.	Lava field
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	/
Vol. [km³±10%]	/
Flu. ems.	/







Morphology

Virgilio II is not a seamount. The shown location (blue triangle) is reported in the CROP project (Finetti, 2005), where this volcanic occurrence was first proposed. This lava field does not show a significant morphologic expression. However, it cannot be excluded that the lava field is in facts a lava flow issued from one of the surrounding seamounts shown in the figure. Consequently, we cannot calculate a related volume for Virgilio II.

Volcanic structure

Virgilio II has been interpreted as a volcanic body in section M-28B of the CROP project (Finetti, 2005).

Chemical composition and age

Chemical composition and age for this lava field are not available. The association of the Virgilio II lava field with the Central Tyrrhenian Volcanic Seamount Sector is therefore tentative, based on its geographic location.

Volcanic products

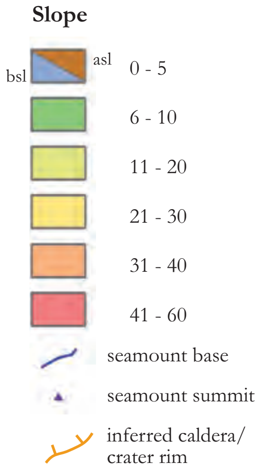
No volcanic product has been sampled or observed for Virgilio II lava field.

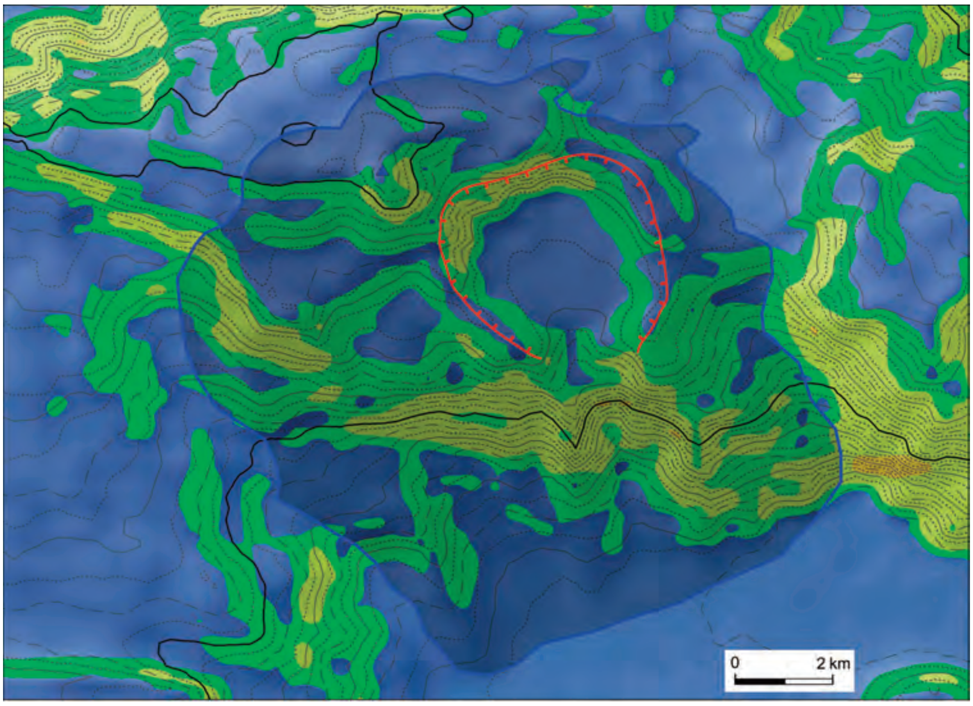
Brief volcanic history

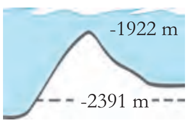
The volcanic evolution of Virgilio II is not known.

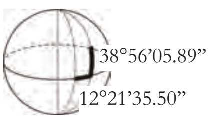
Livia Seamount 5.11

Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	/
Vol. [km^3±10%]	9
Flu. ems.	/









Morphology

This volcanic edifice was indicated in the Structural Model of Italy (Bigi *et alii*, 1990) with no name. Herein this seamount is named Livia in honour of the wife of the Roman emperor Augustus, whose name is given to the nearby volcanic seamount located just to the NNE. Livia seamount is an almost conical edifice located along an E-W-oriented structure of the seafloor. It is about 10 km in diameter. The base lies between -2863 m and -1978 m, averaging at -2391 m. The shallowest peak is at -1922 m for an average height of 469 m. The summit is characterised by a nearly circular depression ~2 km in diameter. Slopes are steeper along the southern flank, where they range between 6° and 25°. Elsewhere slopes are more moderate and rarely exceed 10°-15°.

The edifice volume is about 9 km^3.

Volcanic structure

The morphology evidences the presence of a crater (2 km diameter) enclosed by a rim, breached in its southern side. The dimension suggest that this is a composite edifice characterized by a polygenetic activity. The summit depression could be either a crater or a small caldera. We are not confident that this could be an explosive crater because its dimensions should relate to a plinian activity which is impossible at those depths (cf. Cas & Giordano, 2014). Alternatively, the origin as a caldera should relate to lateral withdrawal of lava, similar to Hawaiian effusive calderas. However, it is also possible that this edifice may have experienced significant subsidence so that the present depth may not correspond to that at the time when the summit depression originated.

Chemical composition and age

There is no information on chemical composition and age of this seamount. The association of the Livia smt with the Central Tyrrhenian Volcanic Seamount Sector is therefore tentative, based on its geographic location.

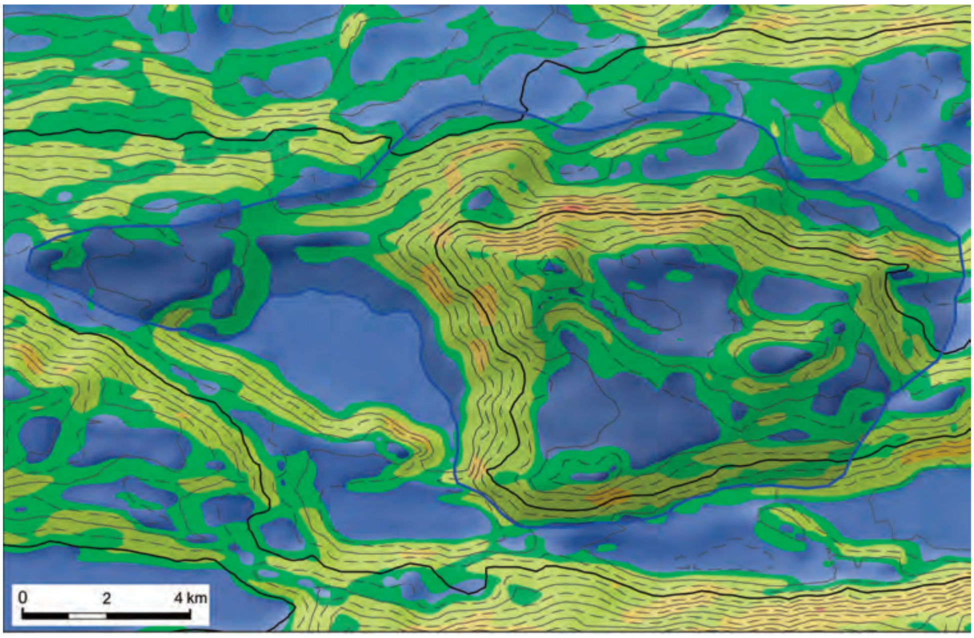
Volcanic products

Volcanic products from Livia smt have not been sampled or observed.

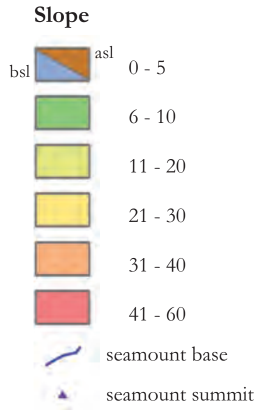
Brief volcanic evolution

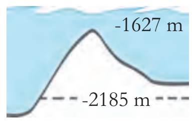
The volcanic history of this seamount is not known.

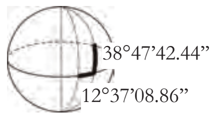
5.12 *Creusa Seamount*



Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	/
Vol. [km^3±10%]	18
Flu. ems.	/







Morphology

Creusa seamount is another volcanic edifice previously un-named. Herein the name has been chosen in honour of the wife of the Trojan hero Aeneas. Creusa smt is located directly to the north of Anchise smt and it is a W-E elongated structure, 15 km long and 7 km wide. The base lies between -2561 m and -1837 m, averaging at -2185 m. The top morphology suggests the presence of a 4 km x 2 km wide depressed area. The shallowest peak of the rim that encloses that depression is -1627 m deep. The seamount height is about 558 m, with the north-facing flank more developed and steeper (5°-35°) than the southern slopes (5°-30°).

The volume of the structure is 18 km^3.

Volcanic structure

The existence of this volcanic edifice was firstly presumed and indicated on the Structural Model of Italy (BIGI *et alii*, 1990) but never named. The depressed area may be associated to the presence of a WNW-ESE-trending volcanic crater or summit caldera. The same considerations made for the summit depression of Livia smt are valid for Creusa smt. We then exclude an explosive origin because the depth is too much to allow significant exsolution of volatiles in the conduit to drive a plinian eruption (CAS & GIORDANO, 2014), as the dimension of the crater would require. The likely alternative for the origin of the summit depression is an effusive caldera, related to the lateral withdrawal of lava, like for Hawaiian calderas (e.g. COLE *et alii*, 2005).

Chemical composition and age

No information on the petrography and age of this seamount are available. The association of the Creusa smt with the Central Tyrrhenian Volcanic Seamount Sector is therefore tentative, based on its geographic location.

Volcanic products

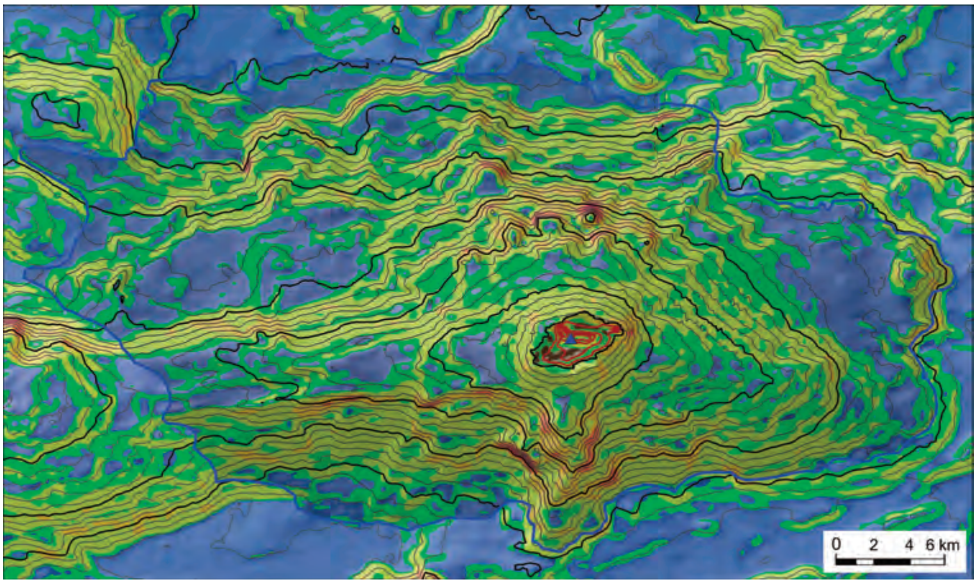
Volcanic products have never been retrieved or observed.

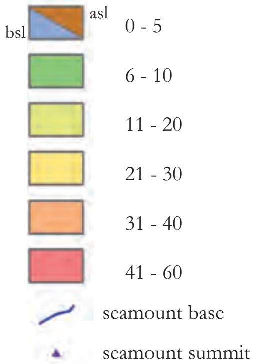
Brief volcanic history

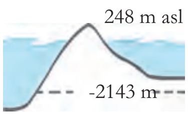
The volcanic evolution of this seamount is unknown.

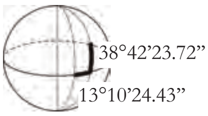
Ustica Island 5.13

Morph. ty.	Stratovolcano
Serie	Na-alkaline, OIB-type
Chem. com.	Hawaiites to mugearites
Act. ty.	Mixed
Act. age r.	0.735-0.132 Ma
Vol. [km^3±10%]	548
Flu. ems.	CO_2 and CH_4









Morphology

Ustica Island is located about 65 km N-NW of the Sicily coast, on the southern edge of the oceanic domain of the Magnaghi/Vittorio Emanuele - Vavilov and Marsili/Plinio basins (Etiope *et alii*, 1999). The 4x2 km^2 wide island represents only the subaerial part of a much larger seamount, about 42 km x 25 km wide.

The base lies across the continental slope, between -3053 m and -1153 m, averaging at -2143 m. The island has a maximum height of 248 m above the sea level, but the entire edifice (with the submarine part) reaches on average a height of 2391 m. The Ustica edifice develops along an E-W-oriented structure and follows the Anchise edifice, located directly to the west and on the same E-W-oriented morphological high. Slopes are steeper along the northern and southern flanks, reaching 45° (occasionally, some cliffs have slope values that reach 55°). Elsewhere slopes are gentler, rarely exceeding 25°.

The sheet F26 of the Progetto Magic (DPC-CNR, 2007-2013) indicates the presence of several parasitic cones along the northern slopes of the edifice at depths comprised between -500 and -2000 m. By contrast the north-eastern and southern slopes appear mostly cut by erosional features.

The total volume of the Ustica edifice is 548 km^3.

Volcanic structure

The edifice of Ustica Island is located at the eastern end of a major E-W-trending submarine ridge that runs for more than 200 km toward Aceste/Tiberio smt, sloping northward toward the Tyrrhenian abyssal plain. The crust in this region is thinned and some authors have suggested a transtensive tectonic framework (Etiope *et alii*, 1999).

Bathymetric maps and geophysical data indicate locally the presence of secondary NE-SW structures related to the main E-W structures, along which CO_2 and CH_4 discharges were recognised by the seawater analyses performed north of Ustica Island during the 1996 oceanographic cruise (Etiope *et alii*, 1999 and references therein).

Chemical composition and age

Basaltic, hawaiitic and mugearitic magmas were mostly extruded during Ustica volcanic activity; the only explosive eruption of trachytic magmas occurred at 424 ka from the island summit (De Vita *et alii*, 1998).

A geochronological study was carried out by means of $^{40}Ar/^{39}Ar$ and ^{230}Th dating methods on magmatic and marine sedimentary rocks, respectively. The results indicate that the ages of the rock presently forming the island span between about 735 and 132 ka (De Vita *et alii*, 1998).

Volcanic products

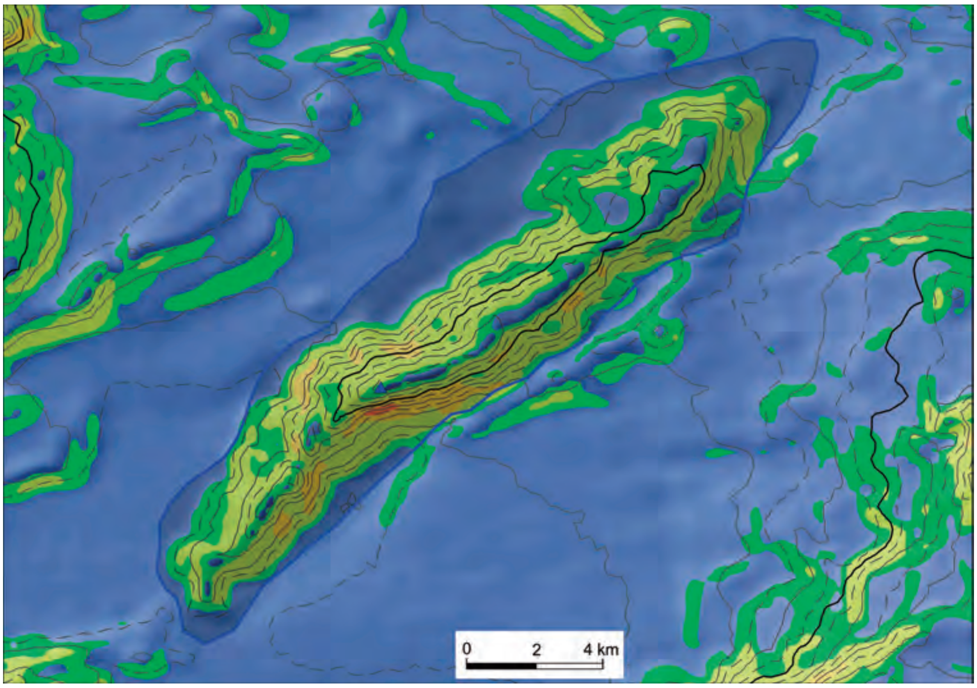
Pillow lavas and hyaloclastic breccias are the oldest products that characterize the submarine eruptive activity. On the other hand, the subaerial sequence is formed by both lava flows and pyroclastic rocks (ETIOPE *et alii*, 1999).

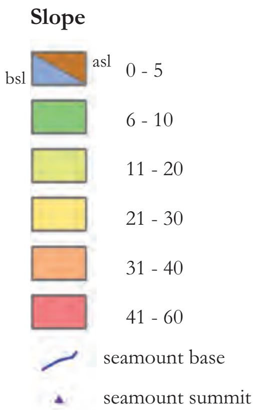
Brief volcanic history

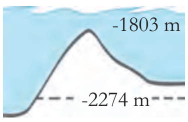
According to DE VITA *et alii* (1998), the volcanic history of Ustica Island can be subdivided into five periods of activity, based on stratigraphical and compositional data. From about 750 to 500 ka, Ustica was a seamount with subaqueous basaltic eruptions. The only trachytic explosive eruption occurred at about 424 ka, after a long period of quiescence, during which the conditions for formation and evolution of a shallow magma chamber were established. The oldest marine terrace is dated at about 350 ka, marking the emersion of the seamount, while the youngest dated terrace formed at around 130 ka, and marks the end of the volcanic activity on Ustica Island.

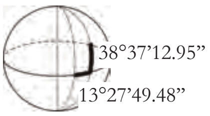
Prometeo Seamount 5.14

Morph. ty.	Fissural edifice
Serie	Na-alkaline, OIB-type
Chem. com.	Mugearites
Act. ty.	Effusive
Act. age r.	/
Vol. [km^3±10%]	9
Flu. ems.	/









Morphology

Prometeo seamount (also identified as lava field in Trua *et alii*, 2003) is an elongated, NE-SW-oriented edifice. It is 20 km long and only 4 km wide. It stands out, isolated, from the abyssal plain with its base lying between -2400 m and -2110 m, averaging at -2274 m. Its shallowest peak is at -1803 m of depth, for an average edifice height of 471 m. Flanks are homogeneously steep, with values between 5° and 25°; they are steeper near the most elevated peak, reaching 26° to 32° of slope.

The estimated volume for this edifice is 9 km^3.

Volcanic structure

There is no specific information on the volcanic structure of Prometeo smt. Based on its morphology we suggest that its edifice formed by the coalescence of fissure-fed eruptions, aligned along a regional fault system.

Chemical composition and age

Prometeo smt samples have a Na-alkaline signature and isotopic compositions compatible with OIB-type magmas with mugearitic composition, petrographically and geochemically similar to the products of Ustica Island (Trua *et alii*, 2003; Peccerillo, 2017).

Information on the age of Prometeo smt is not available.

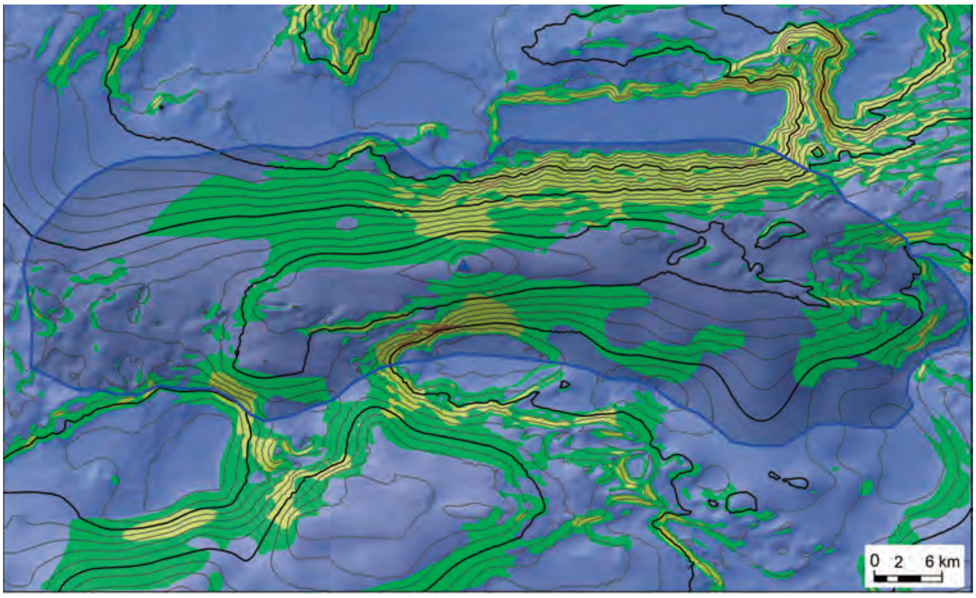
Volcanic products

Samples from Prometeo smt are mugearitic lavas (Trua *et alii*, 2003).

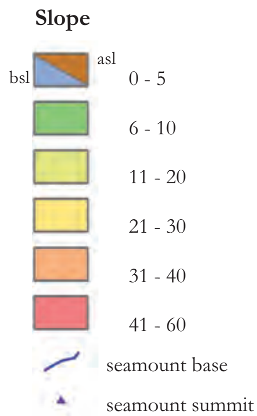
Brief volcanic history

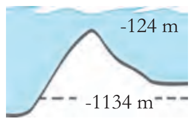
Trua *et alii* (2003) noted a NW-SE alignment between Ustica, Prometeo and Etna volcanoes, which also share a similarity in their erupted OIB-like magmas. The proposed mechanism that may account for the volcanic alignment and at the same time may explain the similarity of these magmas is the presence of a N-NWward asthenospheric African mantle flow below and across the area. The flow would be channelled through a tear at the edge of the Ionian oceanic plate undergoing roll-back subduction, causing the eruption of OIB-like magmas.

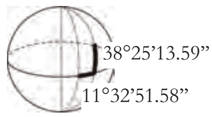
5.15 *Aceste/Tiberio Seamount*



Morph. ty.	Fissural edifce
Serie	Na-alkaline
Chem. com.	Hawaiites, mugearites, trachytes
Act. ty.	Mixed
Act. age r.	Pliocene
Vol. [km³±10%]	445
Flu. ems.	/







Morphology

Aceste seamount (called "Tiberio" seamount in FINETTI & DEL BEN, 1986) is an E-W elongated structure, nearly 80 km long and 20 km wide. The summit is also an E-W elongated ridge that follows the entire structure, with a shallower peak at -124 m located at the centre of the edifice. The base lies between -1866 m and -529 m, averaging at -1134 m, making the height of the edifice 1010 m on average. Slopes are moderate (lower than 10°), except along the northern and southern flanks, where slopes are well developed and connect steeply to the abyssal plain with values that reach 35°.

The estimated volume of the edifice is about 445 km³.

Volcanic structure

Aceste/Tiberio smt is located at the western end of a major E-W trending ridge, more than 200 km long, the other end of which is made by Ustica volcano. This major E-W ridge is largely formed by similarly oriented fault systems that dislocate the continental shelf towards the Tyrrhenian abyssal plain to the north. Very little is known about the volcanic structure of this seamount. Based on its morphology we suggest that this is a fissural edifice characterised by a polygenetic activity, mostly due to coalescence of fissural structures aligned along regional fault systems.

Chemical composition and age

Lavas from Aceste/Tiberio smt are of hawaiitic, mugearitic and alkali-trachytic compositions. In addition, rhyolitic pyroclastic rocks were found. The signature is transitional from OIB-type to arc-type (BECCALUVA *et alii*, 1984). Its age is not younger than the Early Pliocene by biostratigraphic dating of Fe rich clays (BECCALUVA *et alii*, 1984; ARGNANI & SAVELLI, 1999).

Volcanic products

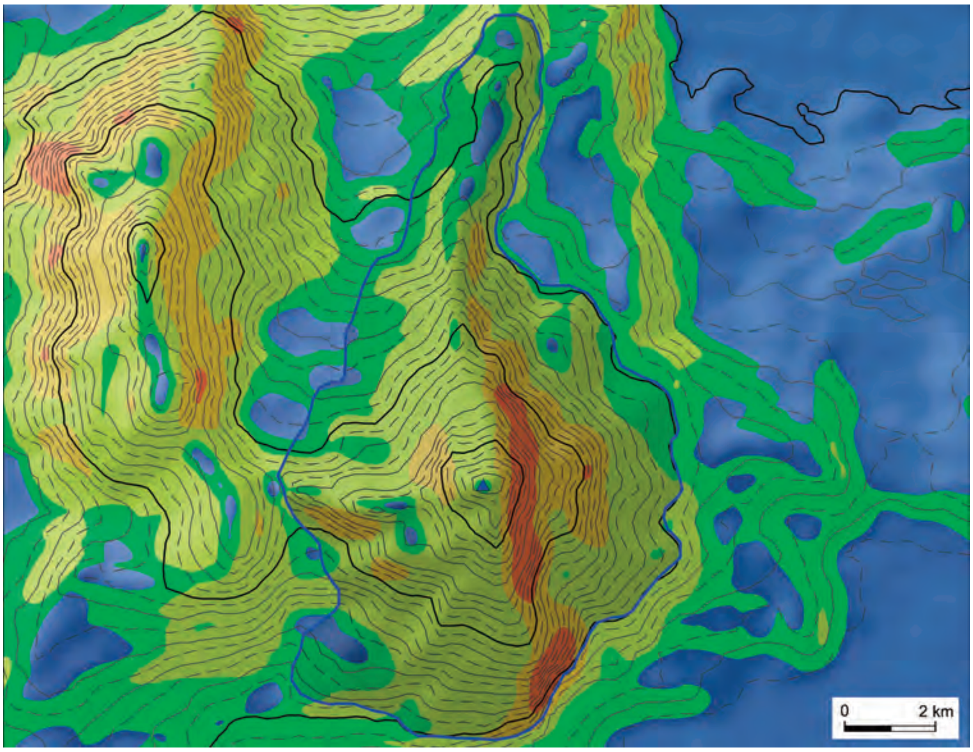
Data from BECCALUVA *et alii* (1984) and ARGNANI & SAVELLI (1999) indicate the presence of both lavas and pyroclastic deposits, which suggests the concurrence of both effusive and explosive activity in this seamount.

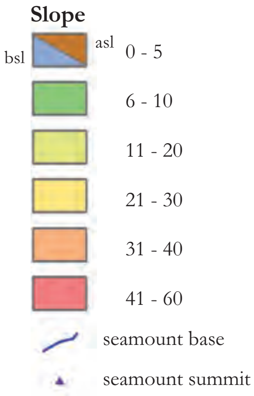
Brief volcanic history

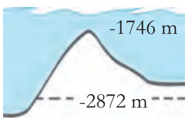
A detailed volcanic history for this seamount is not available, but its geochemical and petrographic similarity with Ustica Island suggests a common and coexistent evolution, tied to the lithosphere convergence and the slab retreat that put them in a distant position with respect to the mantle wedges feeding the Aeolian volcanic arc (ARGNANI & SAVELLI, 1999).

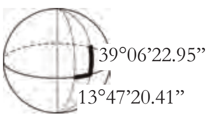
Garibaldi/Glauco Seamount 5.16

Morph. ty.	Composite edifice
Serie	Calc-alkaline
Chem. com.	Calc-alkaline mafic
Act. ty.	Effusive
Act. age r.	Pliocene
Vol. [km^3±10%]	15
Flu. ems.	/









Morphology

Garibaldi/Glauco seamount is located between the Vavilov and Marsili/Plinio basins. It displays a N-S elongated shape with the highest point at -1746 m.Garibaldi/Glauco smt base is broadly rhomboidal and lies between -3205 m and -2384, averaging at -2872 m. The average height of the edifice is 1126 m. The eastern flank is characterised by steeper slopes (up to 45°) while the western flank slopes more gently (20° to 5°) towards the abyssal plain. The edifice extends toward the north with an elongated and narrow ridge. The Garibaldi/Glauco smt volume is approximately 15 km^3.

Volcanic structure

The morphology of Garibaldi/Glauco smt suggests the presence of N-S structural elements that influenced its development. It is located in the middle of the Southern Tyrrhenian Sea on a rise of the basement dividing the Vavilov and the Marsili spreading basins.

Chemical composition and age

The dredged samples from Garibaldi/Glauco smt indicate calc-alkaline mafic composition (Beccaluva et alii, 1981, Peccerillo, 2017). The age of this seamount is not known but it is considered to be Pliocene (Argnani & Savelli 1999, Peccerillo 2005).

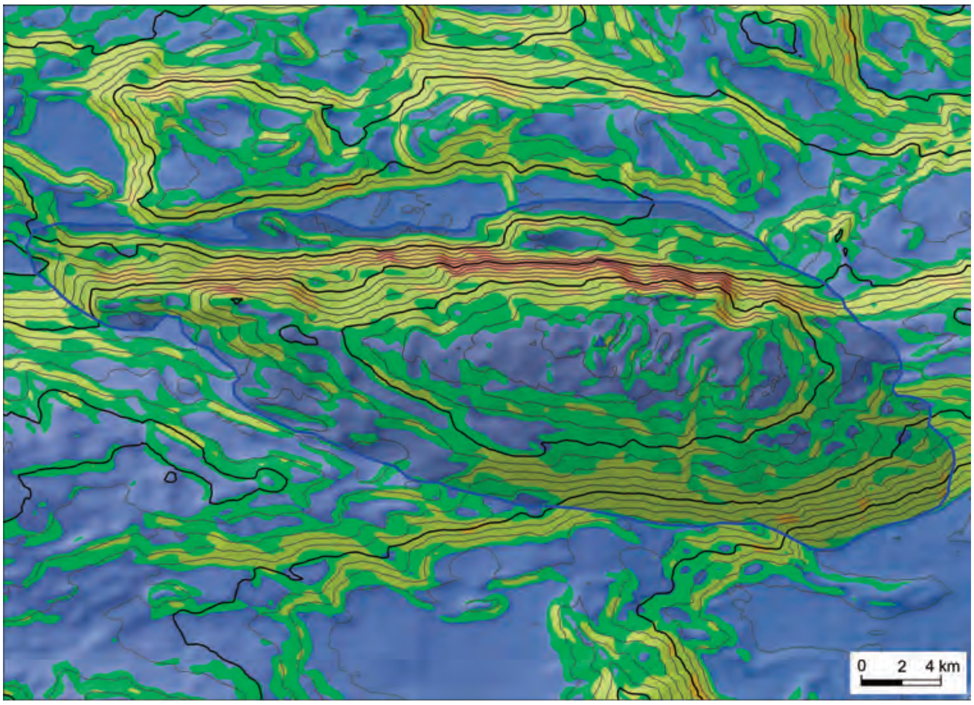
Volcanic products

Sedimentological and geochemical investigations carried out on core samples (TTR4-128G and 129G) from the northeastern flank of Garibaldi/Glauco seamount revealed the presence of distal volcaniclastic turbidites (De Vries & Lucchi, 1995).

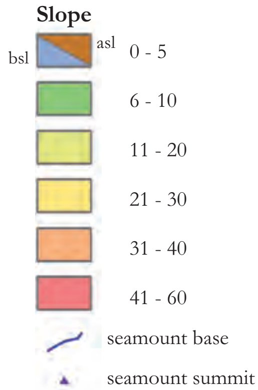
Brief volcanic evolution

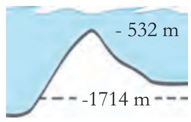
There is no direct information about the evolution of Garibaldi/Glauco seamount. The geographic location of this seamount is at the eastern edge of the Central Tyrrhenian Volcanic Seamount Sector and its inferred age is in agreement with an early arc, extending from the Pontinian Islands to the Anchise smt, and related to the opening of the Vavilov back-arc basin (Argnani & Savelli, 1999; Peccerillo, 2017).

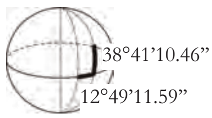
5.17 *Anchise Seamount*



Morph. ty.	Fissural edifice
Serie	HK-Calc-alkaline and Shoshonitic
Chem. com.	Basalts, shoshonites and trachytes
Act. ty.	Effusive
Act. age r.	5.2 Ma and 3.65 Ma
Vol. [km^3±10%]	206
Flu. ems.	Pockmarks







Morphology

Anchise seamount is composed by the coalescence of volcanic centres that define an overall elliptical shape E-W elongated (Calanchi *et alii,* 1984). The Anchise smt is located 35 km to the west of Ustica Island, from which is separated by a saddle at a depth of -1229 m. The northern slopes are very steep up to 46° and level off to depths around -2000 m. The southern flank has a gentler morphology with slope from 20° to 6° which level off at ca. -1500 m. The sheet F26 of the Progetto Magic (DPC-CNR, 2007-2013) shows along the southeastern flank the presence of erosive gullies and landslide scarps distributed radially from the eruptive centre. Calanchi *et alii* (1984) report three different shallow peaks at -595 m, -562 m and -532 m. The base lies between -2317 m and -1090 m, averaging at -1714 m, for an average height of the edifice of 1182 m.

The volume of Anchise smt is 206 km^3.

Volcanic structure

The very steep northern flank of the Anchise smt is affected by the Plio-Quaternary E-W normal faulting (Barone *et alii*, 1982) that determined the elongated shape of the edifice, also controlling the volcanic feeder system. According to Calanchi *et alii* (1984) the E-W fault is responsible for the formation of the deep basin located along the northern side of the seamount.

Chemical composition and age

Chemical compositions of Anchise smt products are high-K calc-alkaline trachyte, shoshonite and basalts (Calanchi *et alii*, 1984; Calanchi *et alii*, 1986). The basalts from the volcanic Anchise smt yielded K-Ar ages between 5.2 Ma and 3.65 Ma (Savelli, 1988; Peccerillo, 2017).

Volcanic products

Rocks dredged from Anchise smt northern flank are mainly composed by lavas with vesicular porphyritic textures (Peccerillo, 2017).

Brief volcanic evolution

There is no detailed information about the volcanic evolution of Anchise smt, but the Pliocene ages available for the deposits led some authors to propose the existence of a Pliocene arc extending from Anchise smt to the Pontinian Islands that sided the opening of the Vavilov back-arc basin (Argnani & Savelli, 1999; Peccerillo 2017).

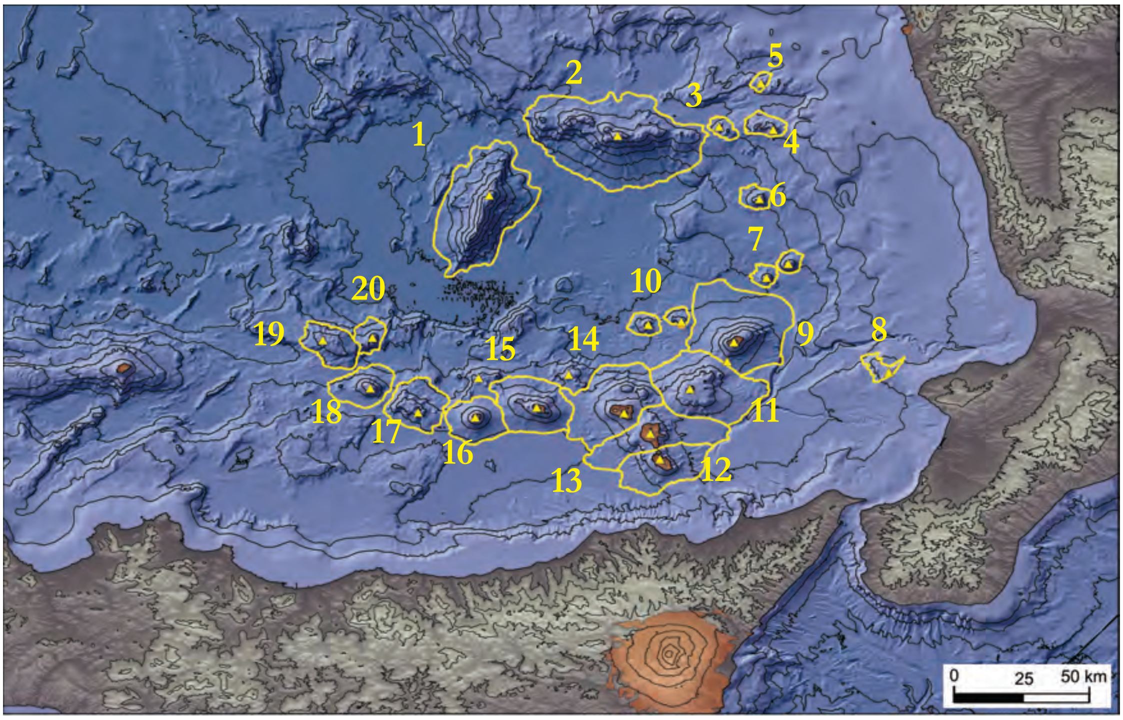


Fig. 13 - Overview of the volcanic seamounts of the Aeolian - E Tyrrhenian Volcanic Seamount Sector.
- Panoramica degli edifici vulcanici sommersi del Settore vulcanico sottomarino Eoliano - E Tirreno.

The Aeolian - E Tyrrhenian Volcanic Seamount Sector is located in the south-eastern portion of the Tyrrhenian Sea, comprised between the Calabrian western coasts and northern Sicily Island shores (fig. 13). This sector is not only composed by the seven Aeolian stratovolcanoes (Stromboli, Panarea, Vulcano, Lipari, Salina, Alicudi and Filicudi Islands), but also by several submerged volcanic edifices (Marsili/Plinio smt, Palinuro/Strabo smt, Glabro smt, Enotrio smt, Diamante smt, Alcione smt, Lametini smts, Capo Vaticano smt, Strombolino I and Strombolino II smts, Eolo smt, Enarete smt, Sisifo smt, Tiro smt).

The Aeolian-E Tyrrhenian Volcanic Seamount Sector relates to the fast retreat of the Ionian slab and the associated spreading of the Marsili basin (2-1 Ma) which overlaps both in time and space with arc-magmatism. As a result of this complex geodynamic framework, the rock compositions (fig. 14) range from calc-alkaline to shoshonitic and potassic alkaline, with an increase in potassium from the western to the central-eastern islands (Peccerillo, 2017). Lavas and pillow lavas constitute the principal products emitted from the seamounts.

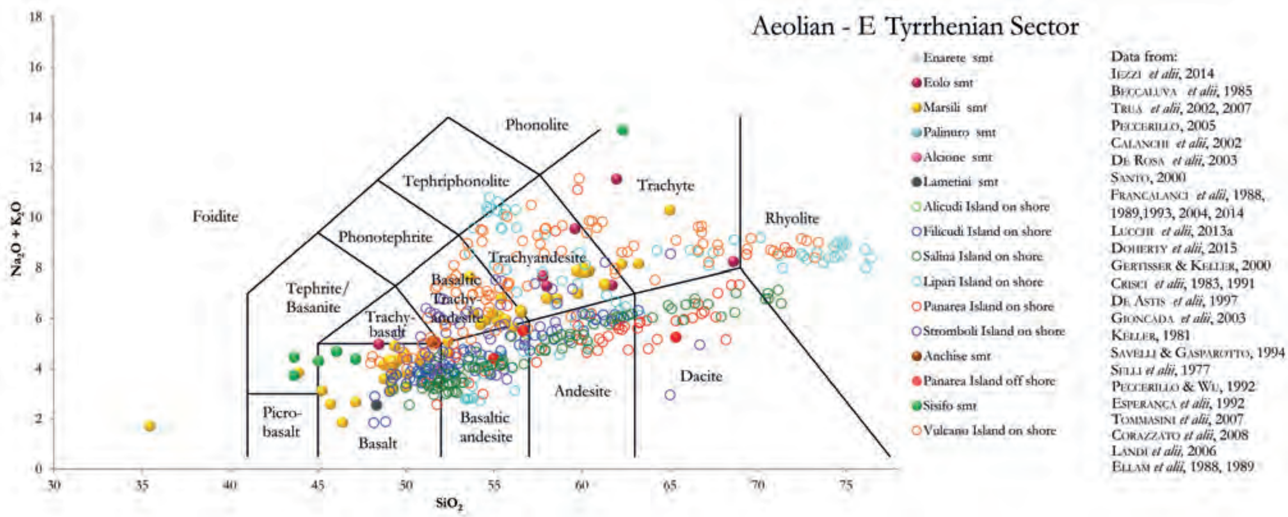
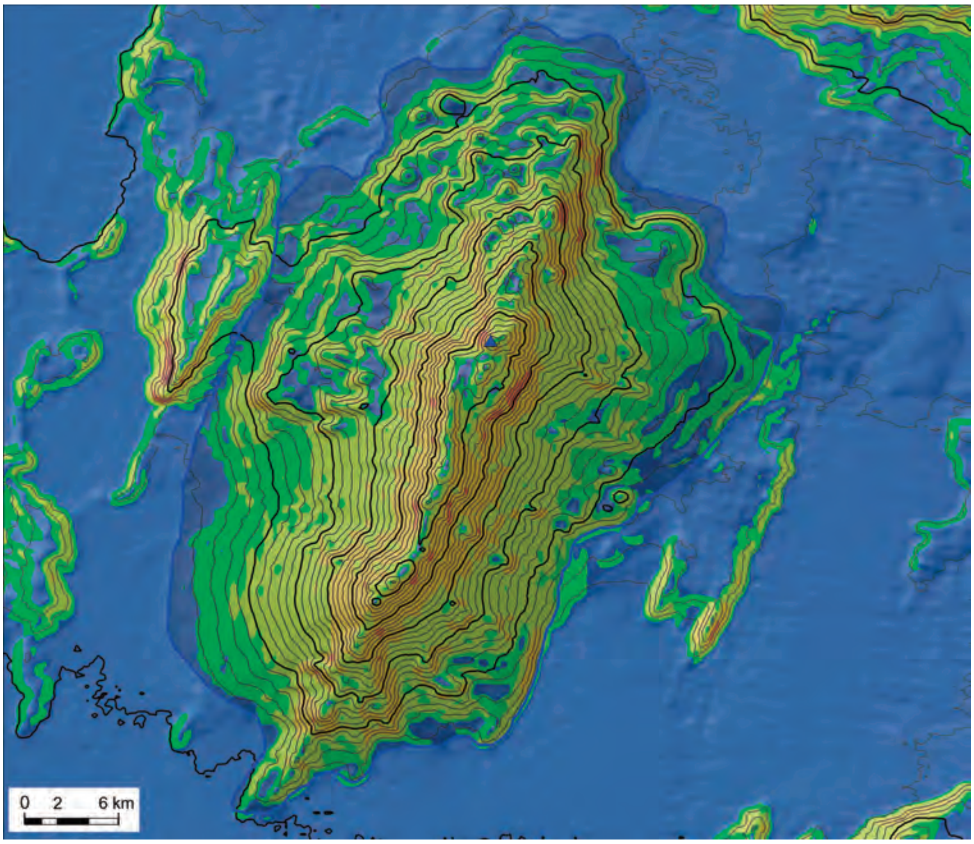
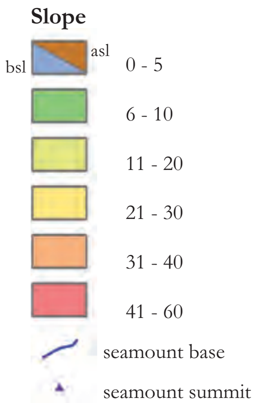


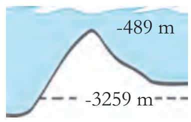
Fig. 14 - TAS diagram of composition of the Aeolian-E Tyrrhenian Volcanic Seamount Sector products. Data are plotted raw from cited sources and may include LOI up to >20%. The reader is referred to the original papers for an evaluation of the data and for the nomenclature adopted in this text.
- Diagramma TAS della composizione dei prodotti vulcanici relative al Settore vulcanico sottomarino Eoliano - E Tirreno. I dati sono tracciati dalle fonti citate e possono includere LOI fino a >20%. Si rimanda il lettore agli articoli originali per una valutazione dei dati e per la nomenclatura adottata in questo testo.

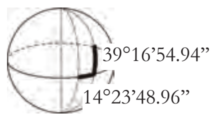
6.1 *Marsili/Plinio Seamount*



Morph. ty.	Fissural edifice
Serie	IAB-type to HK-calc-alkaline
Chem. com.	Basalts, andesites, trachy-andesites
Act. ty.	Mixed
Act. age r.	1 Ma - Present
Vol. [km^3±10%]	644
Flu. ems.	δ^3He hydrothermal activity







Morphology

The Marsili/Plinio seamount is one of the largest among the central Tyrrhenian edifices. Its base lies between -3508 m and -2855 m, averaging at -3259 m. The summit is at a minimum depth of -489 m, for an average height of the edifice of 2770 m. It is elongated ~60 km NNE-SSW with mean width of 30 km. The volcano summit is characterised by a narrow crest, 20 km long and 1 km wide, cut by linear structures, mainly disposed N-S. The volcano is rather symmetrical with slopes that levels from average of 20-30° in the upper reaches, to <10° where they connect to the surrounding seafloor at depths comprised between -3000 m and -3500 m. The sheet F21 of the Progetto Magic (DPC-CNR, 2007-2013) shows the presence of several cones along the summit crest and many others scattered along the slopes, mostly along the projection of the summit crest. A series of fault scarps are also indicated along the lower reaches of the NNE flank.

The total volume of Marsili/Plinio smt is ~644 km^3.

Volcanic structure

Marsili/Plinio is a fissural edifice. The elongation along NNE-SSW direction indicates that feeder conduits are mostly coalescent fissure-systems parallel to major regional fault systems. The youngest vent systems are typically represented by linear structures along the crest. They are small ridges, oriented N-S, i.e. at an angle with respect to the main elongation of the edifice, and are up to 100 m high and 750 m long. The geometry of these segments suggests that they may be en-echelon feeder-dikes (Italiano *et alii*, 2004). Numerous parasitic centres can be recognized especially to the north, where individual cones with circular bases may be up to 300 m high with diameters of 1500 m. Many of them are characterised by flat tops, semicircular terraces whereas a few display summit craters (Marani *et alii*, 2004). Several valleys are linear and oriented perpendicular to the main elongation of the edifice. An arcuate scar is present along the NW flank and may relate to a sector collapse (Italiano *et alii*, 2014). Magnetic and gravity surveys show that large portions of the volcano are hydrothermally altered and prone to sector collapses (Caratori Tontini *et alii*, 2010).

Chemical composition and age

Marsili/Plinio smt is an active volcanic structure (1 Ma-Present). Lava compositions range from basalts with medium-to low-K affinity found on the volcano flanks, to high-K andesites that crop out in the summit zone (TRUA *et alii*, 2002). The early lavas have mostly Island Arc Basalt (IAB) affinities, similar to tholeiitic basalts, while more recent deposits are mainly andesites and trachy-andesites with calc-alkaline affinity similar to those of the Aeolian arc (TRUA *et alii*, 2003). Sparse chronological data indicate that the summit andesitic lavas formed 0.2-0.1 Ma (SELLI *et alii*, 1977). Recent works on drill cores along the flanks of the volcano at depths between ca. -800 m and -900 m indicate the presence of Holocene tephra layers (2 ka to 7 ka) that could be related to strombolian activity of the Marsili/Plinio summit cones (IEZZI *et alii*, 2014; TAMBURRINO *et alii*, 2015). Marsili/Plinio smt is considered quiescent based on seismo-volcanic activity (D'ALESSANDRO *et alii*, 2012) and has recently attracted the attention of media and public for its possible reactivation.

Volcanic products

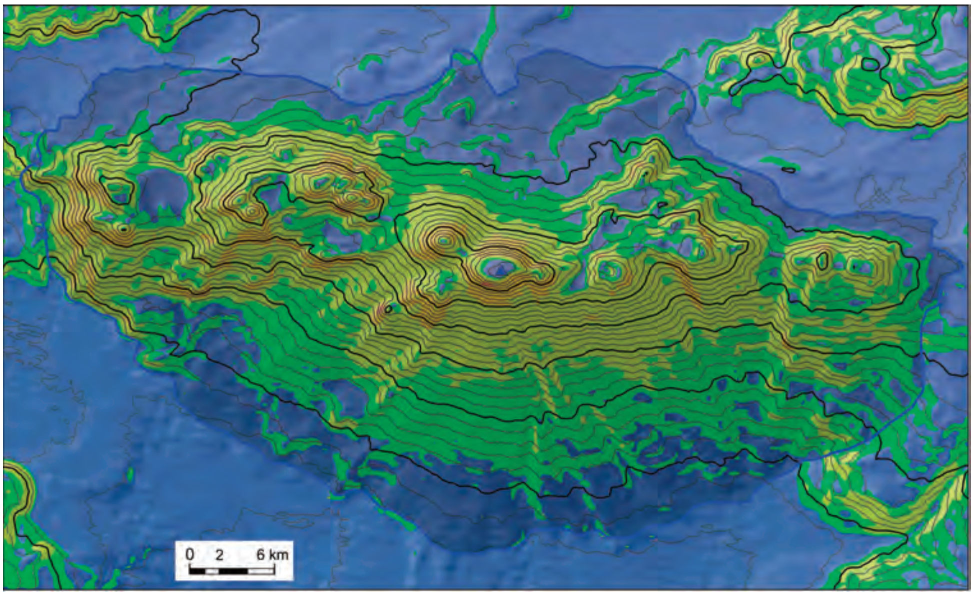
Principal products of Marsili/Plinio smt are effusive basaltic pillow lavas. Vents may be fissures, cones and low shields, suggesting variable eruption rates and occurrence also of mild explosive (strombolian l.s.) eruptions (IEZZI *et alii*, 2014). Strong δ^3He hydrothermal activity is also present (LUPTON *et alii*, 2011).

Brief volcanic evolution

The large volume and morphological complexity of Marsili/Plinio smt indicate that this is a composite, polygenetic structure that evolved over a prolonged period. VENTURA *et alii* (2013) suggest that the central part of the volcano has been fed by a pressurized magma chamber resulting in a central volcano, whereas the peripheral parts are made of fissural effusive systems that account for its elongated shape.

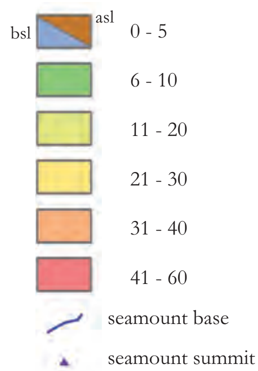
According to magnetic chronology, the beginning of the Marsili/Plinio smt growth started in Jaramillo subchron (1.07 Ma) and coincides with the waning (1.8 cm yr-1) of the spreading of the back-arc Marsili/Plinio basin which started earlier at faster rates (2.8-3.1 cm yr-1) during Matuyama subchron (COCCHI *et alii*, 2009). The Marsili/Plinio smt is therefore associated with a recent magmatic pulse which likely indicates a change in geodynamic framework (MARANI & TRUA, 2002; VENTURA *et alii*, 2013).

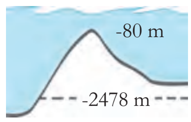
6.2 *Palinuro/Strabo Seamount*

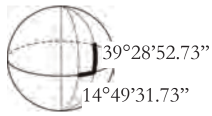


Morph. ty.	Fissural edifice
Serie	Calc-alkaline
Chem. com.	Basalts, basaltic-andesites
Act. ty.	Mixed
Act. age r.	0.8 - 0.3 Ma
Vol. [km^3±10%]	788
Flu. ems.	δ^3He hydrothermal activity

Slope







Morphology

Palinuro/Strabo seamount is one of the largest volcanic submerged edifices in the Tyrrhenian Sea and is located few kilometres northeastward from Marsili/Plinio smt. Palinuro/Strabo smt has an elongated and elliptical shape, with its major axis extending in E-W direction (Colantoni *et alii*, 1981; Passaro *et alii*, 2010; Caratori Tontini *et alii*, 2014). It is 75 km long and 35 km wide and reaches -80 m below sea level at its shallowest summit. The base lies between -3246 m and -1526, averaging at -2478 m. The average height of the edifice is 2398 m. Cocchi *et alii* (2017) associated Palinuro/Strabo smt to a larger volcanic chain, composed by 15 major volcanoes and minor sub-circular cones subdivided into two groups. The western group that constitutes Palinuro/Strabo smt, is formed by 8 different coalesced edifices, while the eastern group, according to those authors, is formed by seven volcanic edifices among which Glabro smt and Enotrio smt. The sheet F29 of the Progetto Magic (DPC-CNR, 2007-2013) shows steep slopes between 20-30° of the southern flank. The northern flank shows less steep slopes (<20°). Palinuro/Strabo edifice is characterized by an articulated morphology dominated by numerous cones, horseshoe-shape rims, landslide scars, and deep erosional gullies radially disposed along the flanks.

Palinuro/Strabo volcano total volume is 788 km^3.

Volcanic structure

Palinuro/Strabo smt is considered a fissural edifice (Milano *et alii*, 2012; Caratori Tontini *et alii*, 2014), located along an E-W trending, possibly strike-slip fault system extending seaward off the Calabrian Arc in the south-eastern Tyrrhenian Sea (Del Ben *et alii*, 2008).

Numerous are the NE-SW oriented dikes along the south and north flanks (sheet F29 of the Progetto Magic DPC-CNR, 2007-2013) and the semi-circular caldera rim in the centre and western part of the Palinuro/Strabo smt, which reaches depths of -1500 m and infer effusive origin (cf. Cas & Giordano, 2014). Shallow eruptive cones rise to depths of -80 m and -170 m, respectively, in the central part of the edifice (Caratori Tontini *et alii* 2014). Their tops are flat and are interpreted as modeled by erosion during the last eustatic sea-level lowering (Ciabatti, 1970; Fabbri *et alii*, 1973).

Several small features rising above the plateau are relics of wave erosion.

Chemical composition and age

Age and petrochemistry of rocks dredged from the Palinuro/Strabo smt are characterized by basalt and basaltic-andesite compositions, similar to the western Aeolian seamounts (Trua *et alii*, 2004a), and have been interpreted as related to the subduction of the Ionian slab beneath the Calabrian Arc (Colantoni *et alii*, 1981). The lavas from its top are Pleistocene in age (K-Ar, 0.8-0.3 Ma; Colantoni *et alii*, 1981; Beccaluva *et alii*, 1985; Savelli, 2002) and display a marked calc-alkaline affinity. Palinuro/Strabo is considered quiescent based on the presence of active degassing and hydrothermal areas (Marani & Gamberi, 2004; Lupton *et alii*, 2011; Petersen *et alii*, 2014).

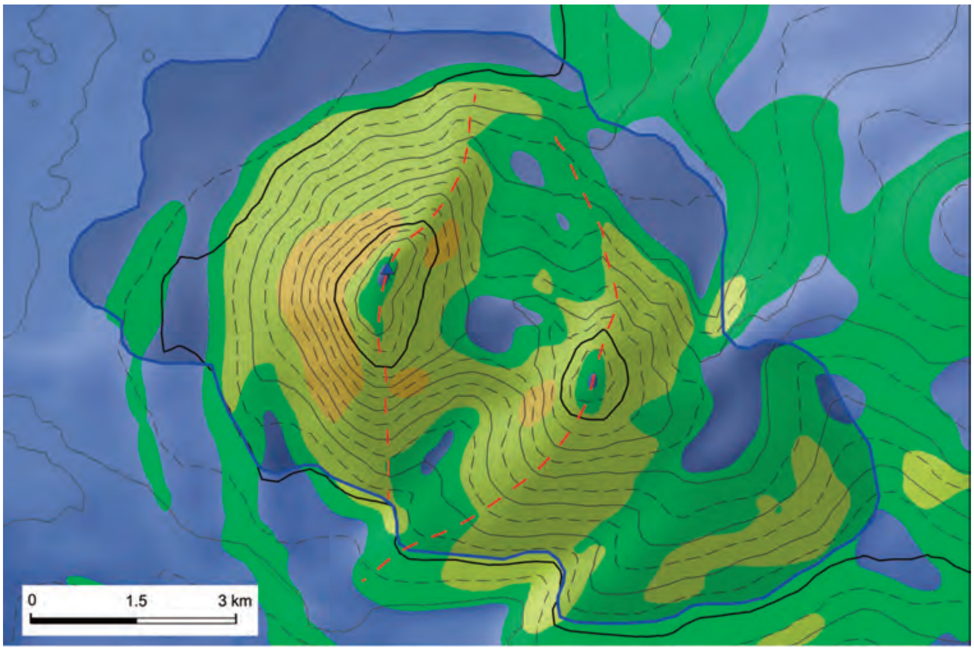
Volcanic products

The Palinuro/Strabo smt main products are lavas and volcanogenic sediments (i.e. crusts and iron- and manganese-bearing nodules sampled from the seamount's top; Rabbi, 1970; Kidd & Armansson, 1979), sometimes mixed with Pleistocene sediments.

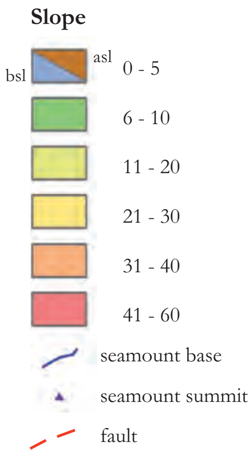
Brief volcanic evolution

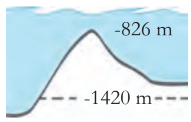
The volume and complex structure of Palinuro/Strabo smt indicates a long-lived system (Beccaluva *et alii*, 1982,1985; Savelli, 2002). The E-W elongation of this fissural edifice is controlled by a regional fault system (e.g., Colantoni *et alii*, 1981; Del Ben *et alii*, 2008). Guarnieri (2006) hypothesized that this fault system is strike-slip and may bound to the north the Calabrian-Arc subduction. The calc-alkaline signature of its magmas indicates that Palinuro/Strabo is part of the Aeolian Volcanic Arc (e.g., Finetti, 2005), although variations in interpretations are also present in the literature (e.g., De Astis *et alii*, 2003; Guarnieri, 2006).

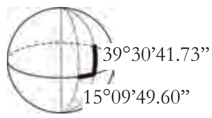
6.3 *Glabro Seamount*



Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	0.8-0.3 Ma
Vol. [km^3±10%]	6
Flu. ems.	δ^3He hydrothermal activity







Morphology

Glabro seamount is located to the east of Palinuro/Strabo fissural edifice. According to Peccerillo (2017) and Cocchi *et alii* (2017) it constitutes the oriental continuation of Palinuro volcanic chain with Enotrio smt and other unnamed volcanic edifices. Glabro smt is built on a structural high of the basement (Marani & Gamberi, 2004) and its base starts at depths around -1500 m. The volcano has an elliptical shape NW-SE elongated and its top is characterised by two highs: the shallowest western point is at -826 m and is characterised by a conical shape, while the eastern high is deeper, reaching -900 m and has an irregular shape. The two peaks are separated by a NNE-SSW depression, bounded by steep slopes (from 36 to 5°) along the NW flank and gentler slopes 21 to 5°along the SE flank. The width of the scar is larger at the top, where it reaches 2 km and narrows towards south, forming a saddle at the centre of the edifice at a depth of -1080 m. The base of the edifice lies between -1597 m and -1175 m, averaging at -1420 m, for an average height of 594 m. Glabro smt volume is approximately 6 km^3.

Volcanic structure

Glabro smt structural setting is mainly dominated by a series of arcuate to semi-arcuate, subparallel fault scarps that dismembered the edifice, testifing the presence of a N10°E striking spreading zone (Marani & Gamberi 2004; Cocchi *et alii*, 2017).

Chemical composition and age

There is no direct information on Glabro smt chemical compositions. Its age is proposed to be between 0.8 and 0.3 Ma (Savelli, 2002). Its association with the Aeolian-E Tyrrhenian Volcanic Seamount Sector is therefore tentative based on its geographic position.

Volcanic products

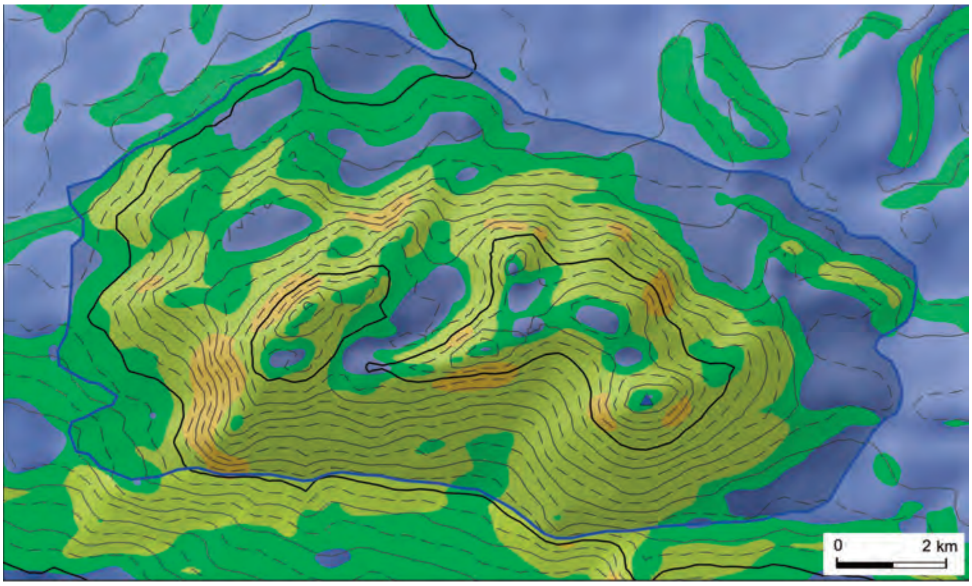
No rock samples are available for Glabro smt, although given its depth a dominant effusive activity is inferred. Very weak hydrothermal activity is present (δ^3He) (Lupton *et alii*, 2011).

Brief volcanic evolution

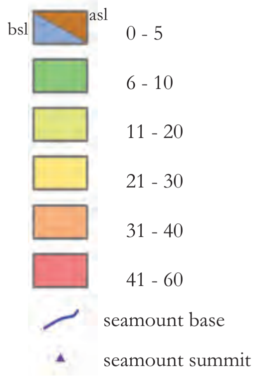
There is no direct information on Glabro smt volcanic evolution. From Caso *et alii*, (2010) the Glabro smt development is connected to the geodynamic evolution of Southern Tyrrhenian basin.

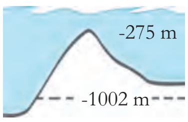
Enotrio Seamount 6.4

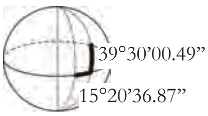
Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	/
Vol. [$km^3 \pm 10\%$]	21
Flu. ems.	/



Slope







Morphology

Enotrio seamount is located east of Glabro smt. It is an E-W elongated edifice, with a maximum axis of 10 km. Its elliptical base lies between -1210 m and -756 m, averaging at -1002 m. Its summit is at -275 m, for an average edifice height of 727 m. The upper portion of the edifice (from ca. -800 m to the top), especially the south part, displays steep flanks with slopes up to 33°. The Enotrio edifice is formed by two partly overlaid cones cut by NE-trending scarps and ridges. A NE-SW ridge that reaches depths between -340 and -400 m is present in the western sector of the edifice, parallel to the central saddle, sided to the east by another NE-trending ridge. The eastern sector of the summit crest is formed by small volcanic edifices with flat top (-275 m/-315 m of depth) in semi-circular disposition open to the SW.

The calculated total volume for Enotrio smt is 21 km^3.

Volcanic structure

Enotrio smt structure is dominated by its E-W overall orientation and by NE-trending ridges interpreted as faults and dikes (Cocchi *et alii*, 2017). This seamount was previously described as an outcrop of acoustic crystalline basement of volcanic or intrusive nature in Bigi *et alii* (1990).

Chemical composition and age

There is no direct information on Enotrio smt chemical composition and age. Its association with the Aeolian - E Tyrrhenian Volcanic Seamount Sector is therefore related only to its geographic location.

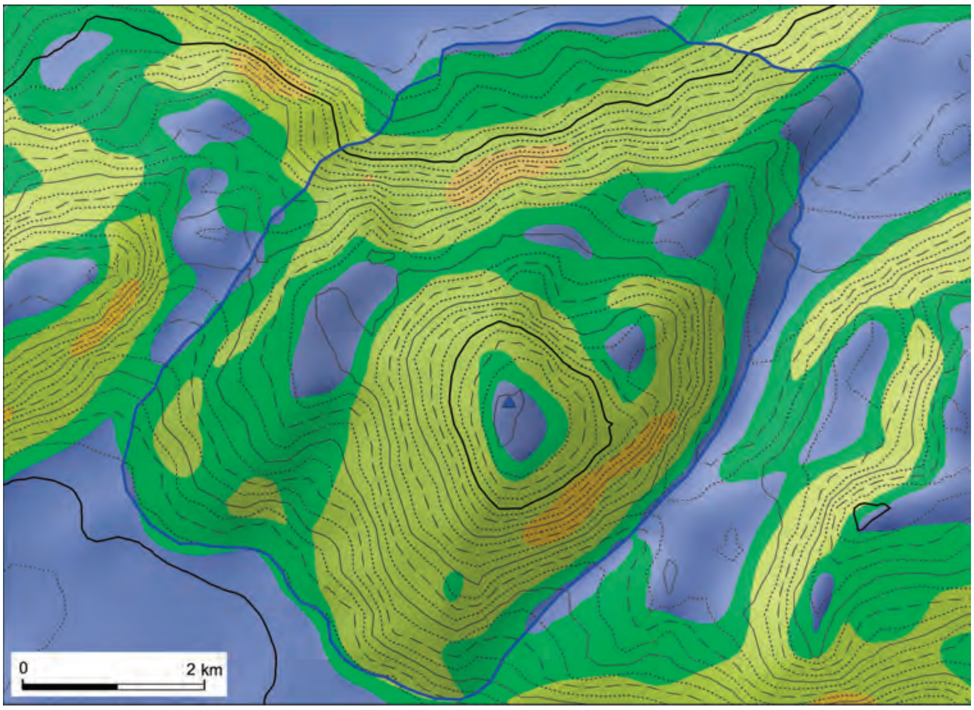
Volcanic products

Enotrio smt products are principally constituted by sheet-like lava flows and isolated lava pillows (Cocchi *et alii*, 2017).

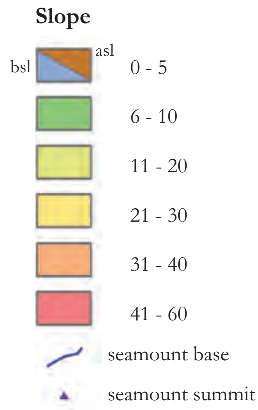
Brief volcanic evolution

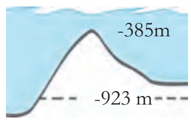
There is no direct information on Enotrio volcanic evolution.

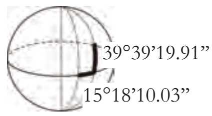
6.5 Diamante Seamount



Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	/
Vol. [km^3±10%]	5
Flu. ems.	/







Morphology

Diamante seamount is located just north of the Enotrio seamount and is a 8 km-long NE-SW elongated structure whose base lies between -1126 m and -719 m, averaging at -923 m. Its summit is at ca. -385 m, for an average edifice height of 538 m. The summit is shifted to the east where flanks are characterised by steep slopes up to 28°. Similarly, steep slopes are present along the north flank that is almost rectilinear trending ENE-WSW. The western and the southern slopes of Diamante smt show gentler slopes (20 to 5°).

Diamante smt total volume is 5 km^3.

Volcanic structure

The morphology of Diamante edifice is affected by NE-trending structural elements, described as listric faults by Rovere *et alii* (2016). This seamount is described by Bigi *et alii* (1990) as an outcrop of acoustic crystalline basement of volcanic or intrusive character.

Chemical composition and age

There is no direct information on Diamante smt volcanic products. Its association with the Aeolian-E Tyrrhenian Volcanic Seamount Sector is therefore tentative based on its geographic position.

Volcanic products

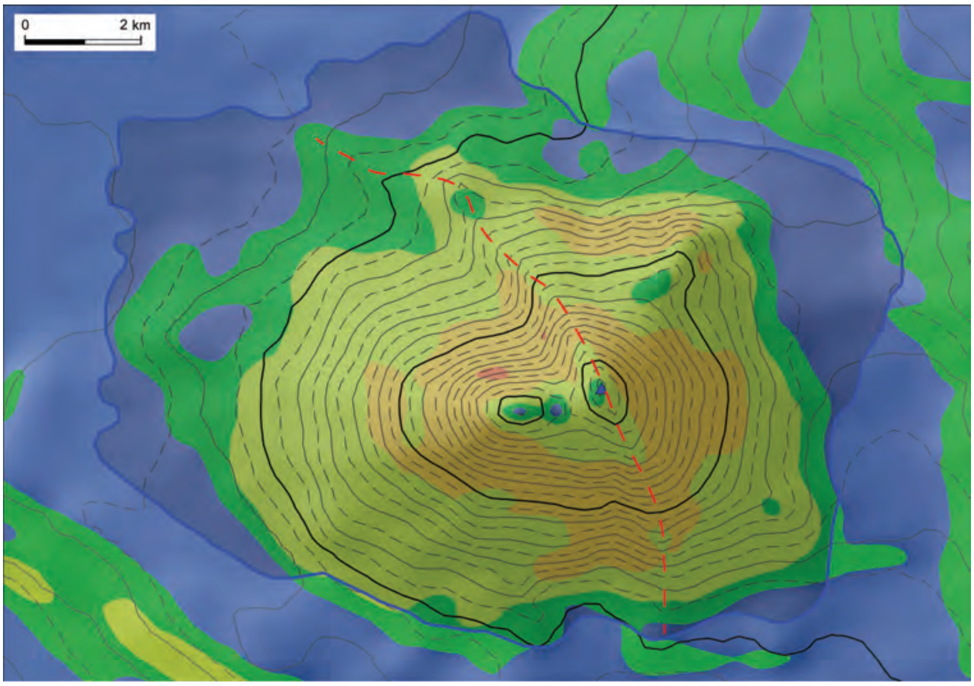
There are no available volcanic products of Diamante smt. Considering the depth, we infer a dominant effusive activity.

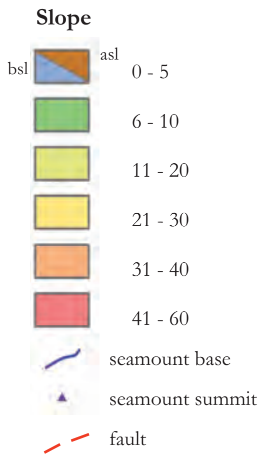
Brief volcanic evolution

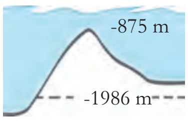
The volcanic evolution of Diamante volcano has not been studied yet.

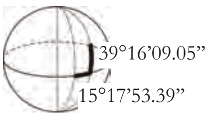
Alcione Seamount 6.6

Morph. ty.	Composite edifice
Serie	HK-calc-alkaline
Chem. com.	Basalts
Act. ty.	Effusive
Act. age r.	/
Vol. [km³±10%]	14
Flu. ems.	Weak hydrothermal activity









Morphology

Alcione seamount lies along the Calabrian slope delimited by the Palinuro/Strabo seamount to the north and Stromboli Island to the south. The volcanic edifice rises from a depth of more than 2000 m. The symmetry of the edifice is modified by a NNW-SSE lineament that crosses the entire structure apparently lowering the western sector. As a consequence, the summit region has two peaks: the eastern peak reaches -875 m while the western summit is at about -900 m (Marani & Gamberi, 2004). The base of the cone lies between -2205 m and -1740 m, averaging at -1986 m. The average height of the edifice is therefore 1111 m. The upper flanks, above -1800 m, show steep slopes up to 36°.

The total volume estimated for Alcione smt is 14 km^3.

Volcanic structure

Alcione smt is generally conical in shape, dissected by NNW-SSE trending faults. A 100 m relief arcuate scarp dislocates downwards the western half of the edifice. The scarp separates the two conical summit areas that characterize the top of the volcano (Marani & Gamberi, 2004).

Chemical composition and age

Lavas sampled on Alcione smt are basaltic in composition (Beccaluva *et alii*, 1985; Peccerillo, 2017). There is no direct age information of Alcione smt so that it can only be generically related to the Aeolian arc age interval (Beccaluva *et alii*, 1985).

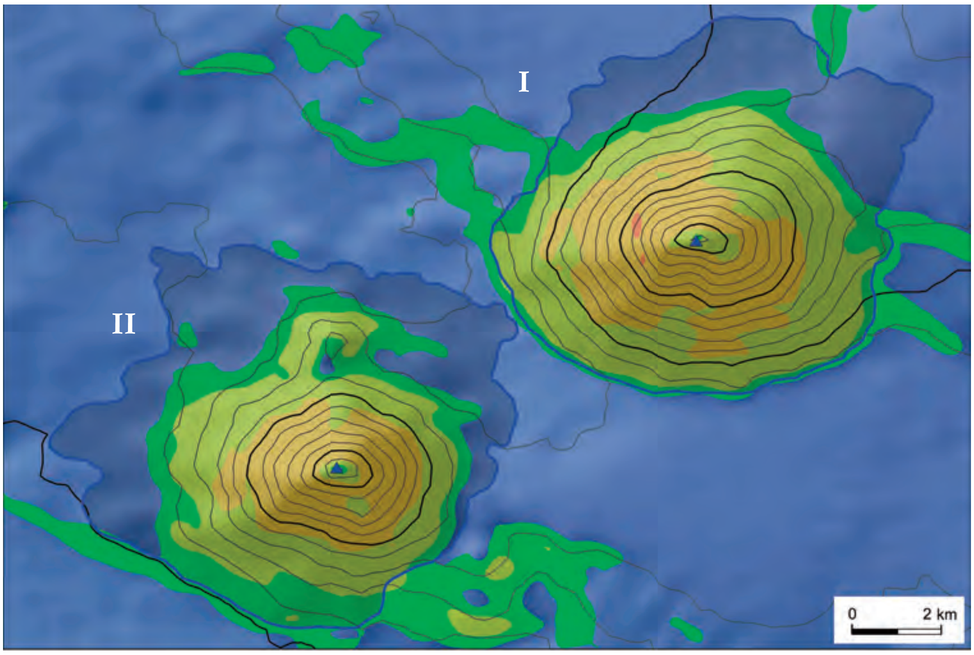
Volcanic products

Alcione smt products are constituted by lavas. Weak δ^3He hydrothermal activity has been measured near the summit (Lupton *et alii*, 2011).

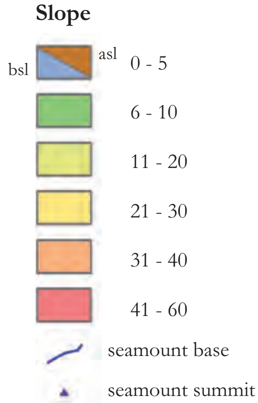
Brief volcanic evolution

There is no direct information about Alcione smt volcanic evolution.

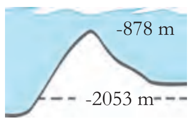
6.7 *Lametini Seamounts*

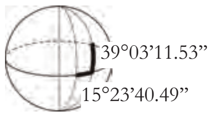


Morph. ty.	Composite edifice
Serie	Calc-alkaline
Chem. com.	Basalts, basaltic-andesites
Act. ty.	Effusive
Act. age r.	< 1 Ma
Vol. [km^3±10%]	12 (I); 8 (II)
Flu. ems.	Weak hydrothermal activity

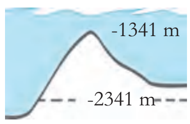


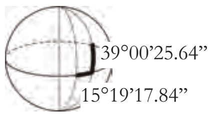
I





II





Morphology

Lametini seamounts are situated on the continental slope, 20 km south of Alcione smt. They are two edifices aligned in a NE-SW direction and 3 km apart and are named Lametini I and Lametini II, respectively. Both volcanoes are rather regular cones in the upper reaches and become elliptical at the base due to the slope of the underlying substrate. The average depths of the bases of Lametini I and II smts are -2053 m and -2341 m respectively, whereas their respective summits are at -878 m and -1341 m. The average height of Lametini I and Lametini II smts are 1175 m and 1000 m, respectively. The upper reaches of both cones above -2000 m are quite steep and reach slopes of 35°.

The volume estimated is 12 km^3 for Lametini I smt and 8 km^3 for the Lametini II smt.

Volcanic structure

The Lametini smts cones are rather regular and steep, suggesting that these structures are recent and undissected.

Chemical composition and age

Radiometric ages for the Lametini smts are not available, but their calc-alkaline affinity suggests a geodynamic environment related to the Aeolian arc, therefore the age should be younger than 1 Ma (Barberi *et alii*, 1974; Peccerillo, 2017). Very weak hydrothermal activity was detected by Lupton *et alii* (2011), but absence of He suggests that the volcanoes are extinct.

Volcanic products

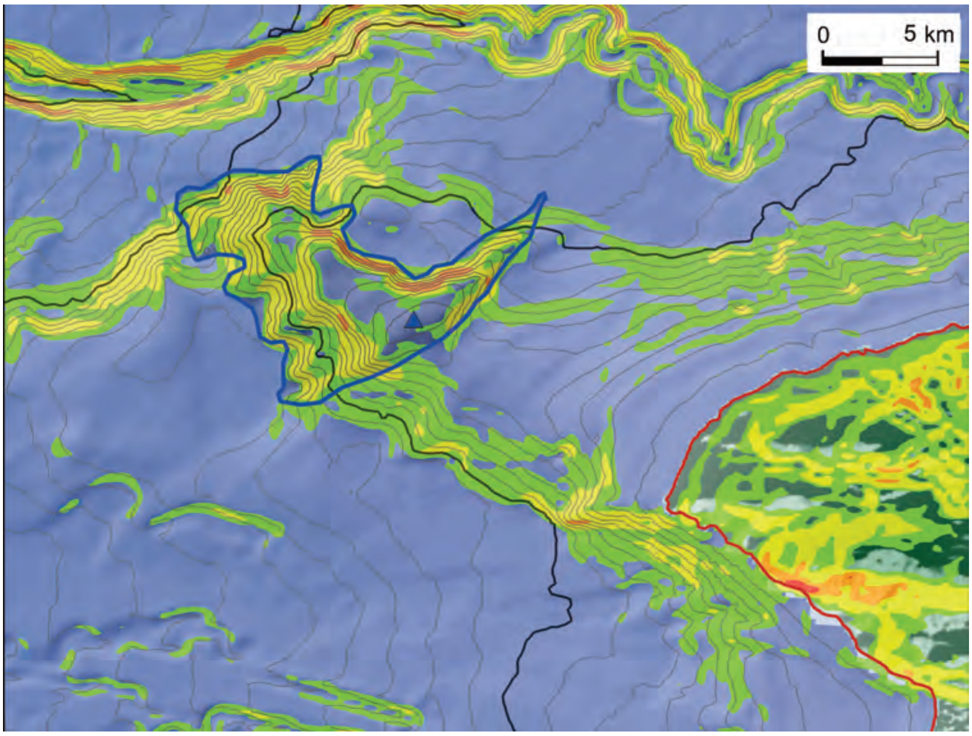
Products associated with Lametini smts have been reported as basalt and basaltic andesite lavas (Peccerillo, 2017).

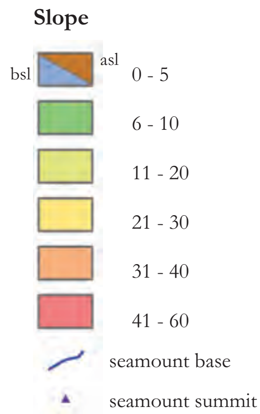
Brief volcanic evolution

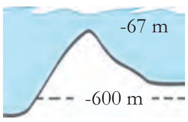
There is no direct information on Lametini smts volcanic evolution.

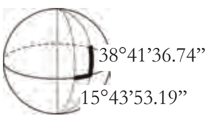
Capo Vaticano Seamount 6.8

Morph. ty.	Fissural (?)
Serie	Calc-alkaline
Chem. com.	Dacites to rhyolites
Act. ty.	Explosive
Act. age r.	/
Vol. [km^3±10%]	11
Flu. ems.	CO_2, CH_4, and ^3He









Morphology

Capo Vaticano seamount is a recently discovered, NE-SW elongated and largely buried structure, interpreted as volcanic in origin from a positive magnetic anomaly, seismic data and degassing (Loreto *et alii*, 2015a,b). The seamount is located at ca. 12 km from the Calabrian coast. The base of the seamount lies at -146 m on the side facing the Calabrian coast and at -1078 m on the opposite side, averaging at -600 m. Its shallowest point is located at -67 m for an average height of 533 m. The ridge appears cut through by NE-trending lineaments.

The estimated volume is ca. 11 km^3.

Volcanic structure

Magnetic data show a 20 km long and 3-5 km wide magnetized body that extends from sea floor to about 3 km below sea level (De Ritis *et alii*, 2010b). The combined interpretation of the magnetic, seismic and available geological data suggest that Capo Vaticano ridge morphology is the result of the presence below of an E-W elongated magmatic body or laccolith extending down to 3 km depth. This deep body is the feeder of the seamount interpreted as volcanic in nature. The ridge is affected by NE-trending Pleistocene extensional faults.

Chemical composition and age

There is no direct information available for the subaqueous products of Capo Vaticano smt, but the geographic location is consistent with its association with the Aeolian arc magmatism and volcanism both in terms of chemistry and age. Pyroclastic rocks outcropping in the Calabrian onshore younger than 1 Ma have been interpreted as related to this volcanic seamount and have a dacitic to rhyolitic composition (De Rosa *et alii*, 2008).

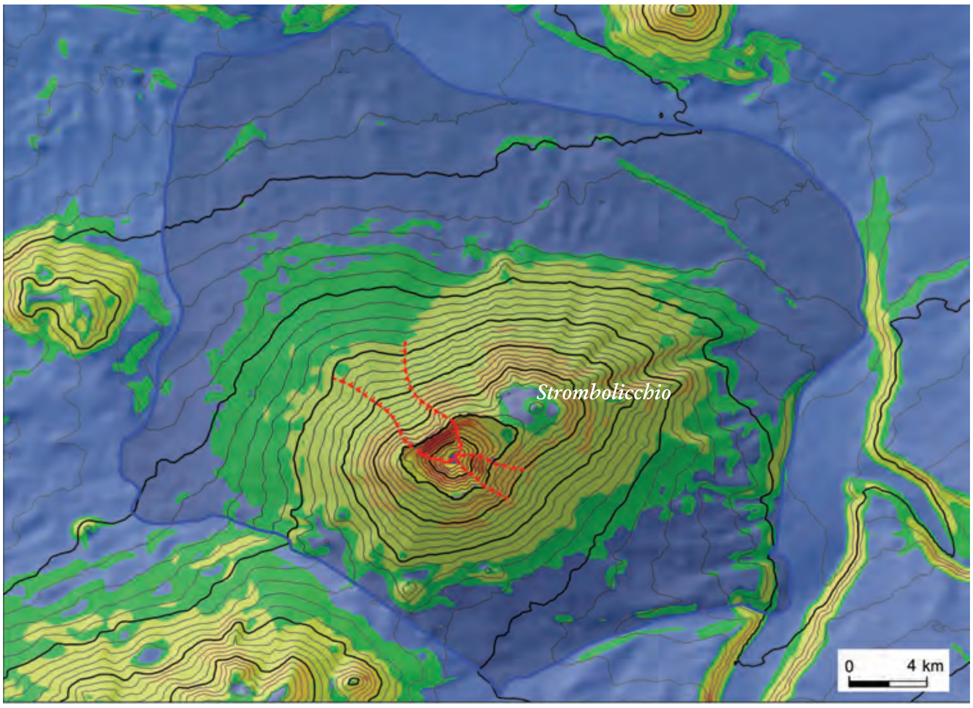
Volcanic products

There is no direct information about the nature of Capo Vaticano smt. CO_2, CH_4, and ^3He fluid emissions were identified by Loreto *et alii* (2015a,b).

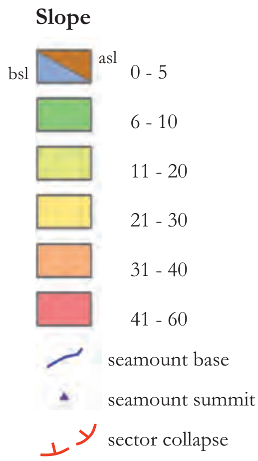
Brief volcanic evolution

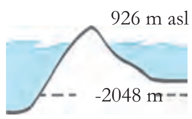
The evolution of Capo Vaticano ridge is linked to the Calabrian Arc during Pleistocene. The fragmentation of the upper crust resulted in the formation of several segments with different uplift rates bordered by transversal faults. Magma emplacement may have occurred along structures like the WNW-trending fault (De Ritis *et alii*, 2010b).

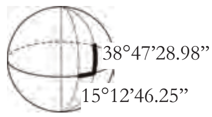
6.9 *Stromboli Island*



Morph. ty.	Stratovolcano
Serie	Calc-alkaline to shoshonitic
Chem. com.	Basalts to dacites, basaltic-trachyandesites
Act. ty.	Mixed
Act. age r.	>0.204 Ma - present
Vol. [km³±10%]	278
Flu. ems.	/







Morphology

Stromboli Island is a stratovolcano 926 m high above sea level, with an area of 12.2 km^2. It represents the emergent part of a large submerged edifice that rises from an average depth of -2000 m with gentle slopes. Its morphology is rather symmetrical with respect to a NE-SW elongation axis. This elongation appears related to the presence at the summit of two source areas, one where the active Stromboli volcano is located and one to the NE, where a shallow trapezoidal erosional platform emerges in the Strombolicchio neck.

The lower reaches slopes of the submerged edifice are 6-10° and steepen up to 20° to average depths of -1000 m, above which they rise to inclinations of up to 30°. Steeper slopes, up to 40° inclined, are present in the shallower northwestern reaches, in correspondence of the subaerial sector collapse scar of the Sciara del Fuoco. This area represents the submerged continuation of the Sciara scar which extends north-westward and connects with a debris fan related to debris avalanche deposit, characterised by an hummocky morphology (Romagnoli *et alii*, 1993, 2009; Kokelaar & Romagnoli, 1995). The submerged part of Sciara is bounded by two steep escarpments, which are up to 200 m high, and slightly converging down slope. The sheet F16 of the Progetto Magic (DPC-CNR, 2007-2013), shows the presence of scattered blocks on top of the debris avalanche fan.

Smaller canyons are present also along the northeastern and southeastern slopes. The southwestern slopes show a quite different morphological fabric, characterised by a much more "granular" texture that can be associated with the presence of parasitic cones. In this area are located two small but well defined parasitic edifices named Cavoni (Gabbianelli *et alii*, 1993) and Casoni (Gamberi *et alii*, 2006) which are located at a depth of around -700 m and -1000 m respectively. The base of Stromboli lies between -2824 m and -1276 m, averaging at -2048 m, for a total average height of the edifice of 2974 m. The volume of Stromboli volcano edifice is 278 km^3.

Volcanic structure

Stromboli stratovolcano consists of two distinct coalescing edifices aligned in the NE-SW direction (Stromboli and Strombolicchio). The NE part is older and the edifice appears largely eroded, whereas the active Stromboli does not show the presence of terraces and connects rather in continuity with the submerged slopes. The elongation of the edifice, the migration of the active areas and the presence of parasitic cones, like Casoni smt and Cavoni smt, along the southewestern slope, suggest that the feeding system of Stromboli is controlled structurally by NE-trending lineaments and an orthogonal extension (e.g. Tibaldi, 2003).

The most prominent structure visible is the large scar of the Sciara del Fuoco along the NW flank of both the subaerial and submerged flank of the edifice, largely formed during multiple collapses in the Holocene (Porreca *et alii*, 2006; Speranza *et alii*, 2008; Francalanci *et alii*, 2013). This depression, partially filled by the products of the present activity of the volcano, extends below sea level down to a depth of -700 m (Chiocci *et alii*, 2008).

Chemical composition and age

The affinity of Stromboli volcano products is variable, ranging from calc-alkaline and high-K calc-alkaline to shoshonitic (Francalanci *et alii*, 1989, 2013). Volcanic products range from basalts to dacites to basaltic-trachyandesites. The oldest rocks dated are the Strombolicchio neck lavas, at 204 ka (K-Ar in Francalanci *et alii*, 2013). A period of quiescence accounts for the erosion of Strombolicchio and the migration of the activity a few kilometers to the SW, where the subaerial part of Stromboli volcano was built in the last 85 ka and is presently in persistent activity (Francalanci *et alii*, 2013).

Volcanic products

Stromboli volcano products are mainly constituted by lavas and pyroclastic rocks. The overall subaerial stratigraphy shows that the volcano has collapsed several times so that the volcanic succession can be subdivided in different unconformity bounded rock-packages that are, from oldest to youngest (Francalanci *et alii*, 2013), from 85 ka to 1.2 ka old.

The Sciara del Fuoco is the presently active area where a large amount of coarse-grained volcaniclastic material, derived by the persistent strombolian activity, is collected and deposited as turbidity currents radially down to -2400 m and 20 km far from the volcano edifice. At about - 800 m these volcanoclastic turbidites are deviated northwards by the presence of a bulge (Casalbore *et alii*, 2010).

During dredging operation along the south west flank of Stromboli Island (sample D01 Gamberi *et alii*, 2006), fresh lava samples and vescicular scoriaceous material were recovered from Casoni seamount.

Brief volcanic evolution

Stromboli volcanic and structural evolution has been characterized by the alternation of constructive and destructive phases. Six main Eruptive Epochs of activity were recognised by Francalanci *et alii* (2013).

- Strombolicchio (ca. 204 ka) represents the ancient activity of a dismantled volcanic edifice whose products compositions are similar to Paleostromboli II material. The only available dating on Strombolicchio was performed by Gillot & Keller (1993).
- Eruptive Epoch 1 (ca. 85-75 ka) Paleostromboli I stratocone: the first subaerial activity of Stromboli volcanic edifice involved the south-eastern sector of the island where nowadays the oldest products are still exposed. The building of the Paleostromboli took place through the alternation of violent strombolian and sub-plinain explosions from the central vent. Previous datings of ca. 156 ka (Condomines & Allegre, 1980) and 110 ka (Gillot & Keller, 1993) have been excluded by Francalanci *et alii* (2013) because of high analytical errors.
- Eruptive Epoch 2 (ca. 67-54 ka) Paleostromboli II stratocone: after a period of quiescence and caldera collapse the second eruptive epoch started with a renovation of the activity from the central vent with the emplacement of lava flows, and strombolian products. The last part of the eruptive epoch 2 was characterised by the partial collapse of the southern western flanks of Paleostromboli II edifice.
- Eruptive Epoch 3 (ca. 41-34 ka) Paleostromboli III stratocone: after the second period of quiescence and caldera collapse, the activity started again within the collapsed area with lava flows and fallout scoriae emplacement that built the Paleostromboli III.
- Eruptive Epoch 4 (ca. 26-13 ka) Vancori stratocone: the third prolongated period of no activity produced the dismantling of Paleostromboli III. The construction of Vancori stratocone developed through the alternation of thick lava flow emissions and periods of quiescence and erosion. The end of the fourth epoch is dominated by the collapse of the NW summit sector of the Vancori stratocone (today occupied by Sciara del Fuoco).
- Eruptive Epoch 5 (ca. 13-4 ka) Neostromboli activities. The depression generated by Vancori stratocone collapse was filled by the new products (thick lava flows) of Neostromboli stratocone. The fifth eruptive epoch was characterised by the alternation of effusive, strombolian and hydromagmatic eruptions from eccentric vents and fissural vents interrupted by periods of no activity and erosions.

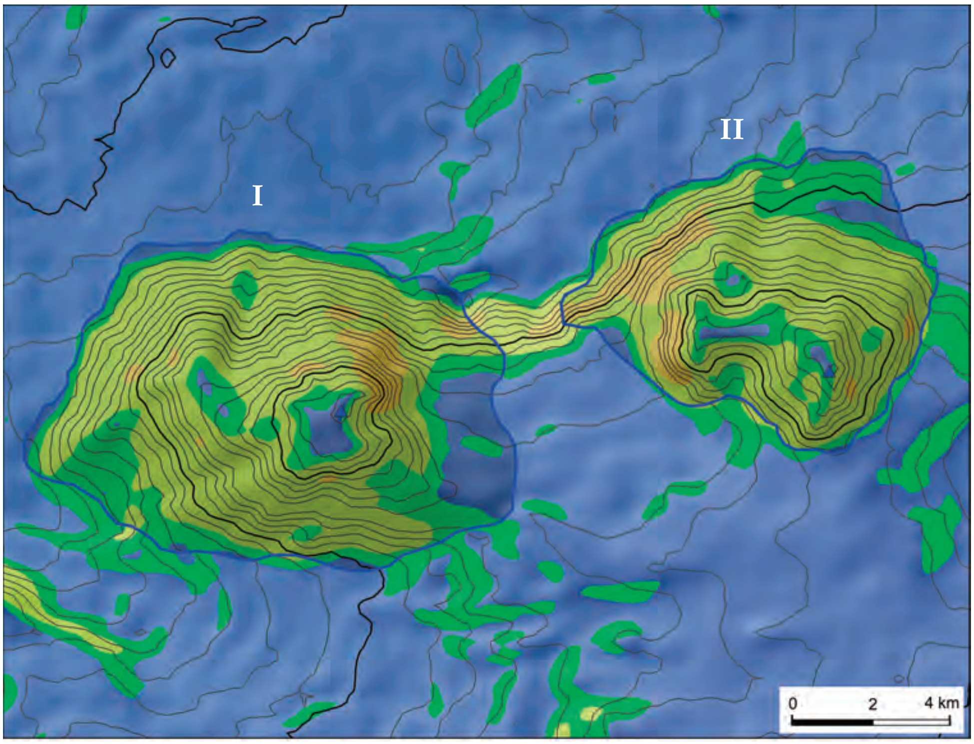
• Eruptive Epoch 6 (2.4 ka-Present) the last eruptive epoch comprises the last 2000 years till present. It is constituted principally by central emissions of lava and strombolian products and secondarily by parasitic fissural vents along the flanks. The subsequent collapses of the Vancori and Neostromboli stratocones summit generated the large NE-dipping horseshoe-shaped scar known as "Sciara del Fuoco", that reached its actual shape during the last period of activity.

Today the activity consists of persistent to quasi-persistent alternation of minor and strong explosions that produce black scorias, spatter deposits, and lapilli tuff principally emitted from three active craters and other minor vents and emplaced along Sciara del Fuoco and nearby the craters. This style of activity gives the name to the strombolian style used in the volcanological literature.

For detailed volcanic evolution of Stromboli volcano see also (ROSI, 1980; CONDOMINES & ALLEGRE, 1980; FRANCALANCI *et alii*, 1989; GILLOT & KELLER, 1993; CORTÉS *et alii*, 2005; FRANCALANCI *et alii*, 2013 and references therein).

Strombolino I and Strombolino II Seamounts 6.10

Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	/
Act. age r.	/
Vol. [km^3±10%]	15 (I) 9 (II)
Flu. ems.	/



Slope

bsl asl 0 - 5

6 - 10

11 - 20

21 - 30

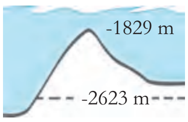
31 - 40

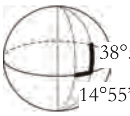
41 - 60

seamount base

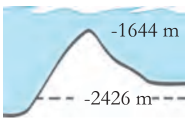
seamount summit

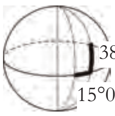
I





II





Morphology

Strombolino I and Strombolino II seamounts are located ca. 15 km WNW from Stromboli Island. There is not much information about these two volcanic edifices; in Bigi *et alii* (1990), they are indicated as inferred volcanic edifices. From the bathymetric analysis (sheet F16 of the Progetto Magic DPC-CNR, 2007-2013) both seamounts have sub-rounded shape with slight E-W elongation. The western edifice Strombolino I shows a more regular conical shape with respect to Strombolino II that is instead characterised by a more articulated morphology. The presence of a horseshoe-shaped depression along the southern slope of Strombolino II edifice can be interpreted as a sector collapse scar.

Both seamounts grow on an inclined basement sloping NNW-ward at depths comprised between -2900 m and -2100 m. The average base depth of Strombolino I and Strombolino II are -2623 m and -2426 m respectively. The summit of Strombolino I is at -1829 m and that of Strombolino II at -1644 m. The heights of the two seamounts are 794 m and 782 m, respectively. Slopes are steeper (up to 33°) along the NE flank of Strombolino I and along the western flank of the Strombolino II. The total volume of Strombolino I is 15 km^3 and 9 km^3 for Strombolino II.

Volcanic structure

The morphology of the two edifices is rather different and may be the result of different ages and/or different ratios of constructive vs destructive processes. The sector collapse scar along the southern slope of Strombolino II is confined by ca. N-S crests that may have a structural control. Similarly, a rather evident NW-trending crest along the northern slope could be interpreted as a radial dyke. Strombolino I appears as a fresher structure, where a ca. N-S lineament along the northern slopes may also have a structural control.

Chemical composition and age

No information is available about the chemical composition and age of the two seamounts, so that their association with the Aeolian - E Tyrrhenian Volcanic Seamount Sector is tentative and related to their geographic location.

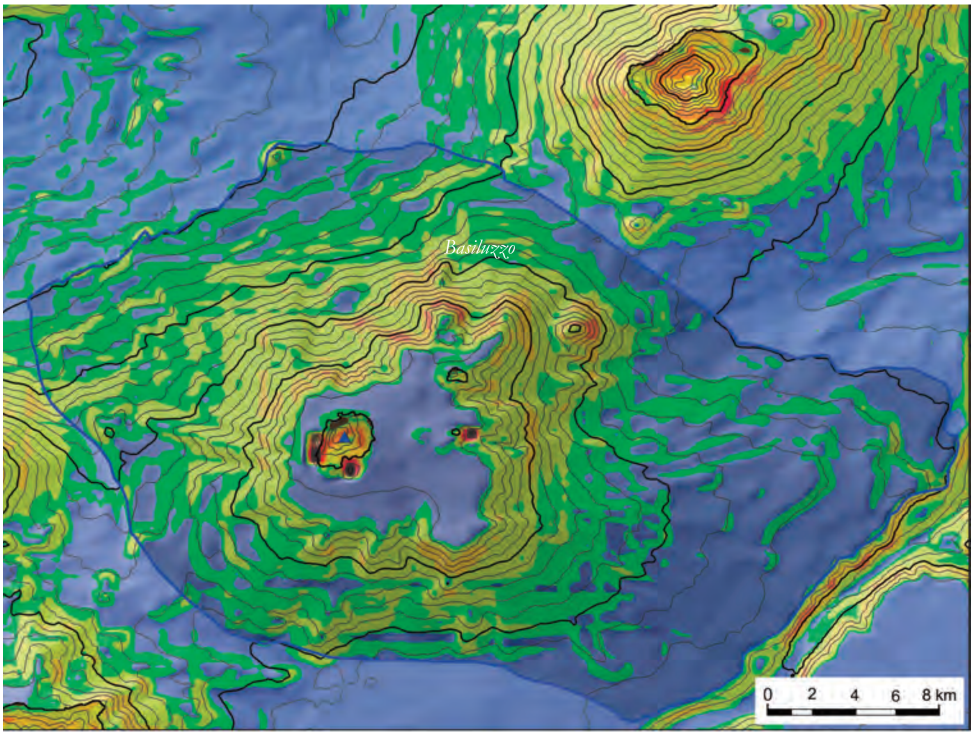
Volcanic products

No information about the two seamounts volcanic products.

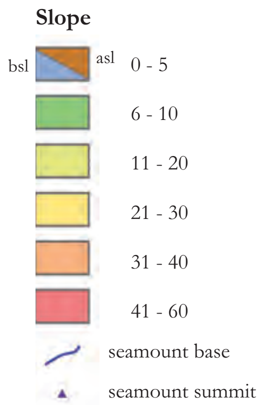
Brief volcanic evolution

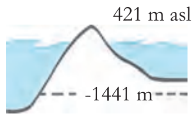
No information about the two seamounts volcanic evolution.

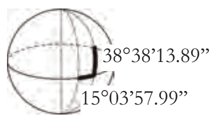
6.11 *Panarea Island*



Morph. ty.	Stratovolcano
Serie	HK-calc-alkaline
Chem. com.	High-K calc-alkaline basaltic-andesites to rhyolites
Act. ty.	Mixed
Act. age r.	0.155 Ma - 0.009 Ma
Vol. [km^3±10%]	293
Flu. ems.	CO_2, SO_2, HCl, HF







Morphology

Panarea Island is located in the Southern Tyrrhenian Sea and is the smallest of the Aeolian archipelago with an area of 3.4 km^2 and an elevation of 421 m above sea level. However most of its edifice is submarine. The base of the edifice lies between -2027 m and -750 m, averaging at -1441 m, for an average height of the edifice of 1862 m. Panarea edifice is truncated cone shaped elongated NE-SW. Panarea Island, together with the surrounding islets of Basiluzzo, Dattilo, Bottaro, Spinazzola, Lisca Bianca, Lisca Nera, Panarelli and Le Formiche (see fig. 5 in MONECKE *et alii* this volume) rise from a relative flat and shallow submerged platform which has an average diameter of ca. 10 km and whose edges lie at ca. -110 m.

The flanks of the edifice are sub-conical on the southern sector that gently slopes towards the abyssal plain with inclinations from 20° to 6°. The eastern and the northern flanks show a much more irregular morphology with abrupt and strong changes in slope and inclinations that exceed 30° at depths above -500 m. From sheet F16 of the Progetto Magic (DPC-CNR, 2007-2013) this part of the edifice results cut by numerous erosional canyons, channels and fault escarpments, the latter oriented NE-SW parallel to the main orientation of Panarea Island. Furthermore, several landslides scars with NW-SE direction are present. The northeastern flank of Panarea volcanic edifice is also marked by numerous gravitational flows, avalanche bodies.

The estimated Panarea volcanic edifice total volume is 293 km^3.

Volcanic structure

Structural studies on Panarea Island and surrounding islets display a principal NE-SW tectonic trend (CALANCHI *et alii*, 1999; ESPOSITO *et alii*, 2006; LUCCHI *et alii*, 2013b). This principal trend is highlighted by the orientations of normal faults, dykes, volcanic alignments and fault scarps recognized in the submerged part between the two largest islands Panarea and Basiluzzo (ESPOSITO *et alii*, 2006). A secondary NW-SE structural system is also recognised especially along Dattilo and Panarelli islets (ESPOSITO *et alii*, 2006) and on the subaerial part of Panarea Island where the presence of this fault system is proved by series of volcanic dykes and alignments. The two NE-SW and NW-SE fault systems are considered as the feeders of the gas discharge in the corresponding fumarolic field comprises among the islets of Dattilo, Panarelli, Lisca Bianca, Bottaro and Lisca Nera. (ESPOSITO *et alii,* 2006; MONECKE *et alii*, 2012; ROMAGNOLI *et alii*, 2013).

The shallow platform wherefrom the island emerges is considered the results of cyclical phases of sea level fluctuation (Late Quaternary), that led to the formation of terraces due to the alternation of erosion and deposition processes (ROMAGNOLI *et alii*, 2013; LUCCHI *et alii*, 2013b).

Chemical composition and age

Panarea volcano chemical compositions range from calc-alkaline basaltic-andesite to rhyolite; however, high K-calc-alkaline affinity has also been recognized for shoshonites (CALANCHI *et alii*, 2002; PECCERILLO, 2005; LUCCHI *et alii*, 2013b). $^{40}Ar/^{39}Ar$ and K-Ar dating of 155-149 ± 5 ka for a sample from Punta Muzza formation (Paleo-Panarea informal unit) has been estimated as the oldest dating available for Panarea Island (CALANCHI *et alii*, 1999; LUCCHI *et alii*, 2013b). The youngest deposits are the Drauto pumices, produced by explosive activity, dated between 24-8.7 ka (LUCCHI *et alii*, 2013b).

Volcanic products

Panarea volcano products are mainly composed by lava flows, lava domes, dykes, and pyroclastic deposits. In many cases lavas contain abundant igneous and metamorphic xenoliths. CO_2-dominated degassing (with minor amounts of SO_2, HCl and HF) and/or hydrothermal phenomena have been detected in the waters around Basiluzzo and Panarea, with the resulting deposition of whitish sulphur precipitates (GABBIANELLI *et alii*, 1986; CAPACCIONI *et alii*, 2007; CAS *et alii*, 2011).

Brief volcanic evolution

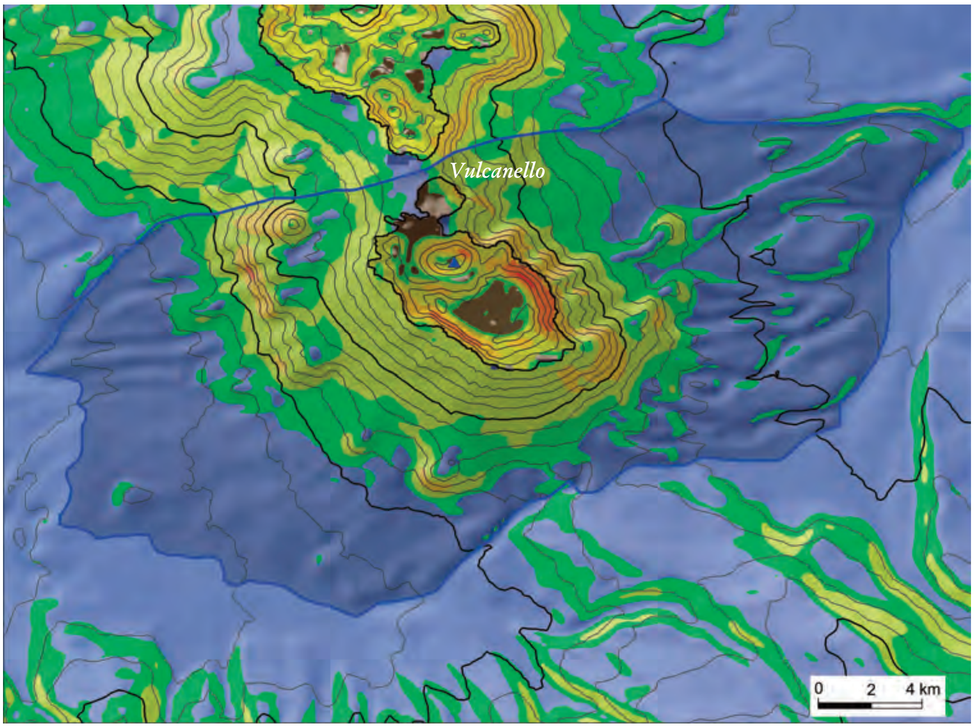
What we know about the evolution of Panarea edifice relates to its emerged portion which is only a minimal part of the entire edifice. Panarea Island was constructed between 155 ka to 8.7 ka (LUCCHI *et alii*, 2013b), by alternation of constructional periods and quiescence periods associated with major tectonic events or changes in eruption composition and style. During quiescence stages, important erosional processes took place due to strong sea-level fluctuations.

LUCCHI *et alii* (2013b) divided the eruptive history of Panarea Island into four main Eruptive Epochs:

- Eruptive Epoch 1 (155-127 ka)-Panarea dome-field: during this period the main dome edifice of Panarea Island was built through the alternation of endogenous dome episodes and explosive activity interrupted by periods of quiescence and erosion.
- Eruptive Epoch 2 (124-118 ka)-Panarea dome-field, upper portion: the second stage of Panarea evolution is characterized by both effusive and explosive activity comprised between two major marine ingressions that occurred during the interglacial peaks (MIS5d-5e 124 ka and 118 ka) and affected the previously emplaced products producing marine terraces.
- Eruptive Epoch 3 (ca. 100 ka)-Punta Falcone scoriae: the third eruptive epoch is mainly characterised by the emplacement of scoriaceous deposits from Punta Falcone.
- Eruptive Epoch 4 (67-8.7 ka)-Basiluzzo and Drauto pumices: the most recent epoch of volcanic activity at Panarea began after a long period of quiescence. The youngest deposits are the Drauto pumiceous layers (24-8.7 ka).

The shallow offshore of Panarea is characterised by explosive degassing events (MONECKE *et alii*, 2012), the most recent of which occurred in 2002 (ESPOSITO *et alii*, 2006).

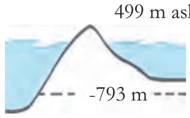
6.12 *Vulcano Island*

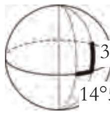


Morph. ty.	Stratovolcano
Serie	HK-calc-alkaline; Shoshonitic
Chem. com.	Basalts to rhyolites
Act. ty.	Mixed
Act. age r.	0.127 Ma- Present (1888-1890 AD)
Vol. [km³±10%]	51
Flu. ems.	Volcanic origin

Slope

bsl asl 0 - 5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 60
seamount base
seamount summit





Morphology

Vulcano Island is the southernmost of the Aeolian archipelago. Vulcano has a total subaerial surface area of about 22 km^2. It is elongated NW-SE as the neighbour Lipari Island from which is separated by a shallow saddle at -50 m, named Bocche di Vulcano. On the north-eastern side there is a recent volcanic rounded edifice named Vulcanello connected to the main island by an isthmus. Similarly to Lipari Island, the Vulcano subaerial portion lies on a marine terrace located at -80/-100 m below sea level.

The submerged portion of Vulcano edifice is characterised by gentle slope from 20° to few degrees towards the abyssal plain (below -1000 m of depth) along the western side; the eastern flank is steeper, with slopes up to 37° in the upper reaches (above -500 m) that level to 5° outward. From sheet F18 of the Progetto Magic (DPC-CNR, 2007-2013) the irregular morphology of the subaerial portion along the eastern and the north-western sides is reflected by the articulated shape of the submerged portion due to the presence of numerous gullies, canyons, erosional scarps, gravitational flows and landslide scarps. Along the western side, between -700 m and -300 m below sea level, five minor volcanic cones were also identified aligned NNW-SSE parallel to the main direction of Vulcano, Lipari and Salina Islands (De Astis *et alii*, 2013 and reference therein). The base of the edifice lies between -1359 m and -33 m along the morphological contact with Lipari edifice. The average depth of the base is -793 m for an average height of 1292 m.

The total volume estimated for Vulcano edifice is 51 km^3.

Volcanic structure

The island of Vulcano, together with Lipari and Salina Islands, is located along the Tindari-Letojanni NNW-SSE strike-slip tectonic system (Billi *et alii*, 2006 and references therein) which dominates all the morphostructural elements of the island. The emerged portion of the edifice is the result of the coalescence of three main volcanic structures: La Fossa and Il Piano calderas and the Vulcanello lava platform. The two calderas characterise the central and south sectors of the island with a diameter of 2.5-3 km and collapsed rims with horseshoe-shape.

Il Piano caldera is filled by parasitic scoria cones (N-S aligned) and cut by NW-SE faults; its caldera rim is truncated north by the La Fossa caldera which is characterised by concentric crater rims and a series of lava domes along its western margin (Mt. Lentia field) aligned NNW-SSE. The western side of the central and south sectors of the island is also characterised by a NW-SE fissural vent (Spiaggia Lunga) and a sector collapse SW dipping (Casa Grotta dell'Abate). The recent volcanic structure of Vulcanello lava platform formed on the northern margin of La Fossa caldera, by lava flows emitted from a central vent.

Chemical composition and age

The analysed rocks of Vulcano Island display a wide range of compositions ranging from basalts to rhyolites with high-K calc-alkaline and shoshonitic affinity (De Astis *et alii*, 2013) emitted during the last 127 ka (last eruption 1888-1890 AD).

Volcanic products

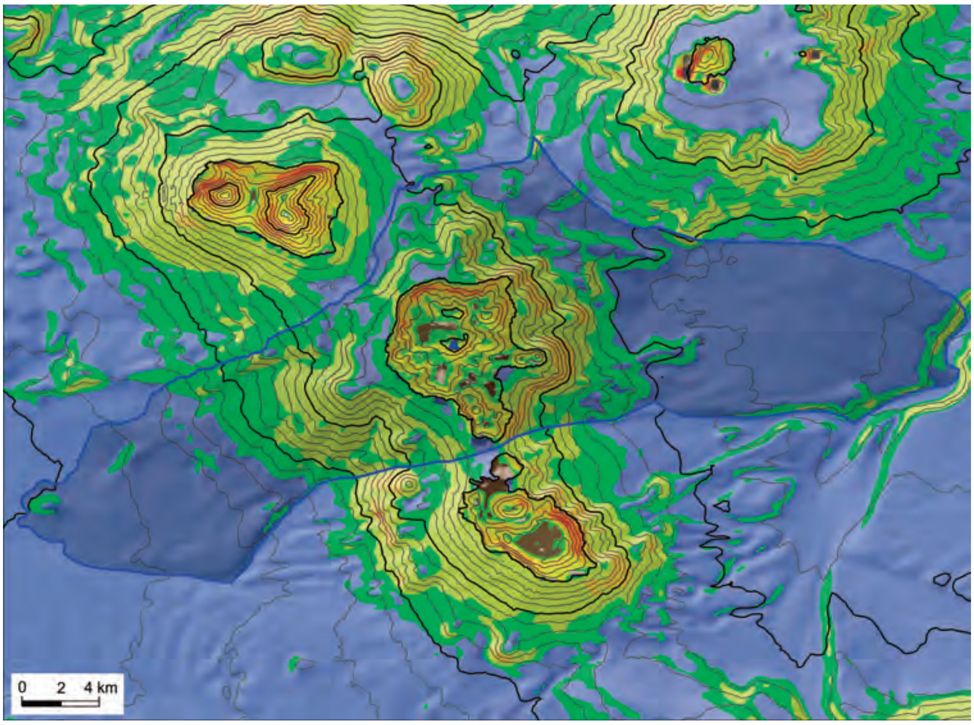
Lava flows, tuff and scoria deposits and pyroclastic deposits are the main products of Vulcano edifice. At present the La Fossa crater is affected by fumarolic emissions, mainly focused along the northern rim of the caldera, which has shown increasing temperatures over the last decades (Nuccio *et alii*, 1999; Paonita *et alii*, 2002; Granieri *et alii*, 2006); also minor submarine gas discharge (hot springs) has been detected along the Porto di Levante harbour.

Brief volcanic evolution

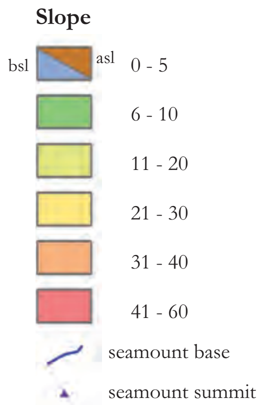
The Vulcano edifice eruptive history is only known for its emerged portion which represents a minority of the total erupted volume. It has been subdivided into 8 main Eruptive Epochs (De Astis *et alii*, 2013).

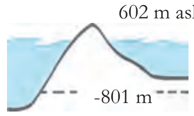
- Eruptive Epoch 1 (ca. 127-113 ka) Paleo-Vulcano: during this first phase the western south sector of the island was involved. Shoshonitic lava flows were emplaced. Today the products are totally underwater.
- Eruptive Epoch 2 (117-101 ka) Primordial Vulcano stratocone: after a period of quiescence, the main eruptive vent migrated towards south, with the formation of the Primordial Vulcano stratocone. The edifice was formed by the alternation of lavas and scoriaceous material related to effusive and strombolian activity; the emission centre was located above the present Il Piano caldera depression.
- Eruptive Epoch 3 (99.5 ka): after a new quiescence stage, during which the Il Piano caldera collapsed, a renewal of volcanic activity produced the emplacement of shoshonite basaltic to leucite-bearing shoshonitic lava flows. The emission points were mainly located along the ring-faults of the Il Piano caldera. The final phase of Epoch 3 is characterised by a volcanic-tectonic collapse which involved the western side of Il Piano caldera and represents the initial phase of the La Fossa caldera formation.
- Eruptive Epoch 4 (ca. 78 ka): the fourth epoch of Vulcano history is mainly characterised by strombolian volcanism reactivated after a period of quiescence. Eruptive NNE-SSW fissures located along the rims of Il Piano produced thick pyroclastic successions ("Lower Grey Tuffs" of Keller, 1980) and lava flows.
- Eruptive Epoch 5 (70-42 ka) il Piano caldera-infilling products: this stage was characterized by the shifting towards the NNW of the eruptive vents, along La Fossa caldera that produced explosive strombolian acitivity with the emplacement of scoriaceous fallout deposits and hydromagmatic pyroclastic density currents and the formation of scoria cones due to NNE-SSW fissural events. This fifth stage was interrupted by a collapse that originated the central-eastern sector of La Fossa caldera.
- Eruptive Epoch 6 (28-21 ka): after a period of quiescence the volcanic activity renewed with multiple eruptive fissural vents that involved the western side of Vulcano Island.
- Eruptive Epoch 7 (21-13 ka): during this stage a further activity shift from west to north of the island occurred with the emplacement of the Piano Grotte dei Rossi tuffs.
- Eruptive Epoch 8 (8 ka-present) La Fossa cone and Vulcanello: the last stage of Vulcano history is characterised by the eruption of different vents in the central and north sector of the island, along the margins and inside the La Fossa caldera. The last eruption of Vulcano occurred in 1888-1890 which has become the reference for intermittent blasts generating surge flows and short lived plumes known as the classic vulcanian style.

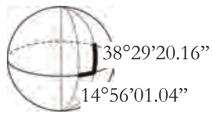
6.13 *Lipari Island*



Morph. ty.	Stratovolcano
Serie	Calc-alkaline; HK-calc-alkaline
Chem. com.	Basalts to rhyolites and HK andesites
Act. ty.	Mixed
Act. age r.	> 0.267 Ma - Present (1230 AD)
Vol. [km^3±10%]	94
Flu. ems.	/







Morphology

Lipari volcano is the largest of the Aeolian Islands situated between Salina and Vulcano edifices. Lipari Island represents the top of a large stratovolcano (Mt. S. Angelo, Mt. Chirica, Mt. Pilato in the central-northern sector of the island) with an elevation of 602 m above sea level. It is separated by a shallow saddle (Bocche di Vulcano) from Vulcano Island and is connected with Salina volcano by the Lipari-Salina Basin. The subaerial portion of the island rises from a marine terrace located at -80/-100 m. Beyond the margin of the submerged terrace, the western flanks of the edifice progressively decrease in slope inclination from 20° along the upper reaches to 5° down to a depth of ca. -1300 m. The eastern flanks are steeper with inclinations that reach 36° between -100 m and -500 m.

It is clear from its complex morphology that the edifice is made by the clustering of various eruptive centres. Sheet F18 of the Progetto Magic (DPC-CNR, 2007-2013) attributes the roughness of the morphology to the presence of landslide scars, bedrock outcrops, numerous parasitic volcanic cones (i.e. Banco del Bagno) mainly located in the western part of the edifice and aligned NNW-SSE. The eastern flank displays principally lobate lava flows, deep gullies and gravitational flows (Casalbore et *alii*, 2016). The base of the edifice lies between -1506 m and -33 m along its lateral contact with Vulcano, for an average depth of -801 m. The average height of the edifice is 1403 m.

The total volume estimated for Lipari volcanic edifice is 94 km^3.

Volcanic structure

Lipari Island, together with Salina and Vulcano Islands, constitutes a NNW-SSE-oriented volcanic cluster within the Aeolian archipelago. Volcanic centres are aligned along the same main orientation. A further E-W structural alignment is present at Monterosa promontory highlighted by the presence of two crater rims. The most recent volcanic centres are oriented N-S.

Chemical composition and age

Subaerial volcanic activity at Lipari dates back to 267 ka (Forni *et alii*, 2013). The chemical compositions of Lipari volcano range from basaltic and basaltic-andesitic during early activity period to high-K andesites during intermediate cycles of activity and to rhyolitic during the younger volcanic cycles (Gamberi & Marani, 1997; Forni *et alii*, 2013).

The most recent eruption occurred from Monte Pilato in medioeval time (calibrated ^{14}C age of 776AD+110/-90 in Keller 2002 or 1230±40 AD according to archeomagnetism in Tanguy *et alii*, 2003) forming a rhyolitic pumice cone and a lava flow (Rocche Rosse lava flow).

Volcanic products

The Lipari products consist of basaltic to andesitic lavas and rhyolitic lava domes, scoriaceous and pumiceous pyroclastic deposits.

Brief volcanic evolution

Lipari Island volcanic evolution is subdivided into nine Eruptive Epochs characterized by different eruptive styles and migration of eruptive vents (FORNI *et alii*, 2013 and reference therein).

• Eruptive Epoch 1: the initial activity of Paleo-Lipari consisted of eruptions from vents mainly located along the western coast. These eruptions produced hydromagmatic explosive fallout, pyroclastic density current deposits, and lava flows.

• Eruptive Epoch 2 (267-188 ka): after a period of quiescence the activity restarted with strombolian activity from numerous cones along the western coast and from fissural vents along north-south alignments.

• Eruptive Epoch 3 (ca. 150 ka): this epoch is characterised by the emplacement of thick successions of lapilli-tuffs and unconsolidated fallout deposits and dilute pyroclastic density current deposits from Mt. Chirica. The third epoch ends with the first marine ingression during a period of quiescence that produced marine terraces.

• Eruptive Epoch 4 (119-114 ka): during the fourth epoch, the activity shifted towards the center and the eastern sectors of the island. From Mt. S. Angelo and Monterosa centres and other minor scoria cones and fissural vents, strombolian scoriaceous material and thick lava flows were emitted. Hydromagmatic products were also found interbedded within fallout scoria.

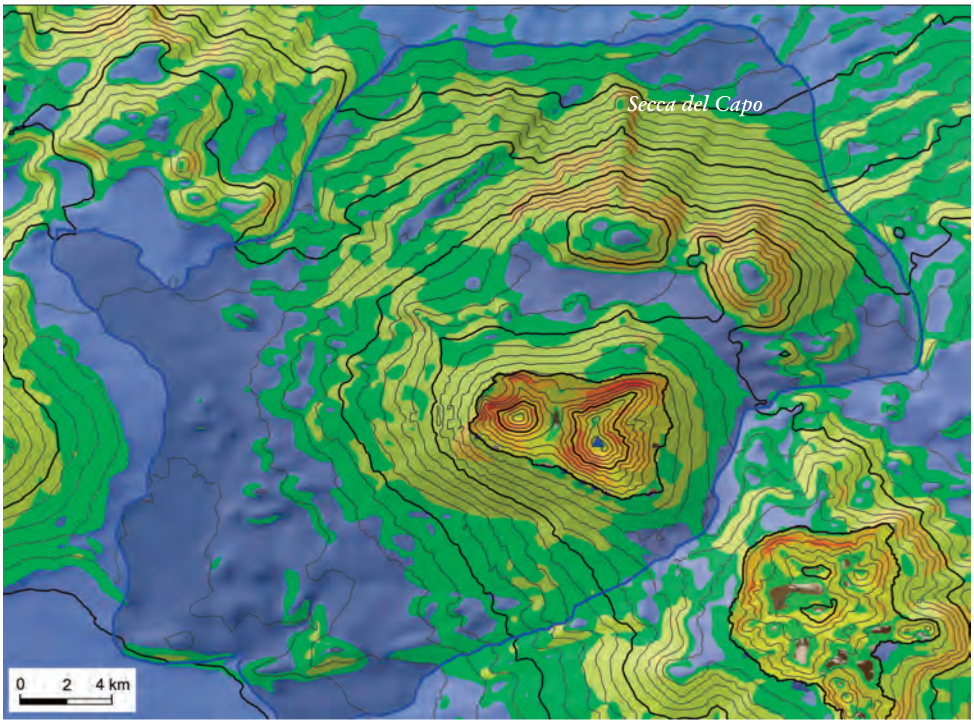
• Eruptive Epoch 5 (105 ka): the construction of Mt. S. Angelo continued during the fifth epoch after a period of quiescence. The activity renewed with intense hydromagmatic eruptions.

• Eruptive Epoch 6 (92-81 ka): this period is characterised by a renewing of the activity of Mt. S. Angelo and Mt. Chirica through vulcanian style eruptions that produced lapilli-tuff, breccias, lava flows and ballistic fallout material.

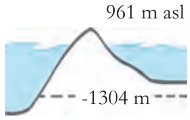
• Eruptive Epoch 7 (43-40 ka) and Eruptive Epoch 8 (27-20 ka): after a dormancy period and a marine ingression, the subaerial activity started again with explosive and effusive eruptions from numerous domes along the south sector of the island (along the NNW-SSE tectonic trend).

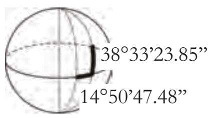
• Eruptive Epoch 9 (8.7 ka- Present [1230 AD]): The last period of activity involved the northeaster part of Lipari Island with the emplacement of obsidian rich lavas and pomiceous material. The emission vents were mainly located along north–south and NE-SW trends.

6.14 *Salina Island*



Morph. ty.	Stratovolcano
Serie	Calc-alkaline; HK-calc-alkaline
Chem. com.	basalts, andesites and dacites
Act. ty.	Mixed
Act. age r.	0.244 - 0.016 Ma
Vol. [km^3±10%]	210
Flu. ems.	/





Morphology

Salina Island is the second largest volcanic island of the Aeolian archipelago, with a surface area of 26.75 km^2. Salina volcano is located at the centre of the Aeolian arc, at the intersection between the arc-shaped structure and the NNW–SSE elongated Salina-Lipari-Vulcano volcanic belt (LUCCHI *et alii*, 2013c). The volcanic edifice of Salina displays two main eruptive centres with conical shape (Monte dei Porri and Monte Fossa delle Felci) aligned along a WNW-ESE direction, conferring an elongated shape to the island. The subaerial flanks of the cones are very steep, up to 42°.

Sheet F18 of the Progetto Magic (DPC-CNR, 2007-2013) shows that Salina Island emerges from a flat submerged terrace at -40 m that surrounds the entire island. The submerged edifice of Salina volcano is sided to the south and east by the volcanic edifice of Lipari. The submerged flanks are cut by radial gullies, landslide scarps, gravitational flows and landslides. Along the northern flank of Salina edifice two secondary eruptive centres are present (Secca del Capo), aligned NNW-SSE (ROSSI *et alii*., 1987; ROMAGNOLI *et alii*, 1989; GAMBERI *et alii*, 1997). The base of the edifice lies between -2299 m and -221 m along the lateral contact with Lipari, averaging at -1304 m. The average height is 2265 m.

The estimated total volume of Salina volcano is 210 km^3.

Volcanic structure

Salina Island is composed by the coalescence of six volcanic centres (BARBERI *et alii*, 1974; GILLOT & VILLARI, 1980; KELLER, 1980; GILLOT, 1987) the largest being the Monte Fossa delle Felci (962 m) to the east and Monte dei Porri (859 m) to the west. The majority of the dikes follow a radial pattern, typical of central activity.

The northern-east sector of the island is characterised by a NE-SW eruptive fissure; the flank of Monte dei Porri is cut by the horseshoe-shaped sector collapse scar. Another volcano-tectonic collapse scar, also horseshoe-shaped, is located along the eastern flank of the island (LUCCHI *et alii*, 2013c and reference therein).

Chemical composition and age

The chemical composition of Salina Island deposits ranges from calc-alkaline basalts, basaltic andesites, andesites and dacites.

K-Ar radiometric dating combined with marine deposits studies provided a series of time-stratigraphic markers that constrain the subaerial geological evolution of Salina between ca. 244 and

15.6 ka (Lucchi *et alii*, 2013c). The oldest products correspond to the basal, intermediate and upper portions of the Pizzo Capo volcanic edifice exposed along the northern coast of the island. The youngest age determinations are at 56 ka for Monte Fossa delle Felci and at 26–15.6 ka for Monte dei Porri (Lucchi *et alii*, 2013c).

Volcanic products

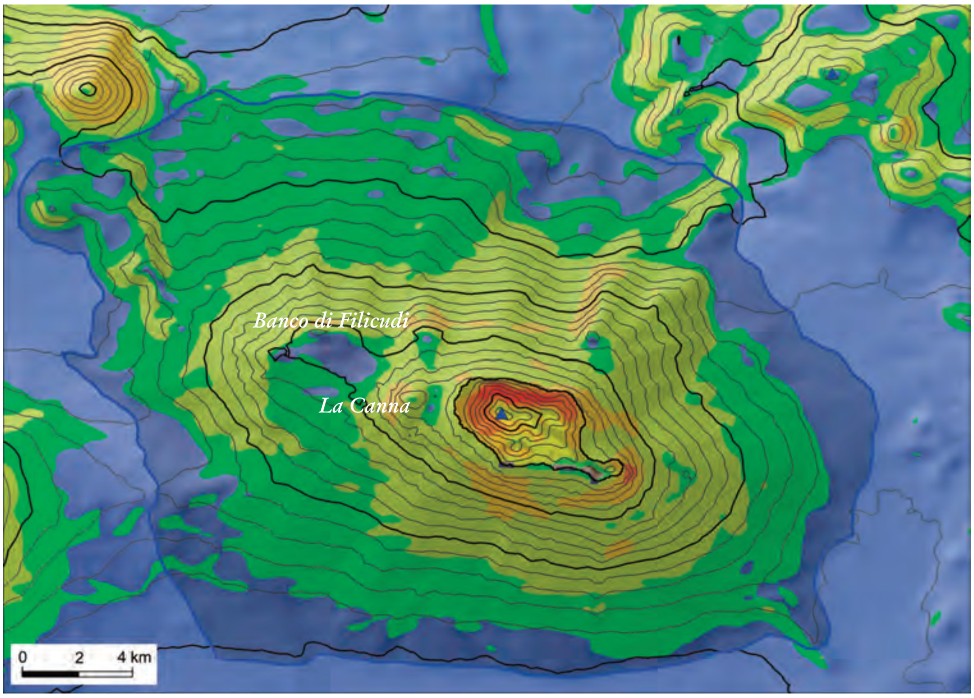
The products of Salina volcano are mainly constituted by basaltic strombolian cinder agglomerates, basaltic, andesites and dacites lava flows, sub-plinian and strombolian fallout deposits (scoriae and pumices clasts). The presence of mounds of semiconsolidated Fe-rich crusts along the Secca del Capo in the north offshore of Salina has been interpreted as evidence of recent hydrothermalism (Gamberi *et alii*, 1997).

Brief volcanic evolution

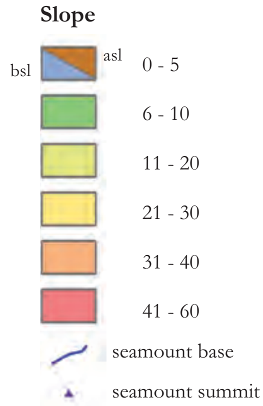
The eruptive history of Salina Island has been subdivided into six Eruptive Epochs alternated with erosional periods (Lucchi *et alii*, 2013c).

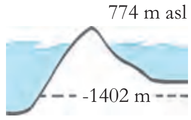
- Eruptive Epoch 1 and Eruptive Epoch 2 (244-226 ka): the earliest subaerial activity was mostly basaltic in composition and localised in the eastern sector of the present island, with effusive and strombolian products.
- Eruptive Epoch 3 and Eruptive Epoch 4 (160-121 ka): the Monte Fossa delle Felci stratovolcano was built in this period in the south-eastern sector of Salina. Monte Fossa delle Felci is a huge stratocone made up of strombolian scoriaceous products, lava flows and subordinate subplinian pumice fall deposits that display peculiar compositional variations from early basalts (Epoch 3) to intermediate dacites-andesites- (early Epoch 4) and late-stage andesites and basaltic andesites (late Epoch 4). These growth stages were followed by erosional stages.
- Eruptive Epoch 5 (70-57 ka) - Monte dei Porri stratocone: highly explosive, subplinian phases occurred during the early stages of development (Grey Porri Tuffs) and were followed by alternating strombolian and effusive activity.
- Eruptive Epoch 6 (30-15.6 ka) - Pollara tuff ring: after a long period of quiescence the activity resumed from the Pollara crater at the north-western edge of the island marking the latest phases of activity on Salina. Two highly explosive subplinian eruption cycles were recorded in the widespread pumiceous Lower Pollara (27.5 ka) and Upper Pollara (15.6 ka) successions.

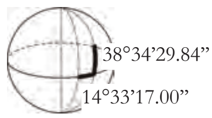
6.15 *Filicudi Island*



Morph. ty.	Stratovolcano
Serie	Calc-alkaline; HK-calc-alkaline
Chem. com.	Basalts to high-K andesites
Act. ty.	Mixed
Act. age r.	0.246-0.029 Ma
Vol. [km³±10%]	121
Flu. ems.	/







Morphology

Filicudi Island is located on the western side of the Aeolian Archipelago. The island has a WNW-ESE elongated shape and rises 774 m from the sea level with an area of 9.49 km^2. The base of the edifice lies on average at -1402 m and it is shallower on the western side where it coalesces with the Alicudi edifice. The average height of the edifice is 2176 m. The island is surrounded by a submerged platform down to the depth of -100 m. The platform is more extended toward the WNW where it is formed by two secondary volcanic centres named Banco di Filicudi and La Canna (Lucchi *et alii*, 2013d and reference therein), aligned parallel to the principal WNW-ESE direction.

La Canna is an emergent neck surrounded by some islets, whereas the centre of Banco di Filicudi is totally submerged (Calanchi *et alii*, 1995). Beyond the edges of the shallow platform, the south-western and south-eastern flanks of the submerged edifice are steeper (slope from 47° to 10°) than the north-western and north-eastern ones (20° to 5°). Sheet F19 of the Progetto Magic (DPC-CNR, 2007-2013) indicates the south-eastern flanks as affected by numerous canyon scarps and gullies; ridges interpreted as radial dikes are also common features. A further noticeable morphological element is represented by a wide depression that could be a landslide scar along the northern flank.

The total volume of Filicudi volcanic edifice is 121 km^3.

A secondary seamount located c.a. 10 km NE from Filicudi Island is considered part of the volcanic complex and herein named "Filicudi NE". There is not much information about this seamount, but from morphological bathymetry analysis it rises from the seafloor from -1500 m and has a sub-rounded shape with an elongation towards SE, parallel to Filicudi Island.

Volcanic structure

Filicudi Island structure is mostly made by the coalescence of two stratocones: Fossa Felci and Chiumento. Fossa Felci is characterised by volcanic plugs and dikes disposed radially from the crater and is separated from Chiumento stratocone by a fissural vent, oriented E-W. The Chiumento stratocone has a horseshoe-shaped rim opened toward the SE. Two lava domes, Mt. Montagnola and Capo Graziano, characterise the southern part of Filicudi Island displaying WNW-ESE alignment parallel to the main structural orientation of the island.

Chemical composition and age

The Filicudi rocks compositions range from calc-alkaline basalts to basaltic andesites and high-K andesites with minor dacites. $^{40}Ar/^{39}Ar$ and K-Ar datings indicate for the oldest product an age of 246-236 ka (Gillot, 1987; Santo *et alii*, 1995; Santo, 2000; De Rosa *et alii*, 2003; Leocat *et alii*, 2009, 2010; Leocat, 2011) and 29 ka for the youngest activity at La Canna neck on the NW submerged part of the Filicudi volcanic complex (Lucchi *et alii*, 2013d).

Volcanic products

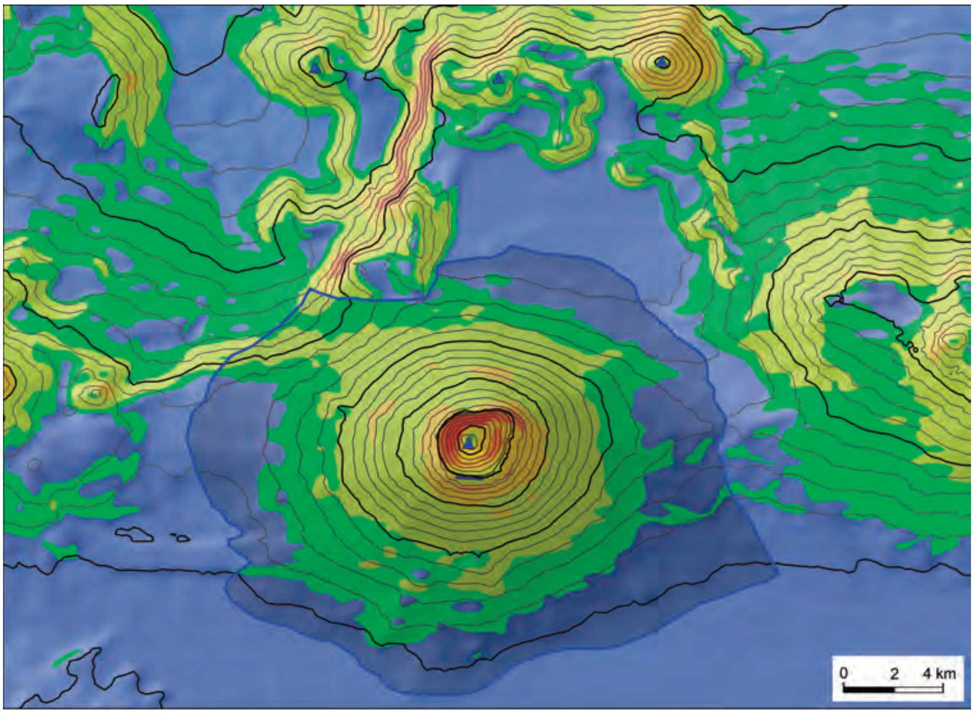
Filicudi Island consists almost entirely of lava flows and pyroclastics. The only exceptions are some coastal and slope sedimentary deposits. Numerous xenoliths of both magmatic and metamorphic origin are commonly found in the Filicudi rocks (Santo *et alii*, 2004).

Brief volcanic evolution

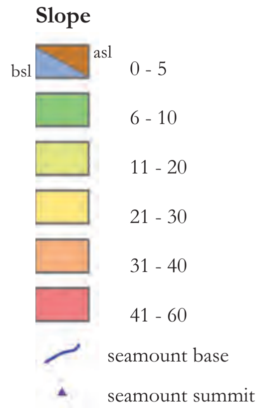
According to the field and age data, the island was built up through four main periods of activity separated by quiescence stages and erosional processes (Lucchi *et alii*, 2013d).

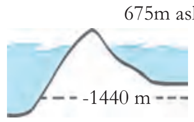
- Eruptive Epoch 1 (246-236 ka): the early activity of the emergent Filicudi involved the north-western sector of the island with the emission of lavas and scoriaceous material.
- Eruptive Epoch 2 (225-189 ka): this period was characterized by the emission of lava flows and scoriaceous products, that resulted in the construction of Fossa Felci and Chiumento stratocones and the Monte Guardia scoria cone along a WNW–ESE tectonic trend.
- Eruptive Epoch 3 (168-146 ka): after a period of quiescence, effusive activity emplaced thick lava coulees in the southern sector of the island.
- Eruptive Epoch 4 (64-56 ka); (29 ka): a prolonged quiescence period occurred during the Last Interglacial period that resulted in the formation of marine terraces and strong erosion processes with the emplacement of volcanic debris deposits. The activity of Filicudi volcano renewed in the central-southern sector of the island. La Canna neck and surrounding minor islets along the north-western coast are considered the remains of a volcanic edifice related to the youngest activity of Filicudi volcano.

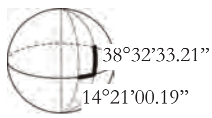
6.16 *Alicudi Island*



Morph. ty.	Stratovolcano
Serie	Calc-alkaline; HK-calc-alkaline
Chem. com.	Basalts, basaltic andesites and andesites
Act. ty.	Mixed
Act. age r.	0.106 - 0.028 Ma
Vol. [km^3±10%]	71
Flu. ems.	/







Morphology

Alicudi Island is located on the western sector of the Aeolian Archipelago. The island has an almost perfect conical shape, extending to 675 m above sea level with a total area of 5.2 km^2 (BONELLI *et alii*, 2004).

A rather narrow submarine platform extends from the coastline to the depth of -100 m. The flanks of the submerged part of Alicudi volcano decrease rapidly with slope between 35-20° down to -1000 m, and then more gently (10 to 5°) towards the abyssal plain. The base of the edifice lies between -1785 m and -1110 m, averaging at -1440 m for an average height of 2115 m.

While the subaerial portion shows a modest NNE-SSW elongation, the submerged edifice displays a mild elliptical shape E-W oriented. According to sheet F19 of the Progetto Magic (DPC-CNR, 2007-2013), numerous dikes are present on the north and western flanks distributed radially from the central vent.

Total volume of Alicudi volcano is 71 km^3.

To the north of Alicudi Island three small seamounts E-W aligned rise from the seafloor from depths of -1500 m. These seamounts may be volcanic in origin; the eastern and western seamounts have conical shapes, while the central one has a more irregular shape.

Volcanic structure

Alicudi Island is characterised by a WNW-ESE structural alignment highlighted by the presence of lava domes aligned on the same orientation. The central sector of the island is dominated by concentric volcano-tectonic rim collapses of the central edifice. Secondary structural elements are represented by minor faults and fractures radially distributed along the flanks.

Chemical composition and age

The Alicudi Island is characterised by calc-alkaline and HK-calc-alkaline rocks with mafic to intermediate chemical composition, ranging from basalts to HKCA andesites (PECCERILLO & WU, 1992).

K-Ar datings, performed on subaerial samples, indicate ages between 120 ka and 26 ka (GILLOT & VILLARI, 1980; CALANCHI *et alii*, 1995). New studies on Alicudi products (LUCCHI et *alii*, 2013e) suggest a period of activity from 106 ka to 28 ka.

Volcanic products

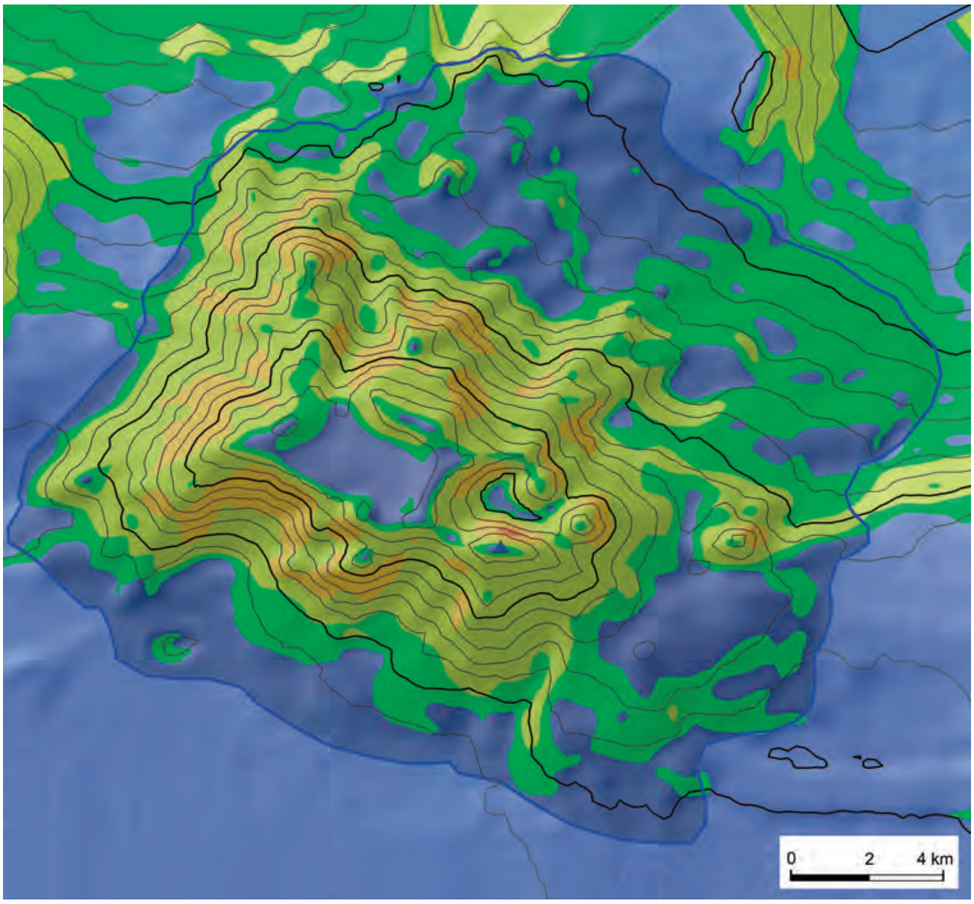
The volcanic products of Alicudi stratovolcano are lavas and minor scoriaceous products (Peccerillo & Wu, 1992; Peccerillo *et alii*, 1993; Lucchi *et alii*, 2013e).

Brief volcanic evolution

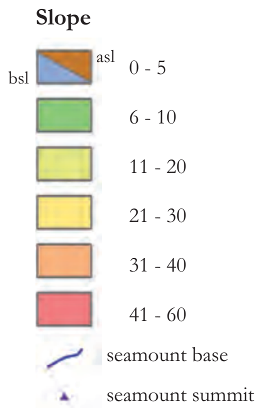
The Alicudi volcano eruptive history has been subdivided into 6 main Eruptive Epochs delimited by important periods of quiescence (Lucchi *et alii*, 2013e).

- Eruptive Epoch 1 (ca. 106 ka): The first subaerial activity of Alicudi volcano involved the western coast of the island with strombolian eruptions and the emplacement of fallout scoriaceous material and lava flows.
- Eruptive Epoch 2: the construction of the early Alicudi stratocone continued during the second epoch after a period of dormancy, during which a strong erosion process modified the stratocone morphology. Strombolian and effusive activity mainly characterised this period that ended with a partial collapse of the stratocone summit.
- Eruptive Epoch 3: after the summit partial collapse in Epoch 2 and a period of quiescence, the activity renewed in the same collapsed area with the emplacement of multiple layers of lava flows and scoriaceous fallout lapilli. Interbedded within lava flows numerous debris avalanche were identified.
- Eruptive Epoch 4 (ca. 80 ka): the fourth period represents the main phase during which Alicudi conical structure was built. After a period of dormancy, new strombolian and effusive eruptions (dome field) involved the caldera central sector, whose deposits (lavas and scoriaceous lapilli) filled the depression.
- Eruptive Epoch 5 (ca. 60-32 ka): the activity from the summit continued during the fifth epoch exposed especially along the northern and eastern sides. This activity produced principally lavas that flowed along the eastern flank till the sea.
- Eruptive Epoch 6 (ca. 28 ka): following a strong period of quiescence, the last activity period of the summit of Alicudi volcano was dominated by the formation of a new endogenous dome that entirely occupied the summit, generating numerous lava flows along the southern and eastern flanks of the volcano.

6.17 *Eolo Seamount*



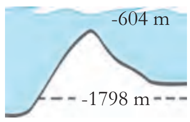
Morph. ty.	Stratovolcano
Serie	HK-calc-alkaline; Shoshonitic
Chem. com.	Shoshonitic basalts to trachytes; shoshonite; HK dacites to rhyolites
Act. ty.	Effusive
Act. age r.	0.85 - 0.58 Ma
Vol. [km^3±10%]	89
Flu. ems.	δ^3He hydrothermal activity

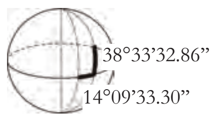


Morphology

Eolo seamount is located ca. 20 km west of Alicudi Island (Marani *et alii*, 1999; Marani & Trua, 2002). Eolo volcanic edifice is characterised by irregular flanks with steeper slopes along the NE and SW flanks (36° to 11°). It shows a flat summit area (3x2 km^2 area) and its sub-squared base area lies between -2105 m and -1368 m, averaging at -1798 m. Its northern flank is cut by numerous erosional gullies radially distributed, while the southern edifice portion displays at the top two main cone vents (350 m, 250 m high), and a third one (175 m high) positioned more to the SE, separated from the previous two by a deep depression (Marani & Gamberi, 2004). Landslide scarps dipping towards NE-SW are also present. The summit of the edifice is at -604 m for an average height of 1194 m.

The estimated volume of Eolo smt is 89 km^3.





Volcanic structure

Together with Enarete smt, Eolo smt is positioned above the seaward-facing border fault of the northern part of the Cefalù basin (Marani & Gamberi, 2004). Numerous dikes radially disposed from the central vent characterise the western and south flanks.

Chemical composition and age

Dredged samples from Eolo smt (T75/41/9 a,c,d,e,f, Beccaluva *et alii*, 1985) display composition from shoshonite basalts to trachyte, shoshonite, high-K dacite and rhyolite dated K-Ar between 0.85 and 0.58 Ma (Beccaluva et *alii*, 1985, Calanchi *et alii*, 2002; Peccerillo, 2017). The more silica-rich rocks characterise the small cones that surround the southwestern depression.

Volcanic products

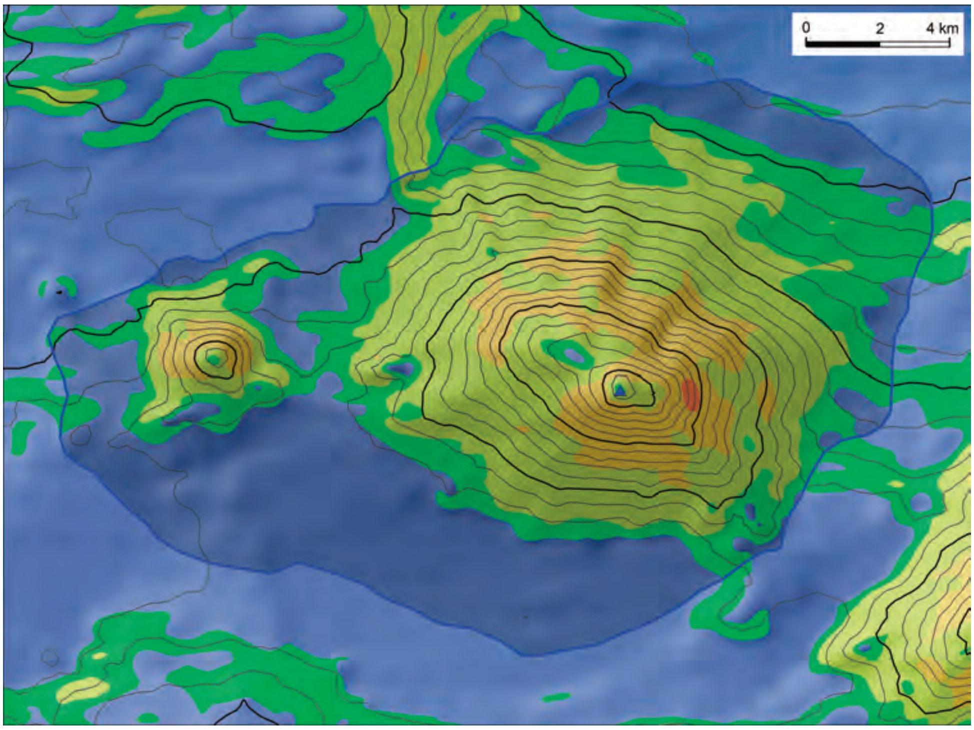
Dredged rocks from Eolo smt are mostly lavas. Samples from Eolo seamount comprise also Fe-Mn crusts characterized by an elevated Fe/Mn ratio (Eckhardt *et alii*, 1997).

Moreover, indications of δ^3He hydrothermal activity (Lupton *et alii*, 2011) are confined to the flat region of the seamount southwest of the summit.

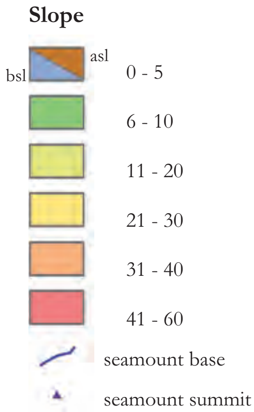
Brief volcanic evolution

There is no information about Eolo volcanic evolution.

6.18 *Enarete Seamount*



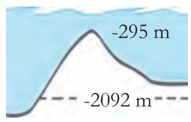
Morph. ty.	Composite edifice
Serie	HK-calc-alkaline; Shoshonitic
Chem. com.	Shoshonitic basalts; shoshonites; basaltic andesites
Act. ty.	Effusive
Act. age r.	0.78 - 0.67 Ma
Vol. [km^3±10%]	75
Flu. ems.	δ^{3}He hydrothermal activity



Morphology

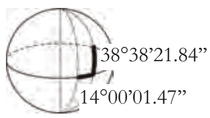
Enarete seamount is located between Eolo and Sisifo smts along a NW-SE alignment. Enarete smt morphology is almost a perfect cone, slightly elongated along a ENE-WSW trend. Its base lies between -2618 m and -1628 m, averaging at -2092 m, for an average edifice height of 1797 m. The edifice slopes are quite regular and steep (up to 40°) along the southeastern flank where they reach a maximum of 61°. The northern flank is cut by numerous radial erosional gullies and ridges. To the west of Enarete, a smaller conical edifice is present that rises from ca. -1700 m to ca. -1350 m.

Enarete smt total volume is 75 km^3.



Volcanic structure

Enarete seamount, together with Eolo smt, is positioned above the fault system bordering the northern part of the Cefalù basin (MARANI & GAMBERI, 2004). Numerous dikes are radially disposed from the central vent.



Chemical composition and age

Chemical composition of samples from Enarete seamount have high-K calc-alkaline to shoshonitic affinity and range from shoshonitic basalts to shoshonites (samples T76/25/18a5, T76/25/19b2 and T76/25/20a from BECCALUVA et *alii*, 1985), to basaltic andesite. Ages available for Enarete smt are 0.78-0.67 Ma (BECCALUVA *et alii*, 1985 and CALANCHI *et alii*, 2002).

Volcanic products

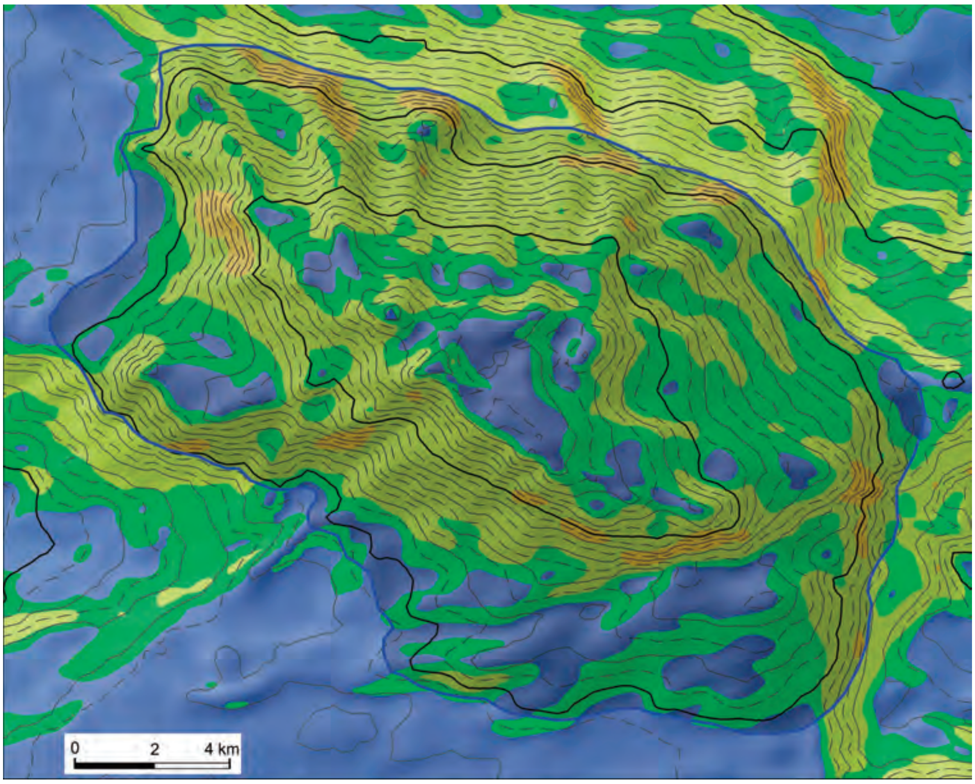
Samples from Enarete smt are principally constituted by lavas (TRUA *et alii*, 2004a,b) and also Fe-Mn crusts characterized by an elevated Fe/Mn ratio (MORTEN *et alii*, 1980). δ^{3}He hydrothermal activity is also present (LUPTON *et alii*, 2011).

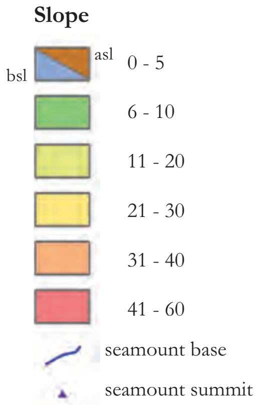
Brief volcanic evolution

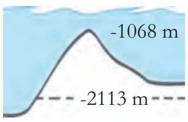
There is no information about Enarete smt volcanic evolution.

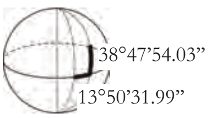
Sisifo Seamount 6.19

Morph. ty.	Composite edifice
Serie	Calc-alkaline; Shoshonitic
Chem. com.	Basalts; Shoshonitic trachytes
Act. ty.	Effusive
Act. age r.	1.3 - 0.9 Ma
Vol. [km^3±10%]	80
Flu. ems.	δ^{3}He hydrothermal activity









Morphology

Together with Eolo and Enarete smts, Sisifo seamount is aligned along a NW-SE trend in the western section of the Aeolian arc. Sisifo smt lies NW of Enarete smt and has a complex and irregular elliptical morphology characterised by numerous erosional gullies distributed radially along the north and south-east flanks (sheet F20 of the Progetto Magic (DPC-CNR, 2007-2013). The eastern flank of the seamount decreases gentlier toward the abyssal plain (20-5°) with respect to the north and south-east flanks whose slopes vary from 40° to 5°. The base of the edifice lies between -2257 m and -2011 m, averaging at -2113 m, for an average height of 1045 m.

Sisifo seamount total volume is 80 km^3.

Volcanic structure

Sisifo volcanic structure is principally defined by the presence of two feeder dikes located at the top of the seamount with NW-SE and NE-SW direction respectively.

Chemical composition and age

Dredged lavas samples (T76/27/3b and T76/27/5al from Beccaluva *et alii*, 1985) belong to calc-alkaline and shoshonitic series (Peccerillo, 2017), ranging in composition from basalt to shoshonitic trachyte, were recovered from Sisifo smt. The oldest products recovered from Sisifo smt (T76/21/3b and T76/21/3b5) give an age interval of 1.3-0.9 Ma (Beccaluva *et alii,* 1985).

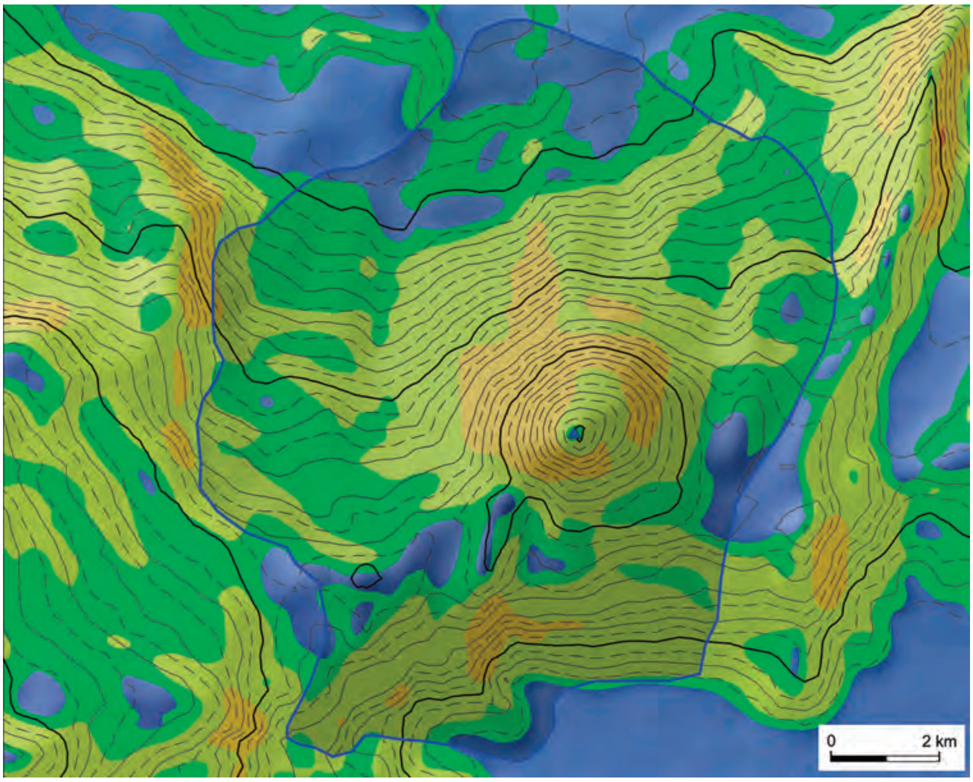
Volcanic products

Sisifo smt volcanic products are mainly constituted by basalts and trachytes (Beccaluva *et alii*, 1985, Marani & Gamberi, 2004). Hydrothermal activity characterised by ^{3}He anomalies in fluid emissions was detected by Lupton *et alii* (2011).

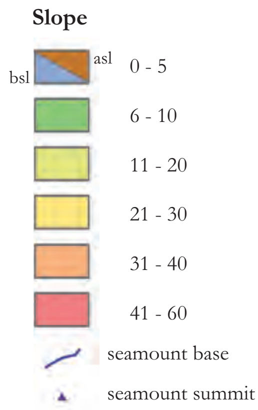
Brief volcanic evolution

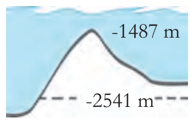
There is no information about Sisifo smt volcanic evolution.

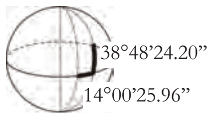
6.20 *Tiro Seamount*



Morph. ty.	Composite edifice
Serie	Calc-alkaline
Chem. com.	Basalts
Act. ty.	Effusive
Act. age r.	1.5 Ma
Vol. [km^3±10%]	18
Flu. ems.	/







Morphology

Tiro seamount is a newly named volcanic seamount located NE with respect to Sisifo and Enarete smts. The volcanic nature of this edifice was inferred by Marani *et alii* (2004), who noticed its conical morphology. The volcanic structure extends from an average depth of -2541 m to -1487 m, for an average height of 1054 m. The edifice is sided, along the WSW margin, by the Sisifo volcanic edifice. Along this boundary the morphology is more articulated with strong variations in slope from 5 to 40 ° that highlight preferential alignments NNE-SSW. Similarly, the eastern boundary of the edifice runs parallel to a major scarp NNE-SSE trending. The regular cone shape is appreciable only from the depth of -2000 m and indicates a rather fresh morphology.

Total volume calculated is 18 km^3.

Volcanic structure

The morphology of Tiro edifice appears controlled by NNE-trending structures.

Chemical composition and age

Information about chemical composition of Tiro smt derives from a single dredged sample (T75/14/BM) collected at -2550 m of depth by Beccaluva *et alii* (1985). Compositional analysis indicates calc-alkaline basalts emplaced c.a. 1.5 Ma.

Volcanic products

The sample collected from this seamount indicates basalt lavas as volcanic product.

Brief volcanic evolution

Tiro smt volcanic evolution is still unknown.

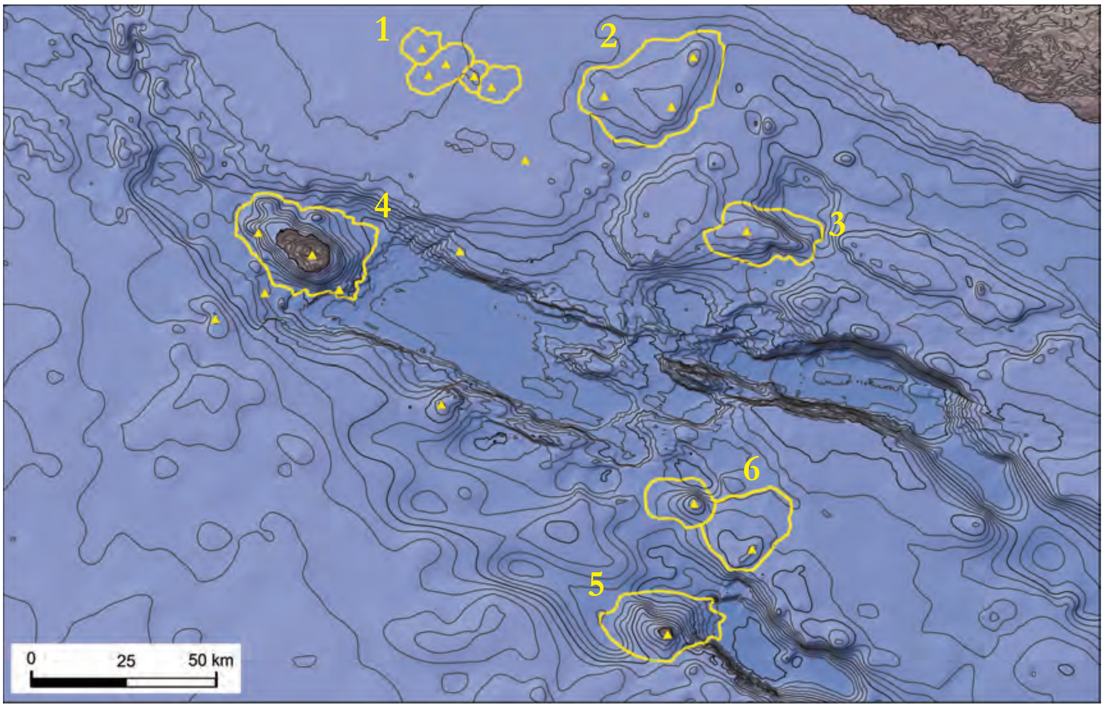


Fig. 15 - Overview of the volcanic seamounts of the Sicily Channel Volcanic Seamount Sector
- Panoramica degli edifici vulcanici sommersi del Settore vulcanico sottomarino Canale di Sicilia.

The Sicily Channel Volcanic Seamount Sector lies between southern Sicily Island coasts and Tunisia NE shores. It is composed by different volcanic morphologies as simple cones (Tetide smt, Anfitrite smt, Galatea smt and Euridice smt), composite edifices (Empedocle with its culminations of Ferdinandea/Graham smt, Terrible smt, and Nerita smt; Nameless smt; Linosa II smt and Alfil/Linosa III smt) and stratovolcanoes (Pantelleria Island and Linosa Island) (fig. 15). A series of poorly known minor seamounts are spread along the extensional Sicily Channel system (Cimotoe smt, Pantelleria SW smt, Pantelleria SE smt, Pantelleria E smt, Central bank smt) and are herein only briefly mentioned associated with nearby larger seamounts. This volcanism is Quaternary in age and is associated with the development of a NW-SE trending rift system. Recent activity is reported, in particular concerning the last historical eruption of Ferdinandea/Graham smt in 1831 and the Pantelleria Island subaqueous eruption in October 1891. Chemical compositions of dredged rock samples range from tholeiitic basalt to alkali basalt, hawaiite and basanite (Calanchi *et alii,* 1989; White *et alii*, 2009), while subaerial products reach peralkaline rhyolitic compositons (pantellerites) (fig. 16); the principal emitted products are lavas and scoriaceous material, spatter-like deposits and lava balloons.

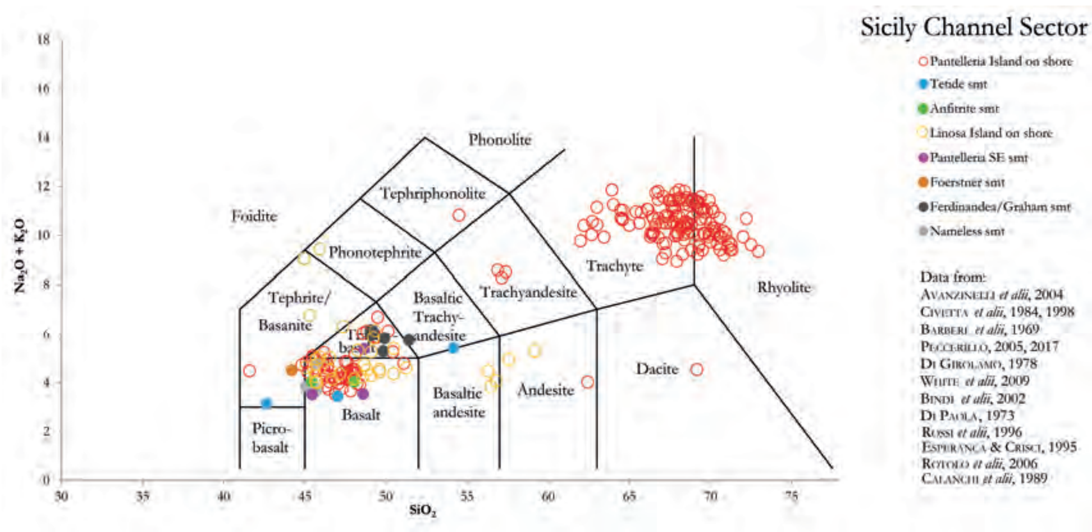
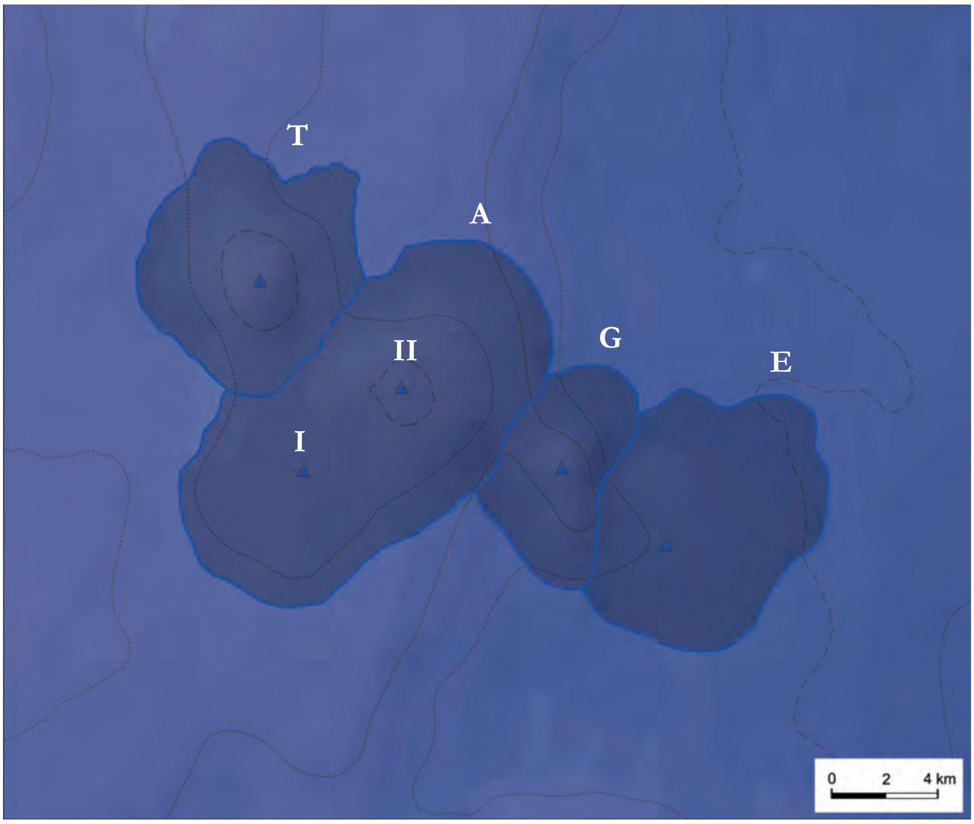
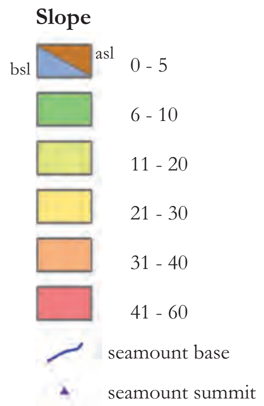


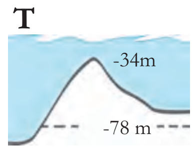
Fig. 16 - TAS diagram of composition of the Sicily Channel Volcanic Seamount Sector products. Data are plotted raw from cited sources and may include LOI up to >20%. The reader is referred to the original papers for an evaluation of the data and for the nomenclature adopted in this text.
- Diagramma TAS della composizione dei prodotti vulcanici relativi al Settore vulcanico sottomarino Canale di Sicilia. I dati sono tracciati dalle fonti citate e possono includere LOI fino a >20%. Si rimanda il lettore agli articoli originali per una valutazione dei dati e per la nomenclatura adottata in questo testo.

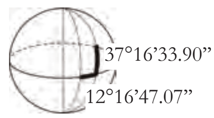
7.1 *Tetide, Anfitrite, Galatea and Euridice Seamounts*

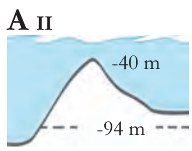


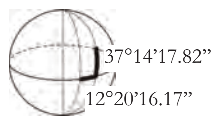
Morph. ty.	Simple cones
Serie	Tholeiitic, Na-Alkaline
Chem. com.	Tholeiites, alkali-basalts
Act. ty.	Effusive
Act. age r.	Pleistocene
Vol. [km^3±10%]	0.7 (T); 1.6 (A); 0.3 (G); 0.1 (E)
Flu. ems.	/











Morphology

Tetide (T), Anfitrite (A), Galatea (G) and Euridice (E) are volcanic seamounts NW-SE-oriented, located on the so called Adventure Bank. They were first recognized and studied by CALANCHI *et alii* (1989), and named after the Nereides, minor marine gods. Euridice is a fourth seamount indicated and named in this work for the first time, whose morphology and location suggests a similar nature as the three nearby seamounts.

Tetide is the northwesternmost centre; it has conical shape with regular and symmetric flanks and its area is 9 km^2 (CIVILE *et alii*, 2016); it rises from the seafloor (average depth of -78 m) reaching a minimum depth of -34 m below sea level. The volume is estimated at 0.7 km^3.

Anfitrite is located south-east with respect to Tetide smt and rises from an average depth of -94 m. Anfitrite smt is characterised by two distinct edifices with conical shape named Anfitrite I and Anfitrite II (CIVILE *et alii*, 2016) aligned NE-SW. Anfitrite I, to the SW, has an irregular summit crest with an overall horseshoe-shape. Anfitrite II is the major edifice with summit at -40 m. The volume is estimated at 1.6 km^3.

Galatea seamount shows a NW-trending summit crest and an overall NNE-trending shape of the edifice due to the coalescence with the nearby smts. Its base is at average depth of -117 m and the top reaches -74 m. It has a volume of 0.3 km^3.

Euridice is the less morphologically developed edifice, that rises for 28 m above the seafloor, reaching a minimum depth of -102 m. It has a volume of about 0.1 km^3.

Slope values are low for the entire area and never exceed 3.2°.

Some 20 km southeast of Euridice smt, Cimotoe smt is located along the southernmost margin of the Adventure Bank. The volcanic origin of Cimotoe smt has been inferred based on magnetic anomalies (CALANCHI *et alii*, 1989). It rises from a depth of ca. -200 m and is composed by a series of conical peaks (PECCERILLO, 2017) elongated NW-SE parallel to Tetide, Anfitrite, Galatea and Euridice smts.

Volcanic structure

The volcanic nature of Tetide, Anfitrite and Galatea is supported by both seismic and magnetic anomalies (CALANCHI *et alii*, 1989; CIVILE *et alii*, 2016). The overall NW-trending of this cluster of seamounts is parallel to the main direction of the Sicily Channel extensional structures, so that a structural control on these cones is evident. The well preserved conical shapes of the cones indicate a rather young emplacement.

Chemical composition and age

Tetide volcano is mainly composed by tholeiites (sample CS75-28); Anfitrite smt products are alkali basalts (sample CS76-2) (Calanchi *et alii*, 1989).

Some erosional features were identified along Tetide and Anfitrite volcanoes; this suggests that sea-level changes accompanied the lava emplacement. Consequently, the maximum age of these lavas is Pleistocene. Galatea smt lacks such erosional features, so the age of emplacement is probably younger than the last glaciation (Calanchi *et alii*, 1989).

No information is available on Euridice smt.

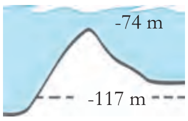
Volcanic products

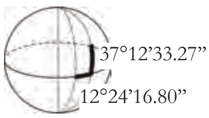
Two of these seamounts were sampled by diving (Calanchi *et alii*, 1989): Tetide volcano is characterized by vescicular lavas (samples CS75-28-SMZT and CS75-28-SMZT) bordered by blocks and rounded pebbles and massive lavas, while Anfitrite smt consists of massive and fractured lavas (samples CS76-2-2A and CS76-2-3A).

Brief volcanic history

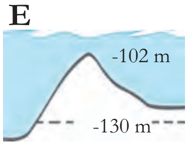
The volcanic history of these volcanoes is still unknown, but the NW-SE alignments of these basic volcanic centres suggest that the emplacement of mantle-derived magmas occurred in a stress regime with extension normal to the rift valley orientation.

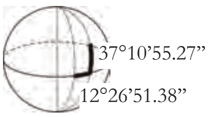
G



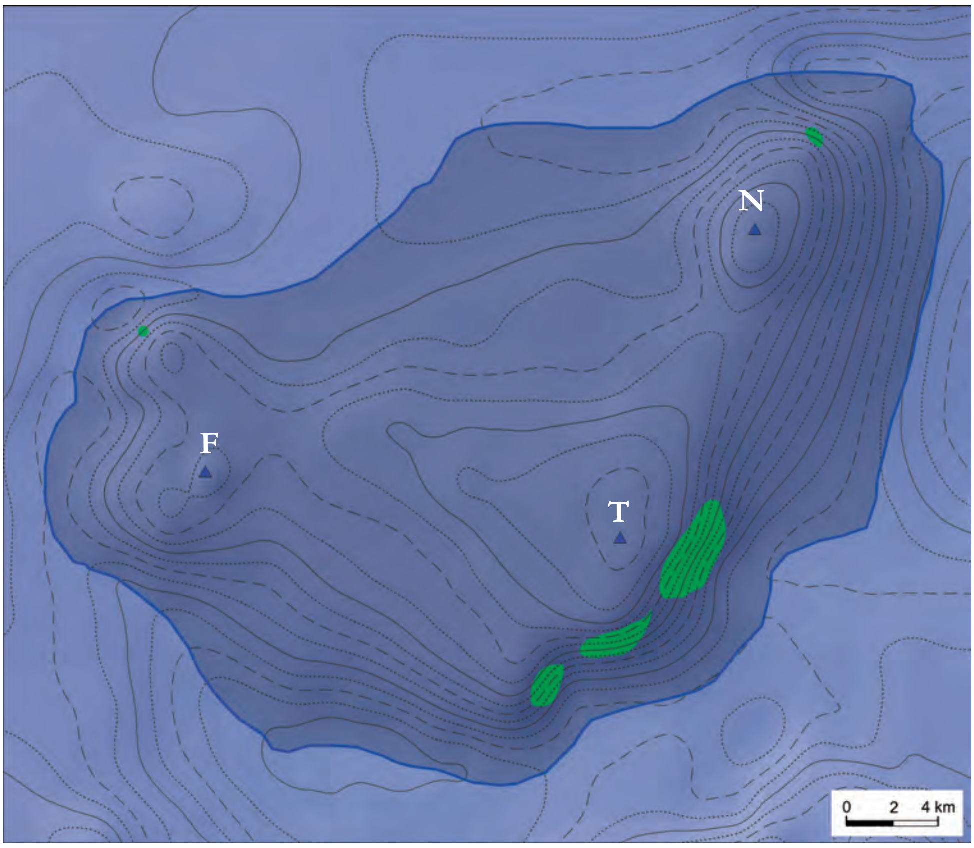


E

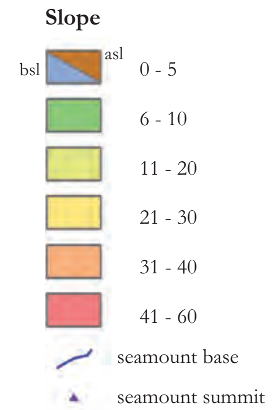


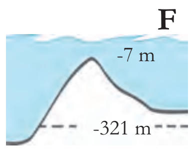


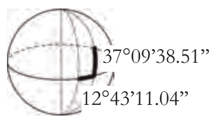
7.2 *Empedocle Seamount: Ferdinandea/Graham, Terrible and Nerita*



Morph. ty.	Composite edifice
Serie	Na-alkaline
Chem. com.	Alkali basalts-hawaiites
Act. ty.	Effusive
Act. age r.	Pleistocene ? - Present (1831AD)
Vol. [km^3±10%]	76
Flu. ems.	Fumaroles







Morphology

The Empedocle seamount is a broadly triangular structure made by the coalescence of three different volcanic edifices: Ferdinandea/Graham (F), Terrible (T) and Nerita (N). Graham and Terrible summits are connected by a WNW-ESE-trending ridge, while Terrible and Nerita summits are connected by a NE-SW-trending ridge. Both ridges are about 20 km long, and the entire structure is almost 40 km long.

The Empedocle edifice rises from depths comprised between -416 m and -216 m, averaging at -321 m. The shallowest summit is Ferdinandea/Graham at -7 m (FALZONE *et alii*, 2009) for an average edifice height of 314 m.

Slope values are low, and the highest values are registered along the southern-looking flanks, yet rarely exceeding 6°.

The estimated total volume of the Empedocle seamount is 76 km^3.

Volcanic structure

The structure of Empedocle seamount underlines the interference of the main NW-SE regional trend of the Sicily Channel with the orthogonal NE-SW trend.

The Graham edifice is made by two coalescing cones, elongated NW-SE, with their summits located 600 m apart. One of the two cones last erupted in 1831. The second cone shows a conical shape and a larger horseshoe-shaped summit; an active field of fumaroles is present on its northeastern side (WÜRTZ *et alii*, 2014).

Chemical composition and age

According to ARGNANI & VIGLIOTTI (2003), lavas erupted from Graham volcano are of basaltic nature, while there are no data available for the other volcanoes. Samples dredged from Graham smt by CALANCHI *et alii* (1989) (CS72-45-1A, CS81-16-2A-I) indicate alkali basalts-hawaiites compositions.

The age of Graham eruption is known from historical accounts (1831 AD). Furthermore, the most recent signs of volcanic activity are dated 2000 and 2002 (WÜRTZ *et alii*, 2014). There are no data on the beginning of the volcanic activity on the Empedocle smt.

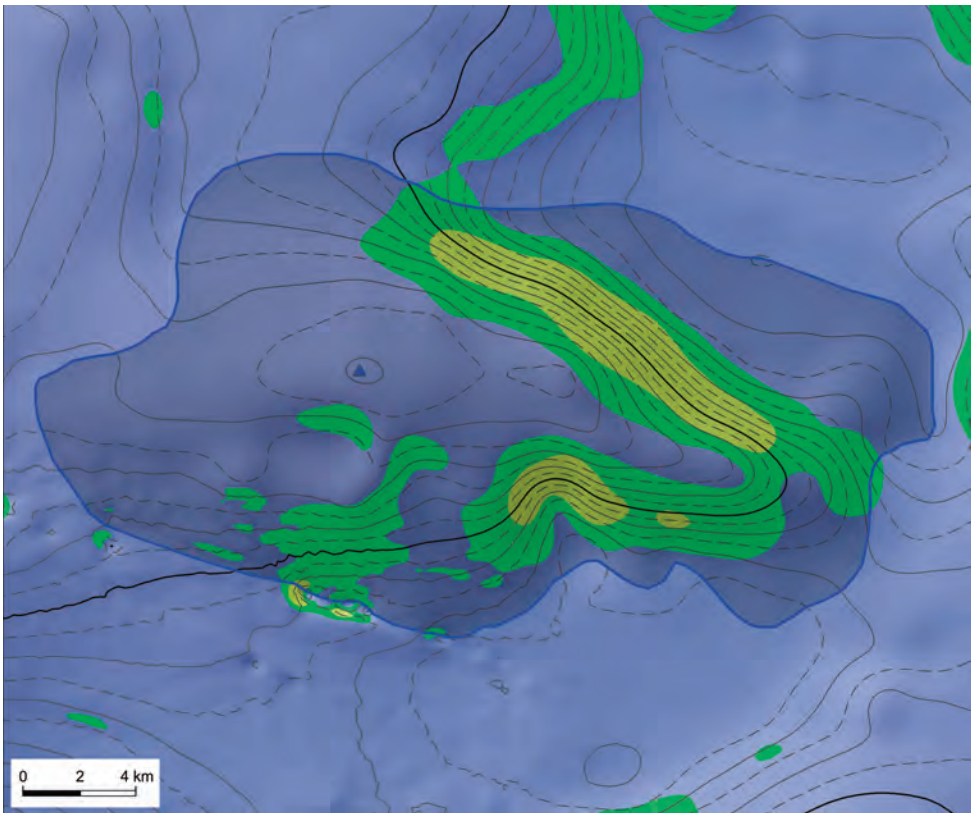
Volcanic products

Available descriptions indicate the presence of both massive lavas and scoriaceous material (Argnani & Vigliotti, 2003; Würtz *et alii*, 2014).

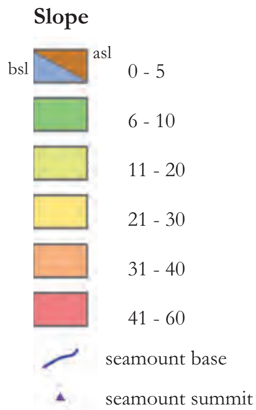
Brief volcanic evolution

The Empedocle smt is famous because of its most recent eruption. On the 1st of August, 1831, this volcano erupted initially under water and later emerged with hydrovolcanic Surtseyan explosions, witnessed by local fishermen (Argnani & Vigliotti, 2003). The ownership and the naming of the new island was disputed between the Kingdom of "Due Sicilie", United Kingdom and France, so that the island was named Ferdinandea, Graham Bank and Iulia in the respective countries. The dispute was still unresolved when the island was progressively destroyed by marine erosion in 1832 (Argnani & Vigliotti, 2003; Würtz *et alii*, 2014).

7.3 *Nameless Seamount*



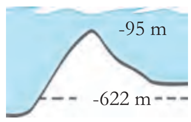
Morph. ty.	Composite edifice
Serie	Na-alkaline
Chem. com.	Basalts, Basanites
Act. ty.	Effusive
Act. age r.	9.5 Ma
Vol. [km^3±10%]	63
Flu. ems.	/



Morphology

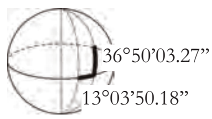
The Nameless seamount is located at the eastern tip of the larger Pinne Bank plateau, located about 40 km to the SE of the Graham bank. It elongates on a E-W trend for 23 km (15 km wide) and its shallowest peak is located at -95 m. The average depth of the base is -622 m. The structure is about 527 m high. The slope inclination is higher along the northeastern flank, up to 21°. To the west, flanks are gentler and slopes never exceed 5°.

The volume of this structure is ~63 km^3.



Volcanic structure

This seamount elongation is likely linked to important regional faults.



Chemical composition and age

Volcanic rocks from Nameless Banks have geochemical characteristics similar to Pantelleria and Linosa Islands, broadly resembling HIMU-OIB type (High U/Pb Mantle - Oceanic Island Basalt; Carminati *et alii*, 2010). Sampled rocks have an hawaiitic affinity and derive from alkaline magmas (Rotolo *et alii*, 2006).

Eocene-Lower Oligocene(?) limestones associated with basaltic fragments were dredged along the northern slope: K-Ar dating of these rocks gave a result of 9.5 Ma (Beccaluva *et alii*, 1981). Calanchi *et alii* (1989) dredge haul located slightly higher on the slope and 2 km westward, yielded basaltic rocks of a different composition (nepheline basanites sample CS81-19-3).

Volcanic products

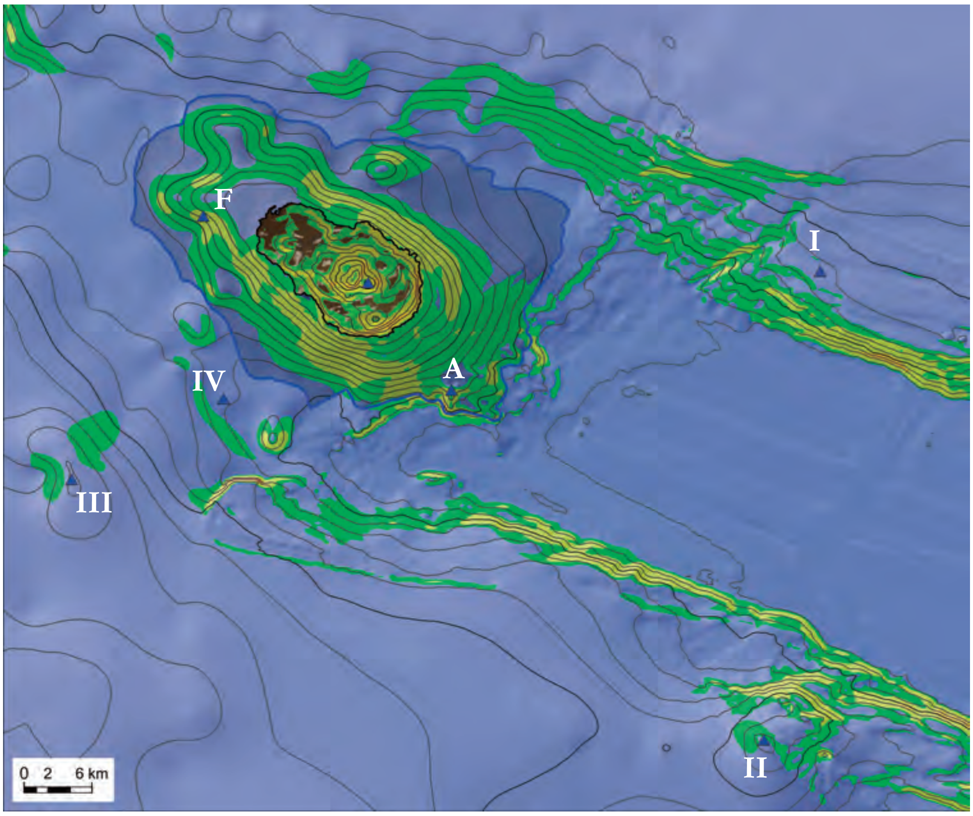
The volcanic succession has not been studied in detail and descriptions of rock types are not available.

Brief volcanic evolution

The wide magnetic anomalies, trending roughly NE-SW from the seamount towards the Malta Rift, indicate that important basaltic bodies occur close to or at the sea bottom in this area. In the northeast, the structure is bounded by a regional normal fault which led to the formation of one of the most prominent basins of the eastern plateau of the Strait of Sicily, the Gela Basin (Calanchi *et alii*, 1989).

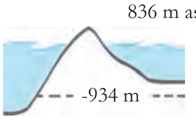
Pantelleria Island 7.4

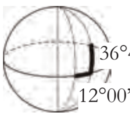
Morph. ty.	Stratovolcano
Serie	Na-alkaline
Chem. com.	Basalts; Trachytes and peralkaline rhyolites (pantellerites and comendites)
Act. ty.	Mixed
Act. age r.	0.32 - Present (1891AD)
Vol. [km^3±10%]	278
Flu. ems.	/



Slope

bsl asl 0 - 5
6 - 10
11 - 20
21 - 30
31 - 40
41 - 60
seamount base
seamount summit





Morphology

Pantelleria is a stratovolcano located in the Sicily Channel. The subaerial part of the volcano measures 13 km by 8 km and reaches 836 m above the sea level (Avanzinelli *et alii*, 2004). Along the submerged slopes of the Pantelleria edifice, two minor centers can be identified: the Angelina seamount (A) and the Fœrstner volcano (F). Fœrstner volcano is located to the NW of the island; Bosman *et alii* (2007) identified about 30 submarine eruptive centres, in the bathymetric range of ~ -250/-800 m and characterized by well-preserved morphologies. The Fœrstner volcano is 90 m high and the most recently erupted cone, last active in 1891 (Conte *et alii*, 2014).

The Pantelleria edifice is a NW-trending, and 32 km long (22 km wide) structure, with its base lying between -1198 m and -558 m, at average depth of -934 m. The total average height of the edifice is 1770 m.

The calculated volume is about 278 km^3.

Around the Pantelleria edifice, several submerged volcanic structures are also present: the Pantelleria E (I), Pantelleria SE (II), Pantelleria SW (III) and Central Bank (IV) smts.

Pantelleria SW smt is a 400 m high, 3 km wide, 11 km long NW-SE oriented structure, with very steep NE and SW flanks (slope gradients up to 27°; Würtz & Rovere, 2015).

Central Bank is located 12 km to the NE of Pantelleria SW (Martorelli *et alii* 2011). This structure is 3.6 km long, 1.8 km wide and about 150 m high (Würtz & Rovere, 2015).

Pantelleria E and Pantelleria SE smts are located on the northern and southern flank of the Pantelleria Graben. Very little is known of these edifices and the available bathymetric maps do not allow a clear description of the structures. Nevertheless, the Pantelleria SE shows a nearly-conical shape of about 5 km in diameter, with a NE-SW-elongated small structure on its northern flank.

Volcanic structure

Pantelleria edifices rise at the NW tip of the Pantelleria Graben, which is a rather narrow and well defined WNW-ESE structure with a flat floor at depths around -1300 m. The structural control on the Pantelleria edifice is evident by its elongation, almost parallel to the graben, as well as the location of the satellite cones. The presence of a summit caldera in the emergent part testifies the presence of a shallow magma chamber where mantle-derived magmas accumulate and differentiate.

The smaller edifices of Pantelleria SW, E and SE are located along the flanks of the graben, morphologically at the footwall of the normal fault bounding the graben, indicating a strong structural control on the location of volcanic edifices (e.g. WÜRTZ & ROVERE, 2015).

Chemical composition and age

Pantelleria Island is made up of alkali basalts to trachytes and peralkaline rhyolites (i.e. pantellerites); its period of eruptive activity ranges between 0.32 - 0.055 Ma (CALANCHI *et alii*, 1989; CIVETTA *et alii*, 1998).

Dredged samples from Pantelleria SE smt showed a bimodal composition: subalkaline basalts and tephrites (ROTOLO *et alii*, 2006).

Volcanic products

The subaerial products of Pantelleria Island are well studied and we refer the reader to the relevant literature (JORDAN *et alii*, 2017 and references therein).

Fœrstner volcano is the site of the most recent eruption in 1891 (CONTE *et alii*, 2014). This volcano exhibited submarine fire fountaining during its eruption, as evidenced also by the deposition of spatter-like deposits and lava balloons (CORTI *et alii*, 2006; KELLY *et alii*, 2014). The collected volcanic seafloor samples consist predominantly of coarser pyroclasts (i.e. lapilli, small bombs and bomb fragments), lava clasts and glass ash-sized grains (CONTE *et alii*, 2014). In the same area, two vents were also identified: a main vent at -250 m and a smaller vent at -350 m water depth (CONTE *et alii*, 2014; WÜRTZ & ROVERE, 2015). The deeper vent produced a considerable amount of pillow flow lobes, indicating a dominantly effusive eruption style (WÜRTZ & ROVERE, 2015).

Samples of porphyritic lavas were dredged on Pantelleria SE smt. Whereas highly vesciculated, glassy lapilli dispersed in mud were recovered from Pantelleria E (ROTOLO *et alii*, 2006).

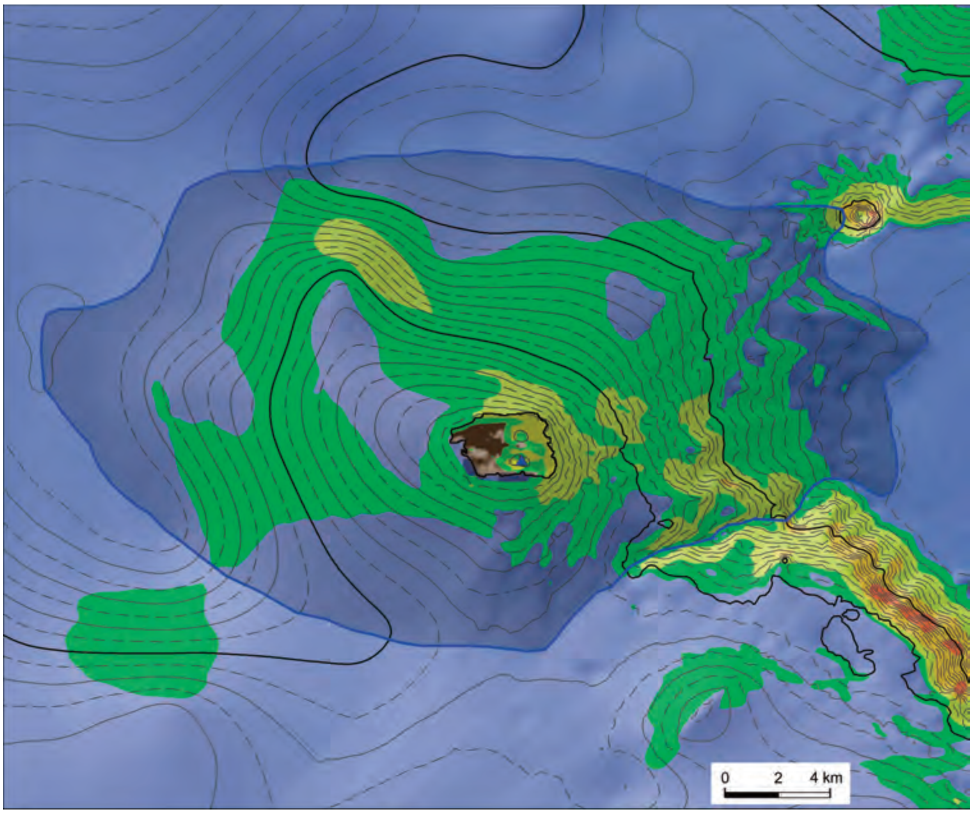
Brief volcanic evolution

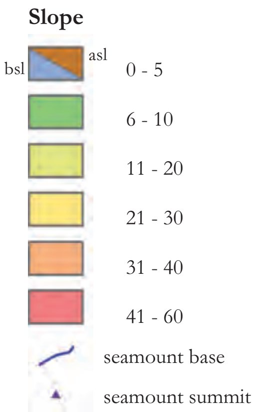
The Pantelleria Island activity spans from 324 ka and 5.5 ka, characterised by emplacement of peralkaline rhyolites and trachytes in the form of lava flows and ignimbrites and subordinate basaltic and hawaiitic lavas followed by periods of quiescence. Two nested calderas are recognisable in the field: the “La Vecchia” caldera has a K/Ar age of 114 ka, whereas the “Monastero” caldera has a K/Ar age of either 45 or 50 ka (AVANZINELLI *et alii*, 2004 and references therein).

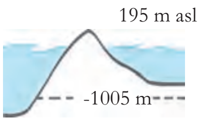
RICCÒ (1892) gave the most detailed account of the 1891 submarine eruption at Fœrstner volcano based on his direct observation and from reports of the authorities and local people. He reported that precursor phenomena occurred from May to June 1890 with a swarm of small earthquakes and uplift (up to 0.75 m) of the NE coast of Pantelleria Island. In October 1891, the seismic activity resumed and lasted for almost 10 days accompanied by the drying up of numerous springs. Several strong earthquakes were felt in the town of Pantelleria and produced minor damage. On October 17, signs of volcanic activity with steam and floating black scoriaceous bombs (i.e., lava balloons) were observed offshore of the NW coast of Pantelleria. On October 18, lava balloons were observed to form a NE-SW strip, up to 850 m long and 50 m wide. The eruption lasted for 7 days accompanied by strong seismicity and lava balloons rising to the sea surface. The eruption ended on October 23.

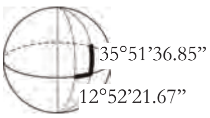
Linosa Island 7.5

Morph. ty.	Stratovolcano
Serie	Na-alkaline
Chem. com.	Basalts to hawaiites Most evolved benmoreites and trachytes
Act. ty.	Mixed
Act. age r.	1.06 - 0.53 Ma
Vol. [km³±10%]	118
Flu. ems.	/









Morphology

Linosa, with Lampedusa and Lampione, belongs to the Pelagie Islands (Sicily Channel). The island represents the 195 m high emerged area of a much larger edifice that reaches a total height of 1164 m from the seafloor. The island extends for approximately 3x2 km, stretching mainly on a NW-SE direction. The entire edifice occupies an area of about 25x20 km, showing a triangular/horseshoe shape with the concavity toward the N. Slopes along the western flank are gentler (6° to rarely 15°) than on the eastern flank, where the flanks face the Linosa graben reaching 20° of slope value and following a NNE-SSW-trending. The base of the edifice lies between -1544 m and -406 m, averaging at -1005 m, for an average height of 1200 m.

The total volume of this edifice is 118 km^3.

Volcanic structure

The Linosa edifice is the emergent summit of a conical stratovolcano located at the NW edge of the Linosa Graben, in the Sicily Channel (Bindi *et alii*, 2002).

Chemical composition and age

The volcanic products are mostly represented by mildly alkaline basalts to hawaiite; the most evolved rocks are represented by abundant lithic fragments of benmoreitic and trachytic composition (Bindi *et alii*, 2002; Peccerillo, 2017).

K-Ar ages indicate that the island was built up from 1.06 ± 0.10 to 0.53 ± 0.07 Ma, through three main stages of activity: Paleo-Linosa, Arena Bianca and Monte Bandiera (Rossi *et alii*, 1996).

Volcanic products

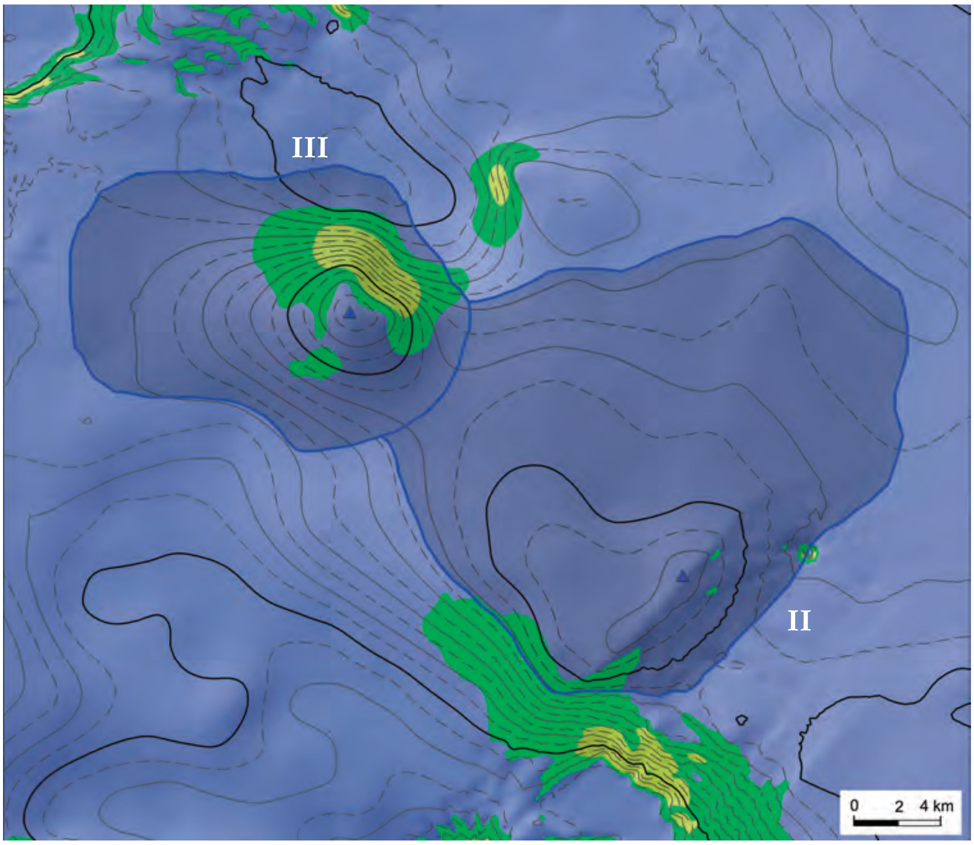
On the island, hyaloclastites are abundantly represented both as individual centres and as remnants of ancient structures affected by sea erosion; these are the best preserved inland examples of the submarine volcanic centres that formed the island (Di Paola, 1973). The subsequent subaerial activity is represented by large basaltic lava fields with associated spatter cones and small secondary centres (Di Paola, 1973).

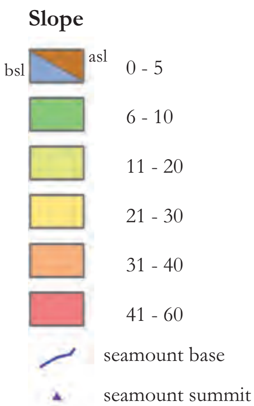
Brief volcanic history

The volcanic history of Linosa can be divided into two distinct main periods: an early period of submarine activity (Paleo-Linosa and Arena Bianca stages), and a late subaerial period (Monte Bandiera stage; Di Paola, 1973; Rossi *et alii*, 1996; Lanzafame & Tranne, 2000). Here we report a brief summary of the volcanic evolution of the island, as well described in Lanzafame & Tranne (2000). During the Paleo-Linosa stage, the most ancient five eruptive centers formed; the eruptions were essentially hydromagmatic, producing great quantities of pyroclastics that first constructed the island. The primordial island was elongated in a NW-SE direction, but its volcanic activity was also controlled by N-S discontinuities. The second, Arena Bianca, stage is characterized by both magmatic and hydromagmatic activity, located at the extremities of the growing island. Again, the activity was controlled by the NW-SE and N-S tectonic trends and a polycentric complex was formed. The third, and last, Monte Bandiera stage produced centers located in the eastern, northern and central parts of the growing island, again controlled by the NW-SE and N-S tectonic trends. The magmatic activity was mostly explosive and effusive and constructed the dominant morphological elements of the modern island.

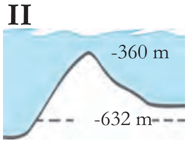
Linosa II and Alfil/Linosa III Seamounts 7.6

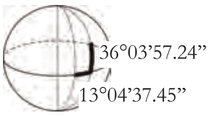
Morph. ty.	Composite edifice
Serie	/
Chem. com.	/
Act. ty.	Effusive
Act. age r.	/
Vol. [km³±10%]	22 (II); 20 (III)
Flu. ems.	/



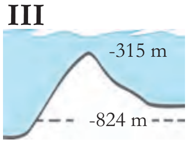


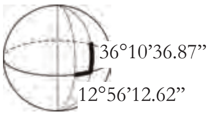
II





III





Morphology

Linosa II seamount and Linosa III seamount (also known as Alfil Bank by WÜRTZ *et alii*, 2014) are located ca. 30 km NW with respect to Linosa Island and are NW-SE aligned. Alfil/Linosa III shows a single central vent and a more regular conical shape with respect to Linosa II that displays multiple vents and an arcuate shape. The top of Alfil/Linosa III is at -315 m with flank slopes up to 20° along the steeper northern flank, to an average depth of -824 m and an average edifice height of 509 m; the top of Linosa II edifice lies at -360 m; its flanks decrease gently towards the abyssal plain (10° to 5°) to an average depth of -632 m and an average edifice height of 272 m. The northern slopes are steeper, up to 20°, likely due to lateral collapse, as possibly indicated by an horseshoe-shaped morphology in the upper reaches, forming a N-facing arcuate structure 3 to 6 km across.

The estimated volume for Linosa II smt is 22 km^3.

The estimated volume for Alfil/Linosa III smt is 20 km^3.

Volcanic structure

There is no direct information about Linosa II and Alfil/Linosa III volcanic structures but the area is characterized by the presence of the main tectonic depression Linosa Rift and numerous minor horst and graben sequences NW-SE oriented (CALANCHI *et alii*, 1989).

Chemical composition and age

Chemical composition and age of these seamounts are still unknown.

Volcanic products

Volcanic products from Linosa II and Alfil/Linosa III seamounts have never been sampled or observed.

Brief volcanic history

The volcanic history of these seamounts is not known.

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