

THE SUBMARINE PORTIONS OF ITALIAN VOLCANOES: THEIR SURVEY AND ASSESSMENT OF THE POTENTIAL VOLCANIC HAZARDS

Scientific Co-ordinator

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ACTIVITY REPORT –2nd YEAR

PROJECT PARTICIPANTS

UNUROMA1	Dip. Sc. Della Terra, Univ. di Roma “La Sapienza”	F. L. Chiocci
IGM - CNR	Istituto di Geologia Marina di Bologna	M. Marani
CNR - ITR	Ist. di Geol. Amb. e Geoingegneria di Roma	P. Tommasi
UNIBO	Dip. Sc. Terra e Geol. Amb., Univ. di Bologna	C. Romagnoli
CNR - IGS	Istituto Geomare Sud, Napoli	G. de Alteriis
OV	Osservatorio Vesuviano	S. de Vita
UNISANNIO*	Dipartimento Scienze della Terra Università del Sannio	M. R. Senatore
UNICO	Univ degli Studi dell’Insubria, Dip. Sc. Chi. Fisi. e Mat., Como	L. Vezzoli

GENERAL OBJECTIVES:

Task 1: DTMM generation for the Vulcano, Stromboli and the southern part of the Ischia Island. Definition of a general standard procedure for DTMM production.

Task 2: Geotechnical characterisation of submarine instabilities and related subaerial phenomena. Geotechnical analysis and modelling of instability phenomena affecting the flanks of the volcanic islands.

Task 3: Researches on Ischia submerged flanks. Reconstruction of the evolutive processes by marine data. Seismostratigraphic analysis.

Task 4: Understanding of the geological processes active in the Italian submarine areas. Evaluation of the Potential risks associated with the volcanic seamounts and with the submerged portions of the volcanic islands of the Tyrrhenian Sea.

Task 5: Investigations of the submerged portion of the Mount Etna volcanic edifice. To ascertain the presence of tectonic lineaments, both extensional and compressional, connected with those on land, due the absence of butress toward the sea.

Task 6: Researches on Stromboli and Vulcano submerged flanks. Study of instability processes from the marine record; comparison with the evolutive framework of the volcanic complexes.

Task 7: Volcanism and structural geology of Ischia Island. Definition of the relationships among slope instability, deformations and volcanism. Correlation between submarine and subaerial deposits.

* Note that UNISANNIO replaces UNINA due to the change in affiliation of UR co-ordinator, Prof. M.R.Senatore. Such a change has been approved and ratified by GNV.

TASK 1: Dimensional surface model generation (DTMM)

- **UR PARTICIPANTS:** CNR – ITR, UNIROMA1

- **2nd YEAR OBJECTIVES:**

ISCHIA

- Acquisition of images at a 1:5000 scale (flight performed by the Provincia di Napoli, 1999); photogrammetric processing aided by a GPS control network on a-posteriori identified points (no additional cost for the project).

STROMBOLI

- Acquisition and organisation of existing data on Stromboli (DTM) (in collaboration with the project: “Development and application of techniques of remote sensing for the monitoring of active volcanoes” coord. by Mauro Coltelli).

VULCANO

- Definition of accuracy standards and specifications for terrestrial and marine data fusion.

- **2nd YEAR RESULTS:**

Methodology:

Implementation of a matching procedure for merging partially overlapping bathymetric data of different spatial resolution and not congruent reference systems.

Identification of structural and morphological features for matching of subaerial and submarine data

Definition of different strategies for merging 3D not contiguous data (from terrestrial and marine surveys) based on geometrical constraints along main structural features and morphometric parameters analysis

Analysis of method for integrating high resolution not contiguous DTM data with lower resolution data derived from available mapping products.

Analysis of methods for the extraction of quantitative information from multibeam data (Ischia Island) by means of classification procedures usually adopted for LIDAR data

Data acquisition:

Vulcano Island: Grid and sparse 3D data derived from 1996 photogrammetric data (1:10000) (Progetto Coltelli)

Stromboli Island : Grid and sparse 3D data derived from 2001 photogrammetric data (1:5000) (Progetto Coltelli)

Ischia Island: selection of images at a 1:5000 scale and vector maps (flight performed by the Provincia di Napoli, 1999); laser scanning data of a sector of the Island (NW).

Processing and interpretation:

Generation of the DTMM model for the Vulcano Island.

Preliminary results for the DTMM of Stromboli Island.

• **RESEARCH PRODUCTS OF THE PROJECT:**

- n° 1 articles published on international journals;
- n° 1 articles published on national journals, proceedings, technical reports.
- n° 1 presentation at international meetings
- n° 1 presentation at national meetings
- Computation codes: 1 software for matching DEMs

• **PUBLICATIONS LIST**

- Baldi P., S. Bonvalot, P. Briole, M. Coltelli, K. Gwinner, M. Marsella, G. Puglisi, D. Rémy “*Validation And Comparison Of Different Techniques For The Derivation Of Digital Elevation Models And Volcanic Monitoring (Vulcano Island, Italy)*” Int. J. Remote Sensing, 2002.

- Achilli V., Baldi P., Fabris M., Marsella M., Melis F., Signoretto V. *High resolution techniques for morphological studies in volcanic areas* Poster presentato al EGS XXVII General Assembly, Nice, France, April 2002.

- Achilli V., O. Al-Bayari , F. Belloli , S. Borgstrom , C. Del Gaudio , P. De Martino , M. Marsella , G. P. Ricciardi , C. Ricco , V. Sepe , M. Silvestri *Misure di Geodesia Classica e Generazione di un DEM da Laser Scanning dell’Isola di Ischia* Atti ASITA, Perugia 2002.

- Atzori S., Baldi P., Marsella M., Signoretto V. *Analysis of high resolution digital elevation model of vulcano island for morphometric relief classification* Poster presentato al Convegno Nazionale GNV, Roma 2001.

TASK 2: Geotechnical characterisation of submarine instabilities and related subaerial phenomena

- **UR PARTICIPANTS:** CNR – ITR, UNIROMA1, UNIBO, CNT – IGS.

• **2nd YEAR OBJECTIVES:**

VULCANO

Geotechnical characterisation of the rock/soil mass/materi.

STROMBOLI

Submarine sampling.

First analysis of the submarine instability phenomena in the volcanic products and of the related debris avalanche/flows

First modelling of the debris avalanche transport/flow characteristics and comparison with morphological/large-scale textural evidences.

ISCHIA

First modelling of the debris avalanche transport/flow characteristics and comparison with morphological/large-scale textural evidences.

• **2nd YEAR RESULTS:**

The following activities were carried out:

a) Sampling and preliminary Geotechnical characterisation of the pyroclastic material at Vulcano

Materials of the more recent activity cycles at la Fossa and Grotte dei Rossi Tuffs were sampled and preliminary data on physical-mechanical properties were gained by means of laboratory testing. The characteristics of the latter material will be correlated to those of the deposit, which are to be sampled in the subsoil of the Punte Nere (Ialoclastiti, Auct.).

The planned geotechnical borehole at Vulcano was not performed due to serious logistic problems during definition of operational procedures for location of the drilling apparatus (conditions did not guaranteed correct and safe drilling operation). An alternative access to an adjacent area was not permitted by regional authorities due to environmental problem in tracing a track for the drilling device. A new site has been chosen, not far from the original one, which can be reached by the drilling equipment and should provide indications for a geotechnical characterisation of the subsoil of the study area. The borehole will be drilled when stable meteomarine conditions are guaranteed (late 2003 spring) producing an unavoidable postponement of research activities

b) Geotechnical characterisation of scoriaceous lava material sampled at the Sciara del Fuoco.

Strength, deformability and dynamic properties of the scoriaceous lava material were evaluated in order to assess the mechanical behaviour of the intact rock portions and of the rock fragment forming volcanoclastic deposits. No sampling of marine material was performed due to the unavailability of R/V Urania requested by RU UNIROMA1.

c) *Geotechnical characterisation of the volcanoclastic material sampled at the Sciara del Fuoco.*

At first small scale laboratory tests on the volcanic grains were performed in order to obtain a geotechnical characterisation of the rock material. Abrasion tests were also conducted for determining the attitude to rounding and to the production of fine particle of the original material. Subsequently the shear behaviour of the volcanoclastic debris material at field scale has been analysed in a large especially designed tilting test shear box (one of the few existing devices suited to the analysis of coarse aggregates). First data on the strength of the aggregate were obtained. Further tests for evaluating of strength variations due to rounding and to change in particle shape/dimension have been planned.

d) *Ischia Island*

Modelling has not been performed, due to difficulty to define the pre-event structure, stratigraphy and lithology of Ischia southern flank. We hope that the possible acquisition of new dredging data (not possible in 2002 due to lack of shiptime) and a closer collaboration with University of Laval will overcome the impasse.

• **RESEARCH PRODUCTS OF THE PROJECT:**

1 article at an international symposium

1 technical report

An especially designed tilting test device for the determination of large scale shear strength of aggregates

• **PUBLICATIONS LIST**

- Migliazza M., Segalini A., Tommasi P. (2002). Experimental studies on the mechanical behaviour of a volcanoclastic material. *Int. Symposium Soil-Rock America 2003*. In press

- ROSA L., TOMMASI P. (2002). Caratterizzazione fisico-meccanica di materiali provenienti dalle isole Eolie (Stromboli, Vulcano). *Rapporto Interno IGAG*

TASK 3: Researches on Ischia submerged flanks
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• **UR PARTICIPANTS:** CNR – IGS, UNIROMA1, UNISANNIO, OV.

• **2nd YEAR OBJECTIVES**

- Collection of new geophysical data (swath bathymetry, mono-and multi-channel high resolution seismic, magnetometry) and of seabed samples carrying out oceanographic surveys (aboard Urania and on a smaller vessel for shallow water researches).

- Execution of granulometric, petrographic, chronostratigraphic analysis on sampled sediments/rocks.

- First Interpretation of collected data and graphic restitution in various kind of maps: a) navigation map, with ship track lines; b) multibeam swath bathymetry with resolution at best than 0.5 % of depth; c) S.S.S. mosaic and interpretation of acoustic facies; d) bathy-morphologic interpretative map (in colours); e) thematic maps (seismostratigraphy, depositional sequences, etc).

• **2nd YEAR RESULTS**

The geophysical survey has been completed with various infillings (bathymetry; side-scan-sonar; chirp and magnetometry) and sea-bottom sampling program (especially coring and dredging).

Due to unavailability of R/V Urania that was requested for 2002, no dredging was performed on Ischia deep waters

Multibeam and side-scan-sonar data have been processed almost completely

Seafloor sample already collected on the 1st year (core and dredging) are under study (core logging, photographs, sedimentological and geochemical analysis have been performed).

1) **CRUISE ACTIVITY**

Two oceanographic legs were dedicated to the Ischia southern flank study: the 1st leg lasted 7 days on January 2002 on R/V Urania. 8 cores were collected in the southern offshore of the island:

In addition an infilling magnetoemric survey allowed to cover most of the southern and western offshore of the islands. The eastern and northern sectors were only partially covered by magnetometry due to shallow water depths that limited the survey.

The 2nd leg (5-10 August 2002) on R/V Urania allowed to collect the following 9 cores:

These cores must be added to the C848 core collected on 2000 cruise (the 1st core on the debris avalanche) and to the Tc55, Tc56 and Tc57 collected during another cruise (Chiocci) so totalling 18 cores over the debris avalanche deposit.

Dredging during the 2nd leg permitted only three dredges due to the short time available and stand-by on weather.

Side scan sonar records with acoustic positioning of the sensor were carried out during the 5-10 August leg but with poor results mainly due to the great water depths and the light sensor (DF1000). In any case a mosaic was attempted over one region of the debris avalanche particularly rich in block.

2) **PROCESSING ACTIVITY**

Multibeam data processing all over the Ischia offshore down to depth of 950-1000m was carried out in PDS 2000 software environment. A 20x20 DTM is was integrated with Geomare sud higher resolution (5x5 or 2.5x2.5) data collected north and west of the island in shallow waters (in the frame of environmental studies for Marine protected Areas). Processing required both manual editing and statistical removal of spiked signals. Particular attention was given to the block population in order to distinguish blocks from noise.

Automatic identification of homologous features (main blocks) on SSS and multibeam data of comparable resolution on sample areas. The aim is to produce an automatic matching to geo-referentiate TOBI data.

Draping of side scan sonar data (at different resolution) over bathymetry, on instability features of small and large dimensions.

Processing of bathymetric data to identify and quantify morphological features on debris avalanche body. An area of ~50 km² between 800 and 1000 m has been analysed to identify blocks on TOBI images (~1400 blocks detected) as well as on multibeam data (~600 blocks detected).

The interpretation of DTM, TOBI and side-scan DF1000 data is in progress.

- **RESEARCH PRODUCTS OF THE PROJECT:**

- 1 article on international journal
- 2 Presentation at international meetings
- 2 poster

- **PUBLICATIONS LIST**

- Bruno P. P., de Alteriis G and Florio G., 2002. The western undersea section of the Ischia volcanic complex (Italy, Tyrrhenian sea) inferred from marine geophysical data. *Geophysical Research Letters*, 29/9, 1029-1034.
- F. L. Chiocci, G. de Alteriis, A. Bosman, F. Budillon, E. Martorelli, C. Violante . The Ischia debris avalanche: the result of a catastrophic collapse of the island southern flank. AEAG Conference, Nice 2002
- F. L. Chiocci, E. Martorelli A. Bosman. *Cannibalization of a continental margin by regional scale mass wasting: an example from Central Tyrrhenian Sea*. AEAG Conference, Nice 2003 (in prep.)
- F.L. Chiocci, A. Bosman, E. Martorelli. *Submarine instability and sedimentary processes around Active Volcanic Islands of the Southern Tyrrhenian Sea*. Gruppo Informale Sedimentologi del CNR – “GeoSed” Potenza Ottobre 2001.
- F. L. Chiocci, A. Bosman, E. Martorelli. Fenomeni d’instabilità gravitativa a piccola e grande scala lungo le pendici sommerse dei vulcani insulari del Tirreno centro-meridionale. III° Convegno Nazionale delle Scienze del Mare. Bari 27-29 Novembre 2002.

TASK 4: Hazard assessment of the submerged portions of the Aeolian arc volcanoes, of Ustica and of the central Tyrrhenian Sea seamounts (Marsili and Vavilov volcanoes).

- **UR PARTICIPANTS: IGM - CNR.**

- **2nd YEAR OBJECTIVES:**

Hazard assessment of the submerged portions of the Aeolian arc volcanoes, of Ustica and of the central Tyrrhenian Sea seamounts Marsili and Vavilov volcanoes:

- Geophysical surveys (southern Tyrrhenian Sea)
- Processing and Interpretation of the acquired data
- Seafloor sampling cruise
- Preliminary report

Research on Stromboli and Vulcano submerged flanks:

- Performing of marine surveys
- Analysis and interpretation of collected data

- **2nd YEAR RESULTS:**

Hazard assessment of the submerged portions of the Aeolian arc volcanoes, of Ustica and of the central Tyrrhenian Sea seamounts Marsili and Vavilov volcanoes.

Data acquisition. Three research cruises were carried out. Aboard the R/V Logachev (27/7/02-12/08/02), a deep-towed side-scan sonar (SSS) profile, a camera run and sampling were acquired on western Palinuro volcano; 8 deep-towed SSS profiles, 2 camera runs and sampling were acquired on Marsili volcano; a deep-towed SSS profile, and 5 seismic reflection profiles were acquired on Vavilov volcano and in the Vavilov basin. Aboard the R/V Urania (30/08/02-19/09/02), the greater portion of the cruise was dedicated to collect 36 dredge samples from Vavilov volcano and to acquire a Chirp sonar survey of the Vavilov basin before collecting three long cores in the area. Aboard the R/V Thetis (07/11/02-12/11/02), a rapid response expedition was organised to acquire ROV observations, CTD data and water samples from the increased venting area offshore Panarea Island.

Data processing and interpretation. Palinuro – SSS line processed, TV run edited and single frame images acquired, samples being analysed. The cone forming the westernmost portion of Palinuro volcano is affected by linear fractures of the volcanics; along these fractures Feoxy-hydroxide and sulphide chimneys are generated, no venting was observed. Volcanic landforms mainly pillow lava, rare sheet flows. Marsili – SSS lines processed and mosaic generated covering southeastern and all northern flanks, TV runs edited and single frame images acquired samples in analysis. Mosaic gives outstanding indication of the construction of the edifice including satellite cones and volcano-tectonic structures. SSS run on summit imaged the elongated cone ridges showing point form eruption sites. TV run on summit discovered an extensive field of fossil hydrothermal chimneys. TV run on one of the

satellite cones sheds light on their growth. Vavilov - SSS line processed, seismic reflection profiles processed. The SSS line runs along the western base of the volcano, which, in association with the parallel seismic line sheds light on the hypothesised sector collapse that has affected the volcano. Other, more regional seismic lines investigate the structure of the Vavilov basin, seemingly affected by very recent faulting.

Research on Stromboli and Vulcano submerged flanks

Data acquisition. The first part of the cruise aboard the R/V Urania (30/08/02-19/09/02) was focused at studying the submerged portions of the Stromboli edifice and its surroundings. 200 miles of Chirp sonar high-resolution seismic lines were acquired and 25 seafloor sites were sampled (1 dredge, 10 box cores and 14 gravity cores).

Data processing and interpretation. A preliminary interpretation of the Chirp sonar lines has been aimed at determining the distribution of the acoustic facies over the study area. The results show that the Stromboli canyon and a smaller one, descending the western flank of Stromboli edifice fed a deep-sea channelled fan with depositional lobes that extend over much of the Marsili basin as far as the base of the Marsili seamount. All the cores have been cut and described. The preliminary interpretation of the sedimentary structures has allowed to evidence that high-density turbidity currents and debris flows are the predominant in the flank of the volcano and in the proximal part of the deep sea fan, while low-density turbidity current deposits are present in the distal portions. The interpretation of the cores has also been focused at the selection of particular horizons that are undergoing mineralogical, petrographic, geochemical and textural analysis in order to evaluate if they can give new insights on the eruptive style of the Stromboli volcano. With the same aim, the fresh lava samples dredged in a submarine cone to the southwest of the island are currently being analysed.

- **RESEARCH PRODUCTS:**

Sidescan sonar mosaic of Marsili Volcano

- **PUBLICATIONS LIST:**

Marani M.P. and Gamberi F. "Geological and Biological Processes at Deep Sea European Margins and Oceanic Basins". Intergovernmental Oceanographic Commission Technical Series, 65, In Press.

TASK 5: Investigations of the submerged portion of the Mount Etna volcanic edifice

- **UR PARTICIPANTS: IGM - CNR.**

- **2nd YEAR OBJECTIVES:**

Geophysical surveys (Etna)
Processing and Interpretation of the acquired data
Seafloor sampling cruise
Preliminary report

- **2nd YEAR RESULTS:**

Data processing and interpretation. Multichannel seismic reflection lines processed. In conjunction with the multibeam morphology, the seismic sections clarify the structural and depositional setting of the area offshore Etna. The canyon system on the Messina Rise has for the most part structural control. The seismic data confirm the fault origin of the ESE-WNW alignment seen on the bathymetry that controls canyon deviation and abuts onshore in the Etna region.

- **RESEARCH PRODUCTS**

Presentation at international meetings

- **PUBLICATIONS LIST**

Marani M.P. and Gamberi F. "Geological and Biological Processes at Deep Sea European Margins and Oceanic Basins". Intergovernmental Oceanographic Commission Technical Series, 65, In Press.

TASK 6: Researches on Stromboli and Vulcano submerged flanks

- **UR PARTICIPANTS: UNIBO, IGM –CNR, UNIROMA 1**

- **2nd YEAR OBJECTIVES:**

STROMBOLI

Acquisition of geophysical data and of sea-bed samples during two marine cruises, one aboard a R/V (the ship URANIA of Italian C.N.R., for instance) for the deep-water surveys and for the sampling operations and another aboard a smaller vessel, with reduced draught, for the shallow-water survey.

Preliminary Acoustic facies mapping, morphological and depositional reconstruction of the area, morphologic-petrographic analysis of sampled sediments.

VULCANO

Acquisition of new data (by means of geophysical surveys and sea-bottom samplings) in concurrence with analogous operations carried out on Stromboli submerged flanks.

First morphologic and structural characterisation of the submerged portions of Vulcano, with particular regard to the Baia di Levante area.

• 2nd YEAR RESULTS:

New data have been acquired on Stromboli and Vulcano submerged flanks. It was originally planned to carry out two marine surveys during the 2nd year of the project, but the request of ship time aboard the R/V *Urania*, made for 2002 by the RU UNIROMA1, has not been accepted by CNR. For this reason, it has not been possible to investigate and sample the deeper portions of both volcanic apparatus. Proposal for shiptime has been re-advanced to CNR by the RU UNIROMA1 and, in next weeks, it should be known if the deep-water survey aboard *Urania* would be realised in 2003.

The shallow-water survey has been carried out, aboard the R/V "Thetis" of Istituto Geomare Sud (CNR), in the period February 21-March 02, 2002. Researchers from several RU of the project (UNIROMA1, CNR-ITR, UNIBO and CNR-IGS) took part in this survey, with the purpose of acquiring multibeam and side scan sonar data on the shallow portions of Stromboli and Vulcano. The survey allowed to obtain an extremely detailed multibeam bathymetry all around the Island of Stromboli, down to 900-1000 m of depth, and in the north-eastern sector of Vulcano, down to -900 m. The reduced draught and good handling of "Thetis" have enabled to approach the coastal zone and to acquire swath bathymetry also above the -50m isobath, then to substantially improve the definition of the submerged features in the shallower sectors of both islands and the study of their relationships with the subaerial morphological and structural lineaments. Moreover, the multibeam data collected have been the base for the generation of Digital Terrain and Marine Models (DTMM) for Stromboli and Vulcano (Task 1).

In the last days of the cruise, the multibeam survey has been extended also to the northern side of Salina Island, where the occurrence of flank collapse has been recently claimed on the base of DEM images. No evidences of large-scale instability processes have been found on the investigated submerged portions of Salina, which extend down to 700 m of depth.

Data processing and interpretation:

The interpretation of the multibeam and side scan sonar data acquired in the survey of 2002 is still at the beginning, since data needed to be processed before becoming available for analysis. For the north-eastern sector of Vulcano, the shallow-water data put in evidence that the area of Baia di Levante is deeply incised by a submerged drainage and that retrogressive erosion is undercutting the Fossa Cone and is promoting flank instability. The detailed bathymetric and morphologic reconstruction obtained for Stromboli down to about -1000 m of depth suggests the occurrence of mass-wasting processes in different sectors of the island; these are going to be better defined on the base of the collected side scan sonar records.

SEM-EDAX analysis have been carried out at the Earth Science Department, University of Liverpool and at Dipartimento di Scienze della Terra e Geologico Ambientali, Università di Bologna, on box-core samples, collected during previous surveys offshore Sciara del Fuoco and in the Stromboli Canyon. The granulometry and particle characterisation, presently under completion, indicates down-current clast population evolution due to selective sedimentation. These observations are being used to clarify the nature and behaviour of the density currents flowing down the offshore extension of Sciara del Fuoco and contributing to the partial blanketing of the fan-shaped deposit related to large-scale collapse events. On Vulcano raw multibeam data have been re-processed to obtain a maximum detail of the erosional/ morphological features on super shallow water. A cruise has been planned for 2003, in collaboration with Università di Catania (Prof. Di Geronimo), to acquire ROV images on shallow depth.

TASK 7: Volcanism and structural geology of the Ischia island

• UR PARTICIPANTS: UNICO, OV

• 2nd YEAR OBJECTIVES

- Detailed geological survey of the area southward of Mt. Epomeo
- First definition of the surface geology and of the morphological and structural setting of the southern sector of the island
- First reconstruction of the volcanological and deformational history of this sector, and its insertion in a general evolutionary framework of the island.
- Definition of the areas covered by lava flows and by pyroclastic fall, flow and surge deposits.
- Sampling of all the units for which different analyses are provided, and preparation of the samples.
- Stratigraphy of mud-flow and debris-flow deposits.
- Definition of the areas invaded by mud-flow and debris-flow deposits.
- Editing of a mud-flow and debris-flow deposits distribution map.
- Analogical modelling of deformational processes.
- First definition of the relationships among volcanism, volcano-tectonics, tectonics and slope instability.
- Petrological characterisation of subaerial and submerged deposits.
- First definition of absolute age of samples.

• 2nd YEAR RESULTS

Methodologies:

In the framework of the researches carried out together with the UR Uniroma 1, the analogical modelling experiments of caldera resurgence in a previously deformed crustal sector, were addressed to: a) the understanding of the effects on the resurgence of an asymmetric magma body; b) the understanding of the kinematics of caldera faults and their relationships with pre-existing structures. 9 experiments were carried out simulating a magma body characterised by either a radial symmetry or an irregular top geometry. 7 experiments were performed with a 5-cm thick, layered sand model; 1 experiment was performed with a 3 cm thick model; and 1 experiment was performed with a 7 cm thick model. To evaluate the role of the pre-existing structures, the experiments were carried out varying the extension from 1.3 to 7 cm. The evolution of the caldera faults has been investigated by a three-time reiteration of the same experiment (thickness = 5 cm; extension = 5.3 cm), stopped at 20, 30 and 45 minutes from the beginning of the collapse.

- Data acquisition:

During the second year the following results were obtained: a) a detailed volcanological and stratigraphic study of the Mt. Epomeo Green Tuff has been carried out, allowing to highlight some problems in the correlation between the Tuff exposed inside and outside the caldera. In order to solve these problems, the sampling of variable tuff deposits in different outcrops has been carried out to perform mineralogical, petrographical, chemical, isotopic and geochronological analyses; b) the reconstruction of the stratigraphic sequence of the south-eastern and south-western part of the island, relatively to volcanic and volcanoclastic deposits older than 55 ky, has been started, allowing a preliminary definition of the surface geology and of the morphological and structural setting of the southern sector of the island; c) rock sampling of these deposits for petrological and geochronological analyses has been started as well; d) all the collected samples have been prepared for the analyses; e) the areas covered by lava flows and by pyroclastic fall, flow and surge deposits have been defined; f) the stratigraphy of mud flow and debris flow deposits in the south-western and south-eastern parts of the island has been completed, as well as the mapping of the areas interested by these phenomena; g) an hypothesis about the volcanological and deformational history of this sector, and its insertion in a general evolutionary framework of the island, has been formulated; h) a first definition of the relationships among volcanism, volcanotectonics, tectonics and slope instability, has been realised; i) a new set of analogical modelling experiments, has been performed.

- Data processing and interpretation:

a) The analysis and interpretation of structural data allowed the reconstruction of the Mt. Epomeo resurgence kinematics. Resurgence occurred through the reactivation of regional faults and by the activation of faults directly related to volcanotectonism, that generated inward dipping, high angle reverse faults in the western sector. These features are cut by late outward dipping normal faults due to gravitational readjustment of the slopes. The northeastern and the southwestern sides are bordered by vertical faults with right transpressive and left transpressive movements, respectively.

b) Two lines of analogical modelling experiments were performed by superposition of two different equipment to simulate: i) resurgence in an area with a simple graben-like structure; ii) resurgence in an area with a caldera collapsed within the previously generated graben-like structure. It has been observed that in the sample in which no caldera collapses were simulated, resurgence occurs through the formation of a discrete number of differentially displaced blocks. The most uplifted block is bordered, along one side, by a newly formed, high-angle, inward dipping reverse fault, which causes horizontal shortening of the sample. To accommodate the resulting shortening, normal faults with similar orientations forms in the opposite side together with the reactivation of the pre-existent graben faults. c) The paleomagnetic analyses, aimed to determine the flow direction of the pyroclastic currents of the Mt. Epomeo Green Tuff, and to verify the occurrence of tilting in differentially displaced blocks, have been performed and the interpretation of the obtained results is starting.

- Others:

The funds supplied till now for the second year, allowed: a) to support the presentation of the results of the OV UR at an international congress; b) to support the permanence of one researcher in the Roma 3 structural laboratory, to carry out the analogical modelling experiments; c) to partially support the field work at Ischia. This work has been suspended in the month of May.

• **RESEARCH PRODUCTS:**

- 3 articles published on international journals (1 in press and 2 submitted)
- 3 presentations at international meetings
- 1 presentations at national meetings

• **PUBLICATIONS LIST:**

- 1) Acocella* V., Marotta° E., Funicello* R., Orsi° G., de Vita° S. The role of extensional structures on experimental calderas and resurgence. *J. Volcanol. Geotherm. Res.* In press.
- 2) de Vita S., Orsi G., Piochi M., Sansivero F., Marotta E. 2002. Volcanological and structural evolution of the island of Ischia (Italy) over the past 10 ka. *J. Volcanol. Geotherm. Res.* Submitted.
- 3) Chiodini G., Avino R., Brombach T., Caliro S., Cardellini C., de Vita S., Frondini F., Marotta E., Ventura G., 2002. Fumarolic degassing west of Mount Epomeo, Ischia (Italy). *J. Volcanol. Geotherm. Res.* Submitted.
- 4) de Vita S., Marotta E., Orsi G., 2002: Structural analysis of Mt. Epomeo resurgent block (Ischia, Italy): deformational features, uplifting mechanism and implications for volcanic hazard assessment. EGS, XXVII General Assembly Nice, France, 21 - 26 April 2002. Abstracts.
- 5) de Vita S., Marotta E., Orsi G., Acocella V., 2002: Analogue modeling of resurgent calderas: the role of preexisting tectonic and volcano-tectonic structures. EGS, XXVII General Assembly Nice, France, 21 - 26 April 2002. Abstracts.

6) Slejko F., Petrini R., de Vita S., Orsi G., Piochi M., 2002: Hydrous species in volcanic glasses from the Cretaio tephra (Ischia island, South Italy): inference on the mechanism of water-magma interaction. EGS, XXVII General Assembly Nice, France, 21 - 26 April 2002. Abstracts.

THE SUBMARINE PORTIONS OF ITALIAN VOLCANOES: THEIR SURVEY AND ASSESSMENT OF THE POTENTIAL VOLCANIC HAZARDS

UNIROMA 1

Francesco Latino Chiocci - Professor. Dipartimento Scienze della Terra, Università di Roma "La Sapienza"

ACTIVITY REPORT-2nd YEAR

RU PARTICIPANTS

Name	Position	Affiliation	man/month
Francesco Latino Chiocci	Professor	Dipartimento Scienze della Terra Università "La Sapienza", Roma	6
Eleonora Martorelli	Post doc	Dipartimento Scienze della Terra Università "La Sapienza", Roma	4
Alessandro Bosman	Phd	Dipartimento Scienze della Terra Università "La Sapienza", Roma	10
Salvatore Milli	Professor	Dipartimento Scienze della Terra Università "La Sapienza", Roma	1
G.Battista La Monica	Professor	Dipartimento Scienze della Terra Università "La Sapienza", Roma	1
Luciana Orlando	Professor	Dip. Idraulica Trasporti e Strade Università "La Sapienza", Roma	1
Giuseppe Cavarretta	Researcher	CNR - C.S. per il Quaternario e l'Evoluzione Ambientale	1
Mario Voltaggio	Researcher	CNR - C.S. per il Quaternario e l'Evoluzione Ambientale	1
Renato Funicello	Professor	Dip. Scienze Geologiche, Università Roma Tre	1
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Valerio Acocella	Phd	Dip. Scienze Geologiche, Università Roma Tre	3
Francesca Cifelli	Phd	Dip. Scienze Geologiche, Università Roma Tre	1

• 2nd YEAR OBJECTIVES

TASK 1

Definition of accuracy standards and specifications for terrestrial and marine data fusion.

TASK 3

- Collection of new geophysical data (swath bathymetry, mono-and multi-channel high resolution seismic, magnetometry) and of sea-bed samples carrying out oceanographic surveys (aboard Urania and on a smaller vessel for shallow water researches) .
 - First interpretation of collected data and graphic restitution in various kind of maps: a) navigation map, with ship track lines; b) multibeam swath bathymetry with resolution at best than 0.5 % of depth; c) S.S.S. mosaic and interpretation of acoustic facies; d) bathy-morphologic interpretative map (in colours); e) thematic maps (sismostratigraphy, depositional sequences, etc).

TASK 6

STROMBOLI

- Acquisition of geophysical data and of sea-bed samples during two marine cruises, one aboard a R/V (the ship URANIA of Italian C.N.R., for instance) for the deep-water surveys and for the sampling operations and another aboard a smaller vessel, with reduced draught, for the shallow-water survey .
- Preliminary Acoustic facies mapping, morphological and depositional reconstruction of the area, orphologic-petrographic analysis of sampled sediments.

VULCANO

- Acquisition of new data (by means of geophysical surveys and sea-bottom samplings) in concurrence with analogous operations carried out on Stromboli submerged flanks
- First morphologic and structural characterisation of the submerged portions of Vulcano, with particular regard to the Baia di Levante area.

TASK 7

-Analogical modelling of deformational processes

2nd YEAR RESULTS

Task 1

Identification of structural and morphological features for matching of subaerial and submarine data

Task 3

Due to unavailability of R/V Urania taht was requested for 2002, no acquisition of new data took place on Ischia deep waters. As new data remain to be acquired, production of interpretative maps has been postponed to the third year.

Automatic identification of homologous features (main blocks) on SSS and multibeam data of comparable resolution on sample areas. The aim is to produce an automatic matching to geo-referentiate TOBI data.

Draping of side scan sonar data (at different resolution) over bathymetry, on instability features of small and large dimensions.

Processing of bathymetric data to identify and quantify morphological features on debris avalanche body. An area of ~50 km² between 800 and 1000 m has been analysed to identify blocks on TOBI images (~1400 blocks detected) as well as on multibeam data (~600 blocks detected). During Thetis cruise, organised by CNR-IGS a small area south of Ischia has been oversampled with multibeam to define the maximum possible resolution on a blocks field.

Task 6

Due to unavailability of R/V Urania taht was requested for 2002, no acquisition of new data took place on Stromboli and Vulcano deep waters.

A shallow-water survey has been carried out aboard the R/V "Thetis" in the period February 21-March 02, 2002, acquiring high resolution multibeam and high resolution side scan sonar data on the shallow portions of Stromboli and Vulcano Islands. The survey obtained an extremely detailed multibeam bathymetry all around the Island of Stromboli, down to 900-1000 m of depth, in the north-eastern sector of Vulcano, down to -900.

On Vulcano raw multibeam data have been re-processed to obtain a maximum detail of the erosional/ morphological features on super shallow water.

A cruise has been planned for 2003, in collaboration with Università di Catania (Prof. Di Geronimo), to acquire ROV images on shallow depth.

Task 7

Analogical modeling experiments of caldera resurgence in a previously deformed crustal sector, were addressed to: a) the understanding of the effects on the resurgence of an asymmetric magma body; b) the understanding of the kinematics of caldera faults and their relationships with preexisting structures. 9 experiments were carried out simulating a magma body characterized by both a radial symmetry or an irregular top geometry. 7 experiments were performed with a 5 cm thick, layered sand model; 1 experiment were performed with a 3 cm thick model; and 1 experiment were performed with a 7 cm thick model.

To evaluate the role of the preexisting structures, the experiments were carried out varying the extension from 1.3 to 7 cm. The evolution of the caldera faults has been investigated by a three-times reiteration of the same experiment (thickness = 5 cm; extension = 5.3 cm), stopped at 20, 30 and 45 minutes from the beginning of the collapse.

• RESEARCH PRODUCTS

Presentation at international meetings: 2

Papers in prints and accepted: 2

Poster: 2

• PUBLICATIONS LIST

- Acocella* V., Marotta° E., Funicello* R., Orsi° G., de Vita° S. *The role of extensional structures on experimental calderas and resurgence*. J. Volcanol. Geotherm. Res. In press.

- F. L. Chiocci, G. de Alteriis, A. Bosman, F. Budillon, E. Martorelli, C. Violante . The Ischia debris avalanche: the result of a catastrophic collapse of the island southern flank. Nizza 2002.

- F. L. Chiocci, E. Martorelli A. Bosman. *Cannibalization of a continental margin by regional scale mass wasting: an example from Central Tyrrhenian Sea*. Nizza 03 (paper in press).

- F.L. Chiocci, A. Bosman, E. Martorelli. *Submarine instability and sedimentary processes around Active Volcanic Islands of the Southern Tyrrhenian Sea*. Gruppo Informale Sedimentologi del CNR – "GeoSed" Potenza Ottobre 2001.

- F. L. Chiocci, A. Bosman, E. Martorelli. Fenomeni d'instabilità gravitativa a piccola e grande scala lungo le pendici sommerse dei vulcani insulari del Tirreno centro-meridionale. III° Convegno Nazionale delle Scienze del Mare. Bari 27-29 Novembre 2002.

- de Vita S., Marotta E., Orsi G., Acocella V., 2002: *Analogue modeling of resurgent calderas: the role of preexisting tectonic and volcano-tectonic structures*. EGS, XXVII General Assembly Nice, France, 21 - 26 April 2002. Abstracts.

ACTIVITY REPORT–2nd YEAR

RU PARTICIPANTS

Name	Position	Affiliation	Man/mth
Michael Marani	Researcher	IGM, CNR, Bologna	24
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Marco Ligi	Researcher	IGM, CNR, Bologna	9
Luigi Vigliotti	Researcher	IGM, CNR, Bologna	6
Giovanni Bortoluzzi	Technician	IGM, CNR, Bologna	9
Daniela Penitenti	Technician	IGM, CNR, Bologna	9
Vladimiro Landuzzi	Technician	IGM, CNR, Bologna	9
Giancarlo Serri	Professor	Parma University, Parma	3
Teresa Trua	Rresearcher	Parma University, Parma	8

• **2nd YEAR OBJECTIVES**

TASK 4

1) HAZARD ASSESSEMENT OF THE SUBMERGED PORTIONS OF THE AEOLIAN ARC VOLCANOES, OF USTICA AND OF THE CENTRAL TYRRHENIAN SEA SEAMOUNTS (MARSILI AND VAVILOV VOLCANOES)

Geophysical surveys (southern Tyrrhenian sea)
 Processing and Interpretation of the acquired data
 Seafloor sampling cruise
 Preliminary report

2) Research on Stromboli and Vulcano submerged flanks

Performing of marine surveys.
 Analysis and interpretation of collected data

TASK 5

Investigations of the submerged portion of the Mount Etna volcanic edifice

Geophysical surveys (Etna)
 Processing and Interpretation of the acquired data
 Seafloor sampling cruise
 Preliminary report

• **2nd YEAR RESULTS**

TASK 4

1) AEOLIAN ARC VOLCANOES, USTICA MARSILI AND VAVILOV VOLCANOES.

Data acquisition. Three research cruises were carried out. Aboard the R/V Logachev (27/7/02-12/08/02), a deep-towed sidescan sonar (SSS) profile, a camera run and sampling were acquired on western Palinuro volcano; 8 deep-towed SSS profiles, 2 camera runs and sampling were acquired on Marsili volcano; a deep-towed SSS profile, and 5 seismic reflection profiles were acquired on Vavilov volcano and in the Vavilov basin. Aboard the R/V Urania (30/08/02-19/09/02), the greater portion of the cruise was dedicated to collect 36 dredge samples from Vavilov volcano and to acquire a Chirp sonar survey of the Vavilov basin before collecting three long cores in the area. Aboard the R/V Thetis (07/11/02-12/11/02), a rapid response expedition was organised to acquire ROV observations, CTD data and water samples from the increased venting area offshore Panarea Island.

Data processing and interpretation. Palinuro – SSS line processed, TV run edited and single frame images acquired, samples being analysed. The cone forming the westernmost portion of Palinuro volcano is affected by linear fractures of the volcanics; along these fractures Feoxy-hydroxide and sulphide chimneys are generated, no venting was observed. Volcanic landforms mainly pillow lavas, rare sheet flows. Marsili – SSSlines processed and mosaic generated covering south-eastern and all northern flanks, TV runs edited and single frame images acquired, samples in analysis. Mosaic gives outstanding indication of the construction of the edifice including satellite cones and volcano-tectonic structures. SSS run on summit imaged the elongated cone ridges showing point form eruption sites. TV run on summit discovered an extensive field of fossil hydrothermal chimneys. TV run on one of the satellite cones sheds light on their growth. Vavilov - SSS line processed, seismic reflection profiles processed. The SSS line runs along the western base of the volcano which, in association with the parallel seismic line sheds light on the hypothesised sector collapse that has affected the volcano. Other, more regional seismic lines investigate the structure of the Vavilov basin, seemingly affected by very recent faulting.

2)Etna

Data acquisition. The first part of the cruise aboard the R/V Urania (30/08/02-19/09/02) was focused at studying the submerged portions of the Stromboli edifice and its surroundings. 200 miles of Chirp sonar high resolution seismic lines were acquired and 25 seafloor sites were sampled (1 dredge, 10 box cores and 14 gravity cores).

Data processing and interpretation. A preliminary interpretation of the Chirp sonar lines, has been aimed at determining the distribution of the acoustic facies over the study area. The results show that the Stromboli canyon and a smaller one, descending the western flank of Stromboli edifice fed a deep-sea channelised fan with depositional lobes that extend over much of the Marsili

basin as far as the base of the Marsili seamount. All the cores have been cut and described. The preliminary interpretation of the sedimentary structures has allowed to evidence that high-density turbidity currents and debris flows are the predominant in the flank of the volcano and in the proximal part of the deep sea fan, while low-density turbidity current deposits are present in the distal portions. The interpretation of the cores has also been focused at the selection of particular horizons that are undergoing mineralogical, petrographic, geochemical and textural analysis in order to evaluate if they can give new insights on the eruptive style of the Stromboli volcano. With the same aim, the fresh lava samples dredged in a submarine cone to the southwest of the island are currently being analysed.

TASK 5

Data processing and interpretation. Multichannel seismic reflection lines processed. In conjunction with the multibeam morphology, the seismic sections clarify the structural and depositional setting of the area offshore Etna. The canyon system on the Messina Rise has for the most part structural control. The seismic data confirm the fault origin of the ESE-WNW alignment seen on the bathymetry that controls canyon deviation and abuts onshore in the Etna region.

- **RESEARCH PRODUCTS**

Sidescan sonar mosaic of Marsili Volcano

- **RESEARCH PRODUCTS**

1 Paper in prints and accepted

- **PUBLICATIONS LIST**

Marani M.P. and Gamberi F. "Geological and Biological Processes at Deep Sea European Margins and Oceanic Basins". Intergovernmental Oceanographic Commission Technical Series, 65, In Press.

CNR - ITR**Paolo Tommasi** - Researcher. CNR-ITR Istituto di Geologia Ambientale e Geoingegneria di Roma

ACTIVITY REPORT–2nd YEAR

RU PARTICIPANTS

Name	Position	Affiliation	man/month
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Renato Ribacchi	Professor	Dip. Ing. Strutt. e geotec. Univ. Roma La Sapienza	2
Tatiana Rotonda	Researcher	Dip. Ing. Strutt. e geotec. Univ. Roma La Sapienza	2
Maurizio Sciotti	Professor	Dip. Idraulica Trasporti e Strade Univ. Roma La Sapienza	2
Andrea Segalini	Researcher	Univ. di Parma	1
Maria Migliazza	Researcher	Univ. di Parma	1
Gianpaolo Giani	Professor	Dip. Ing. Civile Univ. Parma	1
Chiara Deangeli	Researcher	Dip. Georisorse e Territorio Politecnico Torino	1
Lucio Olivares	Researcher	Dip. Ing. Civile II Università di Napoli	1
Jacques Locat	Professor	Univ. Laval - Canada	1
Aldo Evangelista	Professor	Univ. "Federico II" di Napoli	1
Chiesa	Researcher	CNR - Milano	1
Luciano Picarelli	Professor	Dip. Ing. Civile II Università di Napoli	1
Paolo Baldi	Professor	Dip. Fisica Univ. Bologna	1
Vladimiro Achilli	Professor	Univ. Padova	1
Roberto Monticelli	Ex. Coll.	Dip. Idraulica Trasporti e Strade Univ. Roma La Sapienza	3
Vanessa Signoretto	Phd	Dip. Scienze della Terra Università "La Sapienza", Roma	3
Maria Marsella	Researcher	Dip. Idraulica Trasporti e Strade Univ. Roma La Sapienza	3
Carla Nardinocchi	Researcher	Dip. Idraulica Trasporti e Strade Univ. Roma La Sapienza	1

- **2nd YEAR OBJECTIVES**

TASK 1

ISCHIA

- Acquisition of images at a 1:5000 scale (flight performed by the Provincia di Napoli, 1999); photogrammetric processing aided by a GPS control network on a-posteriori identified points (no additional cost for the project).

STROMBOLI

- Acquisition and organisation of existing data on Stromboli (DTM) (in collaboration with the project: "Development and application of techniques of remote sensing for the monitoring of active volcanoes" coord. by Mauro Coltelli).

VULCANO

- Definition of accuracy standards and specifications for terrestrial and marine data fusion.

TASK 2

VULCANO

- Geotechnical characterisation of the rock/soil mass/material.

STROMBOLI

- Submarine sampling.

- First analysis of the submarine instability phenomena in the volcanic products and of the related debris avalanche/flows.

- First modelling of the debris avalanche transport/flow characteristics and comparison with morphological/large-scale textural evidences.

ISCHIA

- First modelling of the debris avalanche transport/flow characteristics and comparison with morphological/large-scale textural evidences.

- **2nd YEAR RESULTS**

Task 1*Methodology:*

Implementation of a matching procedure for merging partially overlapping bathymetric data of different spatial resolution and not congruent reference systems.

Definition of different strategies for merging 3D not contiguous data (from terrestrial and marine surveys) based on geometrical constraints along main structural features and morphometric parameters analysis

ANALYSIS OF METHOD FOR INTEGRATING HIGH RESOLUTION NOT CONTIGUOUS DTM DATA WITH LOWER RESOLUTION DATA DERIVED FROM AVAILABLE MAPPING PRODUCTS.**ANALYSIS OF METHODS FOR THE EXTRACTION OF QUANTITATIVE INFORMATION FROM MULTIBEAM DATA (ISCHIA ISLAND) BY MEANS OF CLASSIFICATION PROCEDURES USUALLY ADOPTED FOR LIDAR DATA***Data acquisition:*

Vulcano Island: Grid and sparse 3D data derived from 1996 photogrammetric data (1:10000) (Progetto Coltelli)
 Stromboli Island : Grid and sparse 3D data derived from 2001 photogrammetric data (1:5000) (Progetto Coltelli)
 Ischia Island: selection of images at a 1:5000 scale and vector maps (fight performed by the Provincia di Napoli, 1999); laser scanning data of a sector of the Island (NW)
Processing and interpretation:
 Generation of the DTMM model for the Vulcano Island
 Preliminary results for the DTMM od Stromboli Island

Task 2

The following activities were carried out:

a) *Sampling and preliminary geotechnical characterization of the pyroclastic material at Vulcano*

Materials of the more recent activity cycles at la Fossa and Grotte dei Rossi Tuffs were sampled and preliminary data on physical-mechanical properties were gained by means of laboratory testing. The characteristics of the latter material will be correlated to those of the deposit which are to be sampled in the subsoil of the Punte Nere (Ialoclastiti, Auct.).

b) *Geotechnical characterization of scoriaceous lava material sampled at the Sciara del Fuoco*

Strength, deformability and dynamic properties of the scoriaceous lava material were evaluated in order to assess the mechanical behaviour of the intact rock portions and of the rock fragment forming volcanoclastic deposits.c)

c) *Geotechnical characterization of the volcanoclastic material sampled at the Sciara del Fuoco*

At first small scale laboratory tests on the volcanic grains were performed in order to obtain a geotechnical characterization of the rock material. Abrasion tests were also conducted for determining the attitude to rounding and to the production of fine particle of the original material. Subsequently the shear behavior of the volcanoclastic debris material at field scale has been analyzed in a large especially designed tilting test shear box (one of the few existing devices suited to the analysis of coarse aggregates). First data on the strength of the aggregate were obtained. Further tests for evaluating of strength variations due to rounding and to change in particle shape/dimension have been planned.

The planned geotechnical borehole at Vulcano was not performed due to serious logistic problems during definition of operational procedures for location of the drilling apparatus (conditions did not guaranteed correct and safe drilling operation). An alternative access to an adjacent area was not permitted by regional authorities due to environmental problem in tracing a track for the drilling device. A new site has been chosen, not far from the original one, which can be reached by the drilling equipment and should provide indications for a geotechnical characterization of the subsoil of the study area. The borehole will be drilled when stable meteomarine conditions are guaranteed (late 2003 spring) producing an unavoidable postponement of research activities

Modelling of Ischia debris avalanche has not been performed, due to difficulty to define the pre-event structure, stratigraphy and lithology of Ischia southern flank. We hope that the possible acquisition of new dredging data (not possible in 2002 due to lack of shiptime) and a closer collaboration with University of Laval will overcome the impasse.

• RESEARCH PRODUCTS

Task 1

n° 1 article at an international symposium

n° 1 technical report

An especially designed tilting test device for the determination of large scale shear strength of aggregates

Task2

n° 1 articles published on international journals.

n° 1 articles published on national journals, proceedings, technical reports.

n° 1 presentation at international meetings

n° 1 presentation at national meetings

Computation codes: 1 software for matching DEMs

• PUBLICATIONS LIST

Task 1

- Migliazza M. Segalini A., Tommasi P. (2002). Experimental studies on the mechanical behaviour of a volcanoclastic material. *Int. Symposium Soil-Rock America 2003*. In press

- ROSA L., TOMMASI P. (2002). Caratterizzazione fisico-meccanica di materiali provenienti dalle isole Eolie (Stromboli, Vulcano). *Rapporto Interno IGAG*

Task2

- Baldi P., S. Bonvalot, P. Briole, M. Coltelli, K. Gwinner, M. Marsella, G. Puglisi, D. Rémy "Validation And Comparison Of Different Techniques For The Derivation Of Digital Elevation Models And Volcanic Monitoring (Vulcano Island, Italy)" *Int. J. Remote Sensing*, 2002.

- Achilli V., Baldi P., Fabris M., Marsella M., Melis F., Signoreto V. *High resolution techniques for morphological studies in volcanic areas* Poster presentato al EGS XXVII General Assembly, Nice, France, April 2002

- Achilli V., O. Al-Bayari , F. Belloli , S. Borgstrom , C. Del Gaudio , P. De Martino , M. Marsella , G. P. Ricciardi , C. Ricco , V. Sepe , M. Silvestri *Misure di Geodesia Classica e Generazione di un DEM da Laser Scanning dell'Isola di Ischia* Atti ASITA, Perugia 2002

- Atzori S., Baldi P., Marsella M., Signoreto V. *Analysis of high resolution digital elevation model of vulcano island for morphometric relief classification* Poster presentato al Convegno Nazionale GNV, Roma 2001.

UNIBO

Claudia Romagnoli - Researcher. Dipartimento di Scienze della Terra e Geologico-Ambientali - Università di Bologna

ACTIVITY REPORT-2nd YEAR

RU PARTICIPANTS

Name	Position	Affiliation	man/month
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Peter Kokelaar	Professor	Earth Sciences Dep. Un. of Liverpool (U.K.)	2
Giorgio Gasparotto	Ricercatore	Dip. Sc. Terra e Geol. Amb., Univ. di Bologna	1
Natale Calanchi	Prof. Ass.	Dip. Sc. Terra e Geol. Amb., Univ. di Bologna	1
Paolo Ferrieri	Tecnico	Dip. Sc. Terra e Geol. Amb., Univ. di Bologna	1

• **2nd YEAR OBJECTIVES**

The RU of the University of Bologna is involved, in conjunction with UNIROMA1 and IGM-CNR Units, in Task 6: “Researches on Stromboli and Vulcano submerged flanks”. The objectives proposed for the second year of the project, relevant to Task 6, were the following:

STROMBOLI: - ACQUISITION OF GEOPHYSICAL DATA AND OF SEA-BED SAMPLES DURING TWO MARINE CRUISES, ONE ABOARD A R/V (THE SHIP URANIA OF ITALIAN C.N.R., FOR INSTANCE) FOR THE DEEP-WATER SURVEYS AND FOR THE SAMPLING OPERATIONS AND ANOTHER ABOARD A SMALLER VESSEL, WITH REDUCED DRAUGHT, FOR THE SHALLOW-WATER SURVEY.

- Preliminary acoustic facies mapping, morphological and depositional reconstruction of the area, morphologic-petrographic analysis of sampled sediments.

VULCANO: - Acquisition of new data (by means of geophysical surveys and sea-bottom samplings) in concurrence with analogous operations carried out on Stromboli submerged flanks.

- First morphologic and structural characterisation of the submerged portions of Vulcano, with particular regard to the Baia di Levante area.

These objectives are of major interest also for Task 1 (“3-Dimensional surface model generation”) and Task 2 (“Geotechnical characterization of submarine instabilities and related subaerial phenomena”); active interactions have been maintained, also during the second year of the project, with the RUs involved in these two tasks.

• **2nd YEAR RESULTS**

Data acquisition:

NEW DATA HAVE BEEN ACQUIRED ON STROMBOLI AND VULCANO SUBMERGED FLANKS. IT WAS ORIGINALLY PLANNED TO CARRY OUT TWO MARINE SURVEYS DURING THE 2ND YEAR OF THE PROJECT, BUT THE REQUEST OF SHIP TIME ABOARD THE R/V URANIA, MADE FOR 2002 BY THE R.U. UNIROMA1, HAS NOT BEEN ACCEPTED BY CNR. FOR THIS REASON, IT HAS NOT BEEN POSSIBLE TO INVESTIGATE AND SAMPLE THE DEEPER PORTIONS OF BOTH VOLCANIC APPARATA. PROPOSAL FOR SHIPTIME HAS BE RE-ADVANCED TO CNR BY THE R.U. UNIROMA1 AND, IN NEXT WEEKS, IT SHOULD BE KNOWN IF THE DEEP-WATER SURVEY ABOARD URANIA WILL BE REALISED IN 2003.

The shallow-water survey has been carried out, aboard the R/V “Thetis” of Istituto Geomare Sud (CNR), in the period February 21-March 02, 2002. Researchers from several RU. of the project (UNIROMA1, CNR-ITR, UNIBO and CNR-IGS) took part in this survey, with the purpose of acquiring multibeam and side scan sonar data on the shallow portions of Stromboli and Vulcano. The survey allowed to obtain an extremely detailed multibeam bathymetry all around the Island of Stromboli, down to 900-1000 m of depth, and in the north-eastern sector of Vulcano, down to -900 m. The reduced draught and good handling of “Thetis” have enabled to approach the coastal zone and to acquire swath bathymetry also above the -50m isobath, then to substantially improve the definition of the submerged features in the shallower sectors of both islands and the study of their relationships with the subaerial morphological and structural lineaments. Moreover, the multibeam data collected have been the base for the generation of Digital Terrain and Marine Models (DTMM) for Stromboli and Vulcano (Task 1).

In the last days of the cruise, the multibeam survey has been extended also to the northern side of Salina Island, where the occurrence of flank collapse has been recently claimed on the base of DEM images. No evidences of large-scale instability processes have been found on the investigated submerged portions of Salina, which extend down to 700 m of depth.

Data processing and interpretation:

The interpretation of the multibeam and side scan sonar data acquired in the survey of 2002 is still at the beginning, since data needed to be processed before becoming available for analysis. For the northeastern sector of Vulcano, the shallow-water data put in evidence that the area of Baia di Levante is deeply incised by a submerged drainage and that retrogressive erosion is undercutting the Fossa Cone and is promoting flank instability. The detailed bathymetric and morphologic reconstruction obtained for Stromboli down to about -1000 m of depth suggests the occurrence of mass-wasting processes in different sectors of the island; these are going to be better defined on the base of the collected side scan sonar records.

SEM-EDAX analysis have been carried out at the Earth Science Department, University of Liverpool and at Dipartimento di Scienze della Terra e Geologico Ambientali, Università di Bologna, on box-core samples, collected during previous surveys offshore Sciara del Fuoco and in the Stromboli Canyon. The granulometry and particle characterization, presently under completion, indicates down-current clast population evolution due to selective sedimentation. These observations are being used to

clarify the nature and behaviour of the density currents flowing down the offshore extension of Sciara del Fuoco and contributing to the partial blanketing of the fan-shaped deposit related to large-scale collapse events.

- **RESEARCH PRODUCTS**

The results of the 2nd year of the project have not been published or presented yet, since the data acquisition has not been completed yet; the integration and final synthesis of the results will be performed in the third year of the project.

CNR - IGS

Giovanni de Alteriis - Researcher. CNR-IGS Istituto Geomare Sud di Napoli

ACTIVITY REPORT-2nd YEAR

Name	Position	Affiliation	Man/month
Giovanni de Alteriis	Ricercatore	Istituto Geomare sud, CNR, Napoli	5
Francesca Budillon	Ricercatore	Istituto Geomare sud, CNR, Napoli	4
Crescenzo Violante	Coll. Esterno	Istituto Geomare sud, CNR, Napoli	4
Massimo De Lauro	Tecnologo	Istituto Geomare sud, CNR, Napoli	3

- 2nd YEAR OBJECTIVES**

TASK 3

- 1) complete the geophysical survey with various infillings (bathymetry; side-scan-sonar; chirp and magnetometry) and sea-bottom sampling program (especially coring and dredging)
- 2) process multibeam and side-scan-sonar data;
- 3) begin the core analysis (core logging, photographs, sedimentological and geochemical analysis).

TASK 6

Infilling of multibeam data in the 0-1000 m range

- 2nd YEAR RESULTS**

Task 3

Cruises: two oceanographic legs were dedicated to the Ischia infilling program; the 1st leg lasted 7 days on January 2002 on R/V Urania. The following 8 cores were collected in the southern offshore of the island:

core #	depth	lat	lon
C1071	-1238	40°22.83	13°43.88
C1072	-1093	40°24.51	13°54.21
C1073	-1100	40°23.81	13°51.71
C1074	-1060	40°27.72	13°51.98
C1076	-1029	40°25.71	13°47.29

IN ADDITION AN INFILLING MAGNETOEMRIC SURVEY ALLOWED TO COVER MOST OF THE SOUTHERN AND WESTERN OFFSHORE OF THE ISLANDS. THE EASTERN AND NORTHERN SECTORS WERE ONLY PARTIALLY COVERED BY MAGNETOMETRY DUE TO SHALLOW WATER DEPTHS THAT LIMITED THE SURVEY.

THE 2ND LEG (5-10 AGUST 2002) ON R/V URANIA ALLOWED TO COLLECT THE FOLLOWING 9 CORES:

core #	depth	northing	easting
C1100	-1131	4468043	408716
C1101	-1094	4474075	400004
C1102	-1095	4476001	405000
C1104	-1099	4480103	398063
C1105	-1059	4480005	405997
C1106	-1061	4480052	406099
C1107	-1030	4484998	396997
C1108	-1030	4485006	404002
C1109b	-993	4490264	405240

THESE CORES MUST BE ADDED TO THE C848 CORE COLLECTED ON 2000 CRUISE (THE 1ST CORE ON THE DEBRIS AVALANCHE) AND TO THE TC55, TC56 AND TC57 COLLECTED DURING ANOTHER CRUISE (CHIOCCI) SO TOTALLING 18 CORES OVER THE DEBRIS AVALANCHE DEPOSIT.

DREDGING DURING THE 2ND LEG PERMITTED ONLY THREE DREDGES DUE TO THE SHORT TIME AVAILABLE AND STAND BY ON WEATHER.

SIDE SCAN SONAR RECORDS WITH ACOUSTIC POSITIONING OF THE SENSOR WERE CARRIED OUT DURING THE 5-10 AUGUST LEG BUT WITH POOR RESULTS MAINLY DUE TO THE GREAT WATER DEPTHS AND THE LIGHT SENSOR (DF1000). IN ANY CASE A MOSAIC WAS ATTEMPTED OVER ONE REGION OF THE DEBRIS AVALANCHE PARTICULARLY RICH IN BLOCK.

PROCESSING: MULTIBEAM DATA PROCESSING ALL OVER THE ISCHIA OFFSHORE DOWN TO DEPTH OF 950-1000M WAS CARRIED OUT IN PDS 2000 SOFTWARE ENVIRONMENT. A 20X20 DTM IS WAS INTEGRATED WITH GEOMARE SUD HIGHER RESOLUTION (5X5 OR 2.5X2.5) DATA COLLECTED NORTH AND WEST OF THE ISLAND IN SHALLOW WATERS (IN THE FRAME OF ENVIRONMENTAL STUDIES FOR MARINE PROTECTED AREAS). PROCESSING REQUIRED BOTH MANUAL EDITING AND STATISTICAL REMOVAL OF SPIKED SIGNALS. PARTICULAR ATTENTION WAS GIVEN TO THE BLOCK POPULATION IN ORDER TODISTINGUISH BLOCKS FROM NOISE.

THE INTERPRETATION OF BOTH DTM, TOBI AND SIDE-SCAN DF1000 DATA IS IN PROGRESS.

- RESEARCH PRODUCTS

- Bruno P. P., de Alteriis G and Florio G., 2002. *The western undersea section of the Ischia volcanic complex (Italy, Tyrrhenian sea) inferred from marine geophysical data.* **Geophysical Research Letters**, 29/9, 1029-1034.
- F. L. Chiocci, G. de Alteriis, A. Bosman, F. Budillon, E. Martorelli, C. Violante . The Ischia debris avalanche: the result of a catastrophic collapse of the island southern flank. AEAG Conference, Nice 2002

ACTIVITY REPORT-2nd YEAR

RU PARTICIPANTS

Name	Position	Affiliation	man/month
Sandro de Vita	Ricercatore	Osservatorio Vesuviano	2
Monica Piochi	Ricercatrice	Osservatorio Vesuviano	1
Gianfilippo De Astis	Ricercatore	Osservatorio Vesuviano	1
Fabio Sansivero	Coll. Esterno	Osservatorio Vesuviano	1
Francesco Dell'Erba	Coll. Esterno	Osservatorio Vesuviano	1
Giuseppe Guzzetta	Prof. Associato	Dip. Geofisica e Vulcanologia Univ. "Federico II" Napoli	1
Enrica Marotta	Dottoranda	Dip. Geofisica e Vulcanologia Univ. "Federico II" Napoli	1
Michael Ort	Ricercatore	Northern Arizona University - USA	1
John Southon	Ricercatore	Livermore National Laboratory Livermore - California (USA)	1
Alan Deino	Ricercatore	Institute of Human Origin Berkeley - California (USA)	1

- **2nd YEAR OBJECTIVES**

TASK 3

ISCHIA

- Execution of granulometric, petrographic, chronostratigraphic analysis on sampled sediments/rocks

TASK 7

ISCHIA

- Detailed geological survey of the area southward of Mt. Epomeo
- First definition of the surface geology and of the morphological and structural setting of the southern sector of the island
- First reconstruction of the volcanological and deformational history of this sector, and its insertion in a general evolutionary framework of the island.
- Definition of the areas covered by lava flows and by pyroclastic fall, flow and surge deposits.
- Sampling of all the units for which different analyses are provided, and preparation of the samples.
- Stratigraphy of mud-flow and debris-flow deposits.
- Definition of the areas invaded by mud-flow and debris-flow deposits.
- Editing of a mud-flow and debris-flow deposits distribution map.
- Analogical modelling of deformational processes.
- First definition of the relationships among volcanism, volcano-tectonics, tectonics and slope instability.
- Petrological characterisation of subaerial and submerged deposits.
- First definition of absolute age of samples.

- **2nd YEAR RESULTS**

Methodologies:

In the framework of the researches carried out together with the UR Uniroma 1, the analogical modeling experiments of caldera resurgence in a previously deformed crustal sector, were addressed to: a) the understanding of the effects on the resurgence of an asymmetric magma body; b) the understanding of the kinematics of caldera faults and their relationships with preexisting structures. 9 experiments were carried out simulating a magma body characterized by both a radial symmetry or an irregular top geometry. 7 experiments were performed with a 5 cm thick, layered sand model; 1 experiment were performed with a 3 cm thick model; and 1 experiment were performed with a 7 cm thick model. To evaluate the role of the preexisting structures, the experiments were carried out varying the extension from 1.3 to 7 cm. The evolution of the caldera faults has been investigated by a three-times reiteration of the same experiment (thickness = 5 cm; extension = 5.3 cm), stopped at 20, 30 and 45 minutes from the beginning of the collapse.

- Data acquisition:

During the second year the following results were obtained: a) a detailed volcanological and stratigraphical study of the Mt. Epomeo Green Tuff has been carried out, allowing to highlight some problems in the correlation between the Tuff exposed inside and outside the caldera. In order to solve these problems, the sampling of variable tuff deposits in different outcrops has been carried out to perform mineralogical, petrographical, chemical, isotopic and geochronological analyses; b) the reconstruction of the stratigraphic sequence of the southeastern and southwestern part of the island, relatively to volcanic and volcanoclastic deposits older than 55 ka, has been started, allowing a preliminary definition of the surface geology and of the morphological and structural setting of the southern sector of the island; c) rock sampling of these deposits for petrological and geochronological analyses has been started as well; d) all the collected samples have been prepared for the analyses; e) the areas covered by lava flows and by pyroclastic fall, flow and surge deposits have been defined; f) the stratigraphy of mud flow and debris flow deposits in the southwestern and southeastern parts of the island has been completed, as well as the mapping of the areas interested by these phenomena; g) an hypothesis about the volcanological and deformational history of this sector, and its insertion in a general

evolutionary framework of the island, has been formulated; h) a first definition of the relationships among volcanism, volcanotectonics, tectonics and slope instability, has been realised; i) a new set of analogical modeling experiments, has been performed.

- *Data processing and interpretation:*

a) the analysis and interpretation of structural data allowed the reconstruction of the Mt. Epomeo resurgence kinematics. Resurgence occurred through the reactivation of regional faults and by the activation of faults directly related to volcanotectonism, that generated inward dipping, high angle reverse faults in the western sector. These features are cut by late outward dipping normal faults due to gravitational readjustment of the slopes. The northeastern and the southwestern sides are bordered by vertical faults with right transtensive and left transpressive movements, respectively.

b) Two lines of analogical modeling experiments were performed by superposition of two different equipments to simulate: i) resurgence in an area with a simple graben-like structure; ii) resurgence in an area with a caldera collapsed within the previously generated graben-like structure. It has been observed that in the sample in which no caldera collapses were simulated, resurgence occurs through the formation of a discrete number of differentially displaced blocks. The most uplifted block is bordered, along one side, by a newly formed, high-angle, inward dipping reverse fault, that causes horizontal shortening of the sample. To accommodate the resulting shortening, normal faults with similar orientations forms in the opposite side together with the reactivation of the pre-existent graben faults. c) the paleomagnetic analyses, aimed to determine the flow direction of the pyroclastic currents of the Mt. Epomeo Green Tuff, and to verify the occurrence of tilting in differentially displaced blocks, have been performed and the interpretation of the obtained results is starting.

- Others:

The funds supplied till now for the second year, allowed: a) to support the presentation of the results of the OV UR at an international congress; b) to support the permanence of one researcher in the Roma 3 structural laboratory, to carry out the analogical modeling experiments; c) to partially support the field work at Ischia. This work has been suspended in the month of May.

• **RESEARCH PRODUCTS**

n° of articles published on international journals : 3 (1 in press and 2 submitted)

presentations at international meetings: 3

presentations at national meetings: 1

• **PUBLICATIONS LIST**

1) Acocella* V., Marotta° E., Funicello* R., Orsi° G., de Vita° S. The role of extensional structures on experimental calderas and resurgence. *J. Volcanol. Geotherm. Res.* In press.

2) de Vita S., Orsi G., Piochi M., Sansivero F., Marotta E. 2002. Volcanological and structural evolution of the island of Ischia (Italy) over the past 10 ka. *J. Volcanol. Geotherm. Res.* Submitted.

3) Chiodini G., Avino R., Brombach T., Caliro S., Cardellini C., de Vita S., Frondini F., Marotta E., Ventura G., 2002. Fumarolic degassing west of Mount Epomeo, Ischia (Italy). *J. Volcanol. Geotherm. Res.* Submitted.

4) de Vita S., Marotta E., Orsi G., 2002: Structural analysis of Mt. Epomeo resurgent block (Ischia, Italy): deformational features, uplifting mechanism and implications for volcanic hazard assessment. EGS, XXVII General Assembly Nice, France, 21 - 26 April 2002. Abstracts.

5) de Vita S., Marotta E., Orsi G., Acocella V., 2002: Analogue modeling of resurgent calderas: the role of preexisting tectonic and volcano-tectonic structures. EGS, XXVII General Assembly Nice, France, 21 - 26 April 2002. Abstracts.

6) Slejko F., Petrini R., de Vita S., Orsi G., Piochi M., 2002: Hydrous species in volcanic glasses from the Cretaio tephra (Ischia island, South Italy): inference on the mechanism of water-magma interaction. EGS, XXVII General Assembly Nice, France, 21 - 26 April 2002. Abstracts.

UNISANNIO

Maria Rosaria Senatore - Professor. Dipartimento di Studi Geologici e Ambientali - Univerisità del Sannio

ACTIVITY REPORT-2nd YEAR

RU PARTICIPANTS

Name	Position	Affiliation	Man/ month
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Alfonsa Milia	Dott. di Ric.	Istituto CNR Geomare Napoli	4
Giuseppe Giaquinto	Tecnico	Dipartimento Scienze della Terra Università di Napoli Federico II	1
Giovanna Capretto	Borsista	Dipartimento di Studi Geologici ed Ambientali Università del Sannio	4

• 2nd YEAR OBJECTIVES

TASK 3

Characterization of the areas surrounding Magnaghi Canyon heads (Gulf Of Napoli and Gulf of Pozzuoli)

• 2nd YEAR RESULTS

TASK 3

THE FIRST YEAR OF ACTIVITY (THE UR WAS NOT OFFICIALLY OPERATING IN 2000-2001) HAS BEEN DEVOTED TO THE STUDY OF A GRAVITY CORE WITH THE AIM TO ESTABLISH THE STRATIGRAPHY AND THE BEGINNING OF THE EROSIIVE PHENOMENA IN THE MAGNAGHI CANYON, THE SUBMARINE VALLEY INTERRUPTED BY THE DEBRIS AVALANCE COMING FROM ISCHIA.

THE CORE WAS COLLECTED AT A DEPTH OF 137 M ON THE OUTER SHELF OF THE GULF OF POZZUOLI, CLOSE TO THE AREA CROSS-CUT BY THE HEAD OF THE MAGNAGHI CANYON. A VISUAL ANALYSIS – USING CURRENT COMPARISON TABLES - HAS BEEN PERFORMED IN ORDER TO DEFINE GROSS LITHOLOGY AND TEXTURAL PARAMETERS. X-RAY RADIOGRAPHS HAVE BEEN USED TO REVEAL SEDIMENTARY STRUCTURES OF PHYSICAL AND BIOLOGICAL ORIGIN.

THE GRAVITY CORE (GP83C99) RECOVERED 322 CM OF SEDIMENT AND SHOW 6 DISTINCT INTERVALS. A BASAL INTERVAL MADE UP OF VERY COARSE TO COARSE SAND AND RICH IN SILTY/SANDY MATRIX, 20 CM THICK. THE SAND IS COMPOSED MOSTLY OF PYROCLASTIC MATERIALS; SCATTERED GRAVEL SIZED PUMICE AND A LARGE AMOUNT OF BIOCLASTS (SPONGE SPICULES, CORALS, PLANKTONIC FORAMINIFERS AS WELL AS ECHINOID, GASTROPOD, AND BROKEN AND UNBROKEN BIVALVE SHELLS) ARE OBSERVED.

The basal interval passes upward to about 10 cm of medium to fine sand and about 30 cm of ocraceous silty sand containing poor sorted coarse to medium sandy lenses.

A SHARP CONTACT MARKS THE TRANSITION TO A 4 CM THICK LAYER MADE OF POORLY SORTED COARSE TO MEDIUM SAND, FOLLOWED BY 30 CM OF SANDY AND SILTY SEDIMENTS.

Another sharp, erosional contact marks the transition to 6 cm of medium to fine sand followed by about 70 cm of silty sands with rare, scattered pumice fragments. The whole interval shows a slight normal gradation.

Upward, a 9 cm thick, poor sorted medium sand level, limited by sharp contacts and characterised by inclined lamination, follows. The sand contains angular granules mostly of volcano-clastic origin. This layer is followed by 20 cm of silty sand with scattered bioclasts and pumices and by 72 cm of strongly bioturbated sandy to silty sediments.

The upper 47 cm of the core is made of fine sand upward grading to silt and containing coal and black scoriae.

¹⁴C AMS analysis carried out on a sample collected at 304-306 cm, indicate a radiometric age of 8899 yr BP (calibrated age).

Mean sedimentation rate, calculated on the base of this determination, is of 34.3 cm/ky.

The intervals individuated in the core have been interpreted as fining up sequences. The mixing of pyroclastic and biocalstic materials, often well recognizable in the coarser base of these sequences, as well as sedimentary structures due to tractive currents, point out the role of the marine environment in primary deposition and reworking of pyroclastic beds.

• RESEARCH PRODUCTS

n° of articles published on international journals: 3

n° of articles published on national journals: 1

• PUBLICATIONS LIST

- PESCATORE T., SENATORE M.R., CAPRETTO G. & LERRO G. (2001) – Holocene coastal environments near Pompeii before the A:D: 79 eruption of Mount Vesuvius, Italy. Quaternary Research, 55, 77-85.

- BUCCHERI G., CAPRETTO G., DI DONATO V., ESPOSITO P., FERRUZZA G., PESCATORE T., RUSSO ERMOLLI E., SENATORE M.R., SPROVIERI M., BERTOLDO M., CARELLA D., MADONIA G. (2002) - A high resolution record of the last deglaciation in the southern Tyrrhenian Sea: environmental and climatic evolution. *Marine Geology*, 186, 447-470.
- D'ARGENIO A., PESCATORE T., SENATORE M.R., BISOGNO G. & TOCCO G. (2002) – Effects of natural events on ancient Benevento, Southern Italy. *Acc. Sci. Lett. Ed Arti*, Napoli, in corso di stampa
- D'ARGENIO A., PESCATORE T. AND. SENATORE M. R - Sea level change and volcano-tectonic interplay. The Gulf of Pozzuoli (Campi Flegrei, Eastern Tyrrhenian Sea) during the Late Pleistocene – Holocene time. *Journal of Volcanology and Geothermal Research*, in corso di accettazione.

UNICO

Luigina Vezzoli - Professor. Università degli Studi dell'Insubria, Dipartimento. Sc. Chi. Fisi. e Mat., Como

ACTIVITY REPORT–2nd YEAR

RU PARTICIPANTS

Name	Position	Affiliation	Man/month
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Alessandro Tibaldi	Prof. Ass.	Univ. degli Studi Milano-Bicocca, Dip. Sc. Geologiche e Geotecnol	1
Evamaria Graziotto	Coll. esterno		1

• **2nd YEAR OBJECTIVES**

Task 3:

ISCHIA

Execution of granulometric, petrographic, chronostratigraphic analysis on sampled sediments/rocks

Task 7:

-Detailed geological survey of the area southward of Mt. Epomeo.

-First definition of the surface geology and of the morphological and structural setting of the southern sector of the island.

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-Petrological characterisation of subaerial and submerged deposits.

- First definition of absolute age of samples.

• **2nd YEAR RESULTS**

Task 3:

Methodologies :

Sampling, sieve grain size analysis, component analysis, 14C analysis.

Data processing and interpretation:

Mud-flow and debris-flow deposit have been analysed to define granulometric characteristics and composition to improve genesis and source interpretation.

Task 7:

Methodologies :

Detailed geological survey, stratigraphic analysis.

Data processing and interpretation:

The detailed geologic map of the southern sector of the island is ready for print, and Stratigraphy and distribution map of subaerial mud-flow and debris-flow deposits are defined.