Anno 2010_Numero 07

miscellanea INGV

Abstracts Volume

Second International Workshop on RESEARCH IN SHALLOW MARINE AND FRESH WATER SYSTEMS

Milazzo, October 3 | 10 | 2010

07

Istituto Nazionale di Geofisica e Vulcanologia

Anno 2010_Numero 07

Miscellanea INGV

ABSTRACTS VOLUME

SECOND INTERNATIONAL WORKSHOP ON RESEARCH IN SHALLOW MARINE AND FRESH WATER SYSTEMS

MILAZZO, OCTOBER 3 | 10 | 2010

Francesco Italiano Editor

INGV (Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo - Geochimica)

07

On behalf of

UNESCO
Organizzazione delle Nazioni Unite per l'Educazione, la Scienza e la Cultura

Commissione Nazionale Italiana per l'UNESCO

REGIONE SICILIA

ARS
Assemblea Regione Siciliana

Comune di Milazzo

Scientific Committee

INGV

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

soprintendenza del mare

Sponsorships

EM SBoSS

USTICA lines

CASTALIA ecolmar

SCUBAPRO

ThermoFisher SCIENTIFIC
The world leader in serving science

arenaria

EUROBUILDING

Index

Characterization of Biodiversity: A Multi-Technique Approach to Study Fish Diversity Associated with Off-shore Platforms

Andaloro F.[(1)], Consoli P.[(2)], Romeo T.[(2)], Castriota L.[(1)], Ferraro M.[(3)]

[1]*ISPRA (Istituto Superiore per la Ricerca e la Protezione Ambientale), Via Salvatore Puglisi, 9 - 90143 Palermo, Italy*
[2]*ISPRA (Istituto Superiore per la Ricerca e la Protezione Ambientale), Via dei Mille 44, 98057 Milazzo (Messina), Italy*
[3]*Eni S.p.A. E&P Division/AMTE, Via Emila 1 20097 San Donato Milanese (Milano), Italy*

Abstract

In the last decades the ecological role of off-shore platforms as a suitable habitat for fish species has been acknowledged in the context of marine conservation and investigated by an increasing number of studies. Fish communities associated with these artificial structures have been analyzed by different approaches such as hydroacoustic surveys, experimental fishing and remotely operated vehicles (ROVs) in many areas of the world. These techniques were generally used separately providing both qualitative and quantitative data at a different level of accuracy.

In the present project, fish diversity associated with Mediterranean gas platforms was studied for the first time by integrating four different methods. More in detail, fishing surveys, video recordings from remotely operated vehicles (ROVs), remote sensing and underwater visual census (UVC) by means of SCUBA divers were employed.

This multi-technique approach allowed for the collection of complementary data and a complete characterization of the fish community. Fish diversity resulted higher than would have been by using each method separately. The use of innovative techniques (ROV, UVC and Remote Sensing) permitted to explore the inner part of the platforms which is typically difficult to study. More in detail, UVC was the most efficient technique to census fish species strictly associated with the pillars. This technique allowed for the censusing of crypto-benthic fish species which represented an important and generally unnoticed component of the biodiversity associated with these structures. These species, which use these artificial structures as a trophic and reproductive substrate, accounted for the 22% of the total species richness. The contemporary application of different techniques to study the platforms fish community allowed also for an evaluation of limits and potentialities of each method also in relation to their costs and scientific outputs. This information can be easily used to formulate investigation protocols also replicable in other areas.

Hydrothermal Effect on Fish Biodiversity in Panarea Islands (Tyrrhenian Sea, Mediterranean)

Andaloro F.[3], Romeo T.[1], Consoli P.[1], Italiano F.[4], Renzi M.[5], Focardi S.E.[5]

[1]*ISPRA (Istituto Superiore per la Ricerca e la Protezione Ambientale), Via dei Mille 44, 98057 Milazzo (Messina), Italy*
[2]*Consorzio Plemmirio, Piazza Euripide 21, 96100 Siracusa, Italy*
[3]*ISPRA (Istituto Superiore per la Ricerca e la Protezione Ambientale), Via Salvatore Puglisi, 9 - 90143 Palermo, Italy*
[4]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Italy*
[5]*Department of Environmental Science, University of Siena, via Mattioli n. 4, 53100, Siena, Italy*

Abstract

The Aeolian Archipelago is a complex volcanic system constituted by seven islands and seamounts in the central Mediterranean (southern Tyrrhenian sea) and characterized by an active submarine hydrothermalism due to the presence of volcanoes, submarine canyons and hydrothermal sources. At the end of October 2002, three kilometers East from the island near the islet of Bottaro, a violent submarine gas eruption occurred. In the same period, after one month, a paroxysmal activity (a violent eruptive manifestation of the volcano) was observed in the Stromboli Island. This explosive event ejected incandescent scoria and booms fall out up to a distance of few kilometers from craters. Biodiversity associated with hydrothermal event was studied by integrating different methods. More in detail, fishing surveys and underwater visual census (UVC) by means of SCUBA divers were employed. Underwater visual census has underlined an immediate effect on the local habitat related to the noise, water heating, gas emission (CO_2 and H_2S), with braking away and dead of fish. The effects on biocenosis were observed for the next months on infralitoral and the associated community. The biocenosis ricolonization was observed the year after. Long term effects were related to the potential harmful trace elements (PHE), such as mercury (Hg), cadmium (Cd), lead (Pb), and arsenic (As). Rocks and sediments could release different trace elements, including PHE, when they are leached by hot fluids such as gas and hot waters which determine emissions at high temperature (around 30 and 130 °C). Sedentary benthonic fishes with longevity characteristics have been chosen in order to give a better description of the site investigated and the bioaccumulation phenomenon. Liver and muscle of the bluemouth rockfish Helicolenus dactylopterus dactylopterus (Delaroche, 1809) and the comber Serranus cabrilla (Linnaeus, 1758) were analyzed. Cd, and Pb determinations were performed by atomic absorption spectrometry with electrochemical atomization (GF-AAS, Perkin-Elmer, mod. Analyst 700). Hg, and As were determined by atomic absorption via cold vapor generation (CV-AAS), according to the US-EPA 7473, and by atomic absorption after the hydride generation following the US-EPA 7011 method, respectively. A high trend of bioaccumulation was observed in selected species with the occurrence of higher levels after ten months from the event; observed higher levels in fisher were reliable to the growth rates as evidenced by the lower BEF observed after ten months; different species evidenced different bioaccumulation behavior, principally related to the trophic level and the diet of the species. Even though volcanic contribution seems to be of a little importance for most trace elements on a global scale, volcanic-derived emissions may become important in areas characterized by active volcanism which could represent local hot-spots of particular importance for the accumulation dynamics along the trophic web also representing a source of pollution for the whole marine ecosystem.

Trace Elements Levels in Aeolian Archipelago (Central Mediterranean Sea) following an Episode of Intense Volcanic Activity

Andaloro F.[(1)], Romeo T.[(1)], Renzi M.[(2)], Guerranti C.[(2)], Perra G.[(2)], Consoli P.[(1)], Perzia P.[(1)], Focardi S.E.[(2)]

[1]*Ispra – Higher Institute for Environmental Protection and Research, STS Palermo, Laboratory of Milazzo, Via dei Mille 44, 98057 Milazzo (ME), Italy*
[2]*Department of Environmental Science, University of Siena, via Mattioli n. 4; 53100, Siena, Italy*

Abstract

Levels of four (Hg, Cd, Pb, As) potential harmful elements (PHE) were measured in three different environmental matrices (sediments, macroalgae, and fishes) from the Aeolian Archipelago and control areas both after one and ten months form a volcanic activity of particular relevance occurred at the end of October 2002. Results were analysed on a multivariate statistical basis with the aim to evaluate: I) general levels of pollution and increase of PHE due to the event; II) differences observed among tested matrices in the time of recovery after the occurrence of the critical event; III) the biological enrichment of PHE along the trophic web produced by the geological event. Results evidenced that volcanic emissions could represent a local source of particular relevance able to determine great enrichments of considered PHE in sediments and biological species. After ten months from the event, levels in sediments and macroalgae notably decreased, whereas fish species evidenced an increase, principally related to the greater dimensions of fishes caught during the second campaign. On the basis of the BEF, major enrichments were evidenced after one month whereas after ten months were recorded values reliable to an incomplete recovery. Concerning Cd, the BEF higher levels reported for the species S. cabrilla was probably related both to the diet and to the specific detoxification rates of this species.

Numerical Modeling and Observational Studies of Coastal Tidal Channel Flow

Azadbakht, Z.,[1], Bidokhti, A.A.,[2] and Namin, M.M.[3]

[1]*Open University and P.S.O. Port and Maritime Organization, Maritime Structure Office, Tehran, Iran*
[2]*Open University and Institute of Geophysics, Tehran University, Tehran, PO Box 14155-6466, Iran*
[3]*Open University and Tehran University, Faculty of Engineering PO Box 11365-4563, Iran*

Abstract

Predicting the natural backfilling of dredge channels is a problem often encountered in ocean engineering practice. Backfilling occurs both when the sediment transport capacities are less within the channel than outside it [Fredsoe, 1978; Alfrink and van Rijn, 1983], and when bed load particles move along a sloping bed affected by the action of gravity [Fredsoe, 1978]. The backfilling of dredged channels can be predicted successfully only if a detailed description of the flow and sediment transport processes is applied.

Many field measurement papers have been written on the analytical siltation in tidal channels and estuaries. In those papers, the important role of tidal phases in this process can be seen. Anastasiou and Chan (1997) identified the main sediment transport processes of the intertidal area in the ebb-tidal delta by using field tidal flow and mathematical models.

Bushehr port on the north coast of the Persian Gulf is the focus of this study due to the high rate of sedimentation in its inner and outer channel. The volume of this sedimentation influences its navigation depth. Two usual tools are marine field measurements and mathematical simulation of hydrodynamics and sedimentation. Field measurements included tidal current, salinity, temperature, sediment measurements (size, shape), etc. in Bushehr port.

Methodology

A 2D shallow water hydrodynamic model has been developed by using field data and the shallow water equations—a well-known set of equations that describe the behavior of flow when the vertical dimension is small [Zhao et al., 1994]. From this model, a flow pattern was obtained by which the behavior of the tidal current as well as the sedimentation in that area was studied. The numerical model is second-order accurate; it is based on a cell-center finite volume upwind scheme on unstructured triangular grids and employs a cell- centered finite volume formulation to solve conservative two-dimensional shallow water equations [Gottlieb et al., 2001; Anastasiou and Chan, 1997; van Rijn, 1987]:

$$\frac{\partial \vec{U}}{\partial t} + \nabla . \vec{F} = S \qquad (1)$$

In other to calculate the eddy viscosity coefficient (i.e., v_t = eddy viscosity) as well as the eddy viscosity shear stress in Eq. (1), the Smagorinsky turbulent model has been used [Smagorinsky, 1963]. The Smagorinsky coefficient is considered to be 0.3, because the results of sediment sampling were showing silt and clay in this study area.

A cell-centered finite volume method was formulated for Eq. (1) on a triangular control volume [LeVeque, 2002; Namin et al., 2004] (Figure 1).

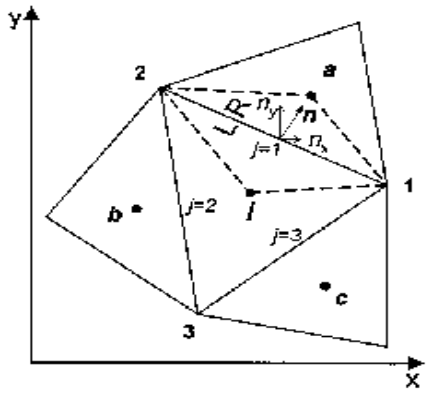


Figure 1. Typical control volume.

Hydrodynamic Model Application

The 2D shallow water unstructured triangular model was applied to predict the flow pattern in Bushehr Bay and its access channels. Bushehr Bay is located in the northwest of the Persian Gulf. The bathymetry of this bay is very complex, and the data were worked out from hydrograph operations in 1999–2000 and the Admirality map 2000, and the currents have been used from field data. The total research area in Bushehr gulf is about 116058110 x 10^{10} m^2. The width of the sea boundary was about 110 km. In the current study, the model is applied in 2 states, with intervals of 15 and 3.5 days. For the first case, the mesh size varied from 7500 m in the vicinity of the eaward boundary to 200 m in the vicinity of Bushehr Bay, as can be seen in Fig. 2(a) and the other case for gaining finer grid the mesh size varied from 7500 m in the vicinity of the seaward boundary to 50 m in the vicinity of Bushehr Bay. The model time step in the two cases was chosen to be 2 sec and the output data models include velocity component, water level variation, and water depth.

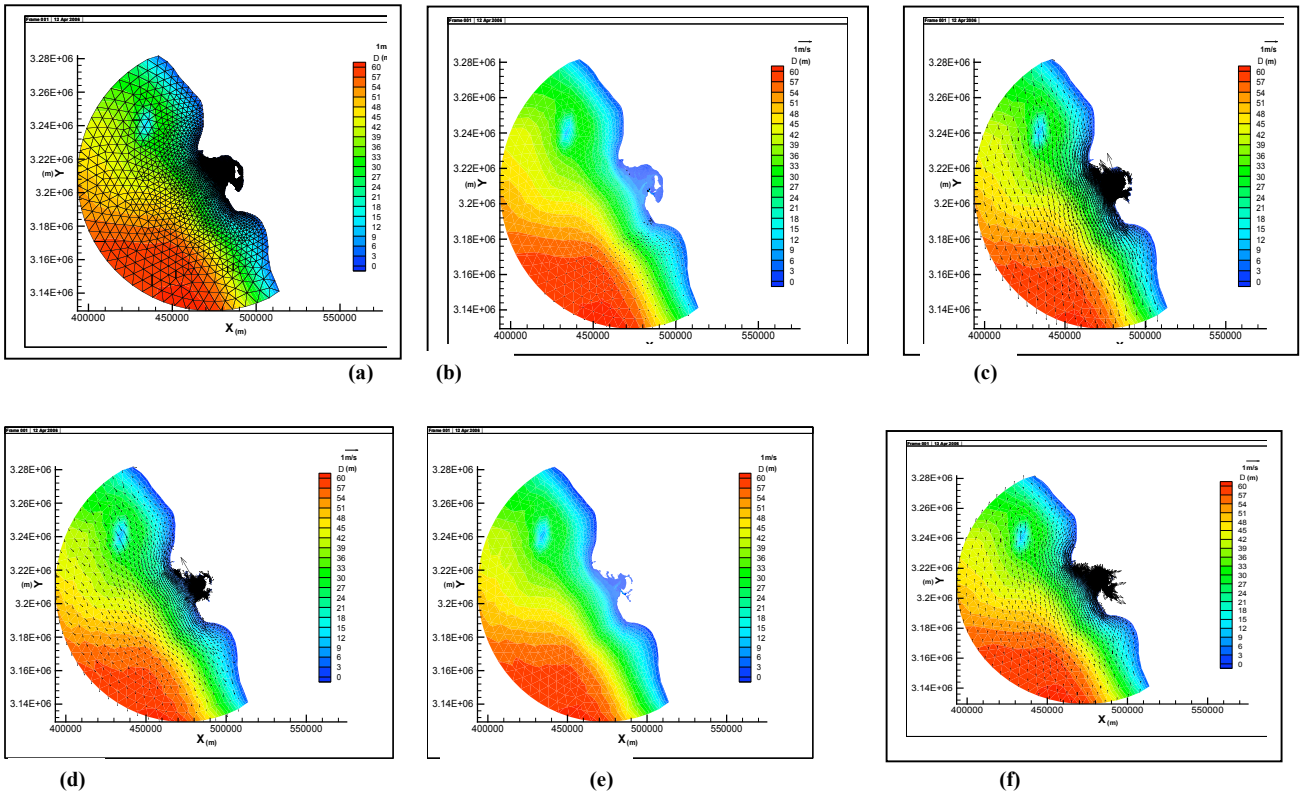


Figure 2. Flow pattern model in Bushehr Bay (mesh size 7500–200 m).

Model results

- The model application with a duration of 3.5 days and the use of finer grids demonstrate that the horizontal components of velocity near the outer channel area are usually across the channel direction.
- The model shows that eddies are presented in the transition from high water to low water. This could be the main reason for sedimentation in the outer channel.
- It was deduced that when the current vectors are packed together and parallel to the channel direction, erosion takes place instead of sedimentation, just as it occurs at the beginning of the outer channel.

Recommendations

To study the Bushehr area more accurately, it will be necessary to implement tidal current measurements in longitudinal and cross profiles in the inner and outer channels for a duration of one month.
Also, it will be instructive to apply a 3D triangular unstructured model to the bay and channel by considering the wave-current interaction.
Mixing and stratification in the position of buoys 7 and 8 should be studied for its effect on sedimentation in the area.
An appropriate plan should be designed to control sedimentation in Bushehr Bay.

References

Alfrink, B.J., and van Rijn, L.C. 1983. *Two-equation turbulence model for flow in trenches.* Journal of Hydraulic Engineering 109(7):941–958.

Anastasiou, K., and Chan, C.T. 1997. *Solution of the 2D shallow water equations using the finite volume method on unstructured triangular meshes*. International Journal for Numerical Methods in Fluids 24:1225–1245.

Fredsoe, J. 1978. *Sedimentation of river navigation channels.* Journal of the Hydraulics Division, ASCE 104(2):223–236.

Gottlieb, S., Shu, C.-W., and Tadmor, E. 2001. *Strong stability-preserving high-order time discretization methods.* Society for Industrial and Applied Mathematics Review 43:89–112.

LeVeque, R.J. 2002. *Finite Volume Methods for Hyperbolic Problems*. Cambridge Texts in Applied Mathematics, Cambridge University Press.

Namin, M.M., Lin, B., and Falconer, R.A. 2004. *Modelling estuarine and coastal flows using an unstructured triangular finite volume algorithm.* Advances in Water Resources 27(12):1179–1197.

Smagorinsky, J. 1963. General *circulation experiments with primitive equations: 1. The basic experiment.* Monthly Weather Review 91:99-104.

Van Rijn, L.C. 1987. *Mathematical modeling of morphological processes in the case of suspended sediment.* Delft Hydraulics Communication No. 382, Delft Hydraulic Laboratory, Delft, The Netherlands.

Zhao, D.H., Shen, H.W., Tabios, III, G.Q., Lai, J.S., and Tan, W.Y. 1994. *Finite-volume two- dimensional unsteady-flow model for river basins.* Journal of Hydraulic Engineering 120(7):863–883.

Development of Methods to Determine the Geothermal State of Shallow Submarine Geothermal Systems

Barth G.[1], Müller C.[2], Merkel B.[2]

[1]*TU Bergakademie Freiberg, Institute for Thermodynamic, Gustav Zeunerstr. 4, 09599 Freiberg*
[2]*TU Bergakademie Freiberg, Institute for Geology, Gustav Zeunerstr. 12, 09599 Freiberg*

Abstract

Temperature gradients and heat flow are two important parameters to describe the geothermal state and potential of geothermal systems. Because no commercial probes suitable for shallow underwater investigations were available, we designed and build two probes. Both probes were tested in the lab and on Panarea, Italy, at several submarine sites. Both probes provided reliable and exiting results. Rather high heat fluxes of up to 2509 W/m^2 were obtained. The combination of both probes is a powerful tool for future investigations of the submarine geothermal area of Panarea and other submarine geothermal systems.

Introduction & Motivation

The monitoring of areas with submarine volcanism and geothermal systems is important for both identifying changes and discontinuities at an early stage in sense of risk management assessment and evaluating the geothermal potential of a system in sense of utilization the geothermal energy. Important parameters to describe the geothermal state and potentials are temperature gradients and heat fluxes. Because no commercial devices were available the goal was to design and build such devices waterproof and resistant against aggressive water. Finally a temperature gradient and a heat flux probe was build and tested both in the laboratory and at field conditions in Germany.

During the yearly diving field trip of the CMAS Scientific Diving Center from the Technical University Bergakademie Freiberg in 2010 we tested the instruments determining temperature gradients and heat fluxes at several submarine sites at diving spots easterly of Panarea, Aeolian Island, Italy (Sieland et al. 2009, Italiano 2009).

Temperature gradient sensor

To determine the temperature gradient in sediments one has to read the temperature in different depth and calculate the quotient of the temperature difference to the depth. Theoretically such readings can be done by means of one thermo-element stabbed into different depth of the sea bottom sediments. However, under water it is difficult to get accurate readings of the penetrated depths. Thus we designed and used a gradient sensor consisting of four thermo couples in a thin lance (diameter 10 mm). By this device we were able measuring the temperature simultaneously in 4 different depths. The probe has a length of 50 cm and takes the temperature in depth of 5, 20, 35, and 47 centimeters (Fig. 1). The thermo element used for the gradient probe stem from the same charge with the same thermo electrical properties which were tested in the laboratories of the Institute of Thermodynamics, TUBAF. The outer shell of the probe is made of a special material (Tufor) that has similar thermal conductivity than sediment-water mixtures (approximately 1 W/mK). Thus the temperature difference when putting the probe in place can be disregarded.

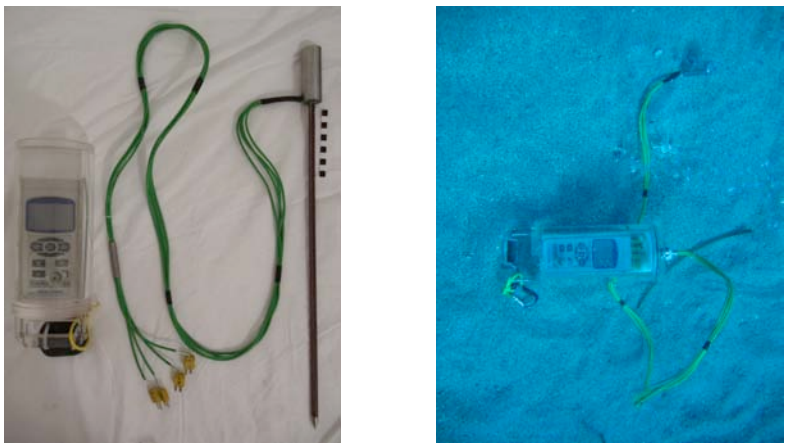


Figure 1. Temperature gradient sensor.

If the sensor could not stabbed vertical to sediment depth of 50 centimeters the actual depth has to be documented in order to calculate the temperature gradient. The recording of the temperatures is maintained with a temperature logger (T-390, PCE) which takes readings of four thermo element couples to the same time on a SD card. The temperature logger is housed water proof in a acryl-glass container which allows the underwater handling of the most important features of the device.

Heat flux sensor

The core of the heat flux probe developed is a plate made by AHLBORN Typ FQ90118 with a dimension of 120 x 120 x 1.5 millimeters. Normally it is used to measure heat flux of building materials. To use the plate under water it was encapsulated with bitumen to protect the sensitive instrument against the aggressive sea water. The edges of the plate were treated with epoxy resin and stiffen by thin plastic stabs. The measurement device used is an Ahlborn ALMEMO® 2590 which can log the heat flux density as well. The device is housed water proof in an acryl-glass container which allows the underwater handling of the most important features of the device.

A heat flux plate consists of meandered thermo couples imbedded in a carrier material. When heat flux is occurring through the plate with a definite thickness, it generates a temperature gradient that is proportional to the density of the heat flux. The sensor delivers signals in milli-volt range. The heat flux density is calculated by multiply the measured direct voltages with a calibrated constant which is determined by a one-plate-facility [Koschke et. al., 2009].

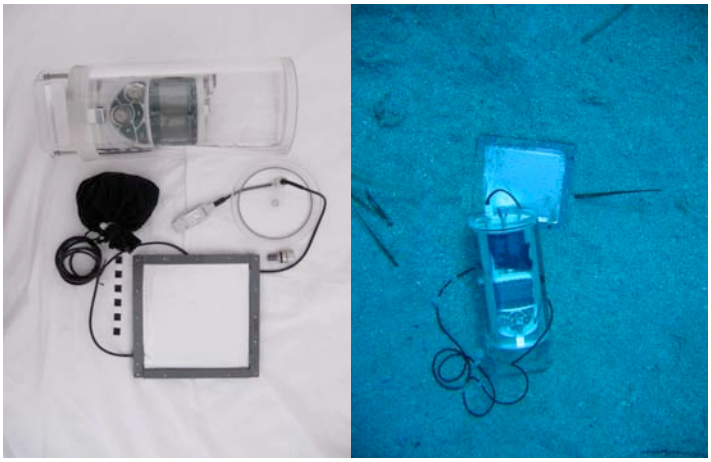


Figure 2. Heat flux sensor.

First measurements

To get reliable results with the gradient probe the whole probe has to be stabbed vertical into the sediment. That means that this device can not be used on hard ground. The temperature gradient is calculated from the four temperatures. Reaching constant temperature depends on the sediment but is normally achieved after approximately 4 minutes. Then the temperature gradient of another point can be logged. Depending on distances and water depth 10 to 30 points can be monitored during one dive. First readings of one point at the diving spot Area 26 are shown in Fig 3. One can see a temperature gradient of 12 K within 47 cm. After approximately 4 minutes the measurement can be stopped although the shallow depth of 5 cm needs obviously more time to equilibrate.

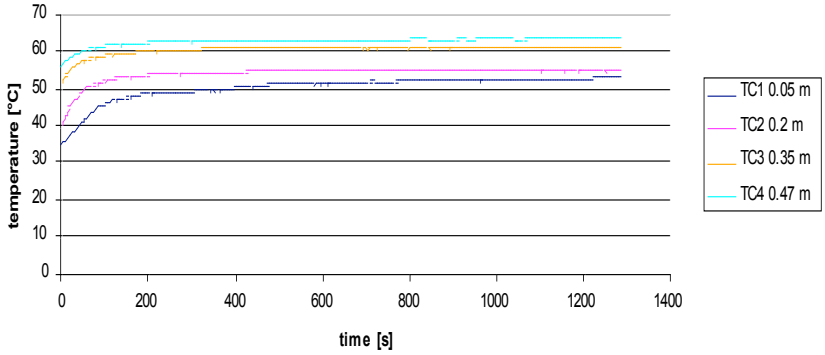


Figure 3. Measurement with the gradient sensor at a spot with a sediment depth of more than 50 cm. (TC – thermo couple). Sampling location: Area 26.

The use of the heat flux plate is only possible on a planar sediment surface. To fix the plate at the bottom it was stabilized with two weights at the rim of the plate. Measurements were made at different diving locations, for example Area 26, Black Point, Bottaro West, Point 21, Black Point, and Hot Lake. Fig. 4 shows a measurement of the heat flux density at Black Point as an example. It reveals that a constant heat flux density is achieved after approximately 5 minutes. The recorded heat flux of ~1200 W/m^2 shows clearly that heat flux is mainly controlled by advection (flow of hot geothermal water). Diffusive heat flux through a sediment-water layer in geothermal systems would end up with approximately 0.3 W/m^2. Thus both methods can be used to calculate and model the flow of geothermal water through the sea bottom at different locations.

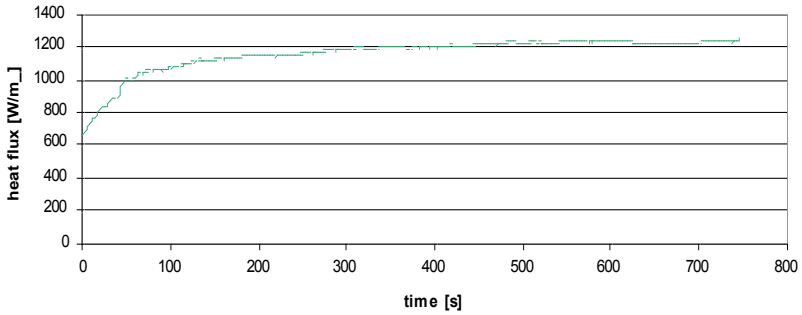


Figure 4. Measurement with the heat flux sensor. Sampling location: Black Point.

Outlook

The measurements are showing that the novel probes are providing excellent results of the temperature gradient and the heat flux distribution. In the future we will now be able to measure more points at different diving locations and along transects. By this it will be possible to generate temperature gradient and heat flux maps which are an important basis for future monitoring activities of this area. On the other side it is possible to monitor e.g. the heat flux at a certain site over long periods which will deliver more information than simple temperature measurements.

References

Koschke P., Hüttl W., Rinn C.: Ahlborn ALMEMO® Handbook Mess- und Regelungstechnik GmbH, 8. überarbeitete Auflage, Holzkirchen 2009, Germany

Sieland, R., Steinbrückner, D., Hamel, M., Merkel, B., Schipek, M. (2009): *Geochemical investigations and gas quantification of submarine fluid discharges in the hydrothermal system of Panarea (Aeolian Islands, Italy).* FOG - Freiberg Online Geoscience, 22, pp. 87-93.

Italiano, F. (2009): *Hydrothermal fluids vented at shallow depths at the Aeolian Islands: Relationships with volcanic and geothermal systems.* FOG - Freiberg Online Geoscience, 22, pp. 55-60.

Remote Sensing for Coastal Waters Research: The Retrieval of CDOM

Bassani C.[(1)], Betti M.[(2)], Braga F.[(3)], Campanelli A.[(2)], Cavalli R. M.[(1)], Marini M.[(2)], Pignatti S.[(4)], Santini F.[(1)]

[1]*Institute for Atmospheric Pollution Research (IIA), Italian National Research Council (CNR), Via Fosso del Cavaliere 100, 00133 Rome, Italy*
[2]*Institute of Marine Sciences (ISMAR), Italian National Research Council (CNR), Largo Fiera della Pesca, 60125 Ancona, Italy*
[3]*Institute of Marine Sciences (ISMAR), Italian National Research Council (CNR), Arsenale Tesa 104, Castello 2737/F 30122 Venice, Italy*
[4]*Institute of Methodologies for Environmental Analysis (IMAA), Italian National Research Council (CNR), C.da S. Loja - Zona Industriale, 85050 Tito Scalo, Potenza, Italy*

Abstract

The CDOM (Coloured Dissolved Organic Matter), also named yellow substances or gelbstoff, comprises a collection of dissolved organic substances consisting of humic and fulvic acids. CDOM can be the product of local organic particles degradation (like phytoplankton cells) or may originate from inland sources. In the last case, much higher concentrations can be reached. In coastal areas, rivers that flow through organic-rich soils can bring a load of CDOM accumulated along their flow path. In the framework of HYPAD.COM project, funded by the Italian Ministry for the Environment and Territory, five oceanographic cruises (2008 and 2009) were carried out from the northern margin of Montenegrin coastal area to the northern margin of Albanian coast. Several measurement stations have been situated along transects showing an high spatial gradients related to the organic compound concentration. In each station spectral data were collected by means of a hyperspectral spectroradiometer following the SeaWiFS protocol in order to obtain the Rrs (Reflectance remote sensing) and water samples were collected for CDOM, TSM (Total Suspended Matter) and Chlorophyll a concentrations retrieval. The goal of the mission was to exploit the relationship between Rrs and the CDOM concentration, considering that the capability of quantifying CDOM may improve remote sensing retrievals of Chlorophyll a and better understand biological processes in the coastal area. The preliminary results start up the development of an algorithm to retrieve not only CDOM but also Chlorophyll a and TSM from hyperspectral remote sensing reflectance by in situ and, in the next time, by airborne and satellite sensors.

Distribution and Accumulation of Arsenic in Tissues of two Cetacean Species (Stenella Coeruleoalba and Tursiops Truncatus) Stranded from the Italian Coast

Bellante A.[(1)], Sprovieri M.[(1)], Buscaino G.[(1)], Buffa G.[(1)], Di Stefano V.[(1)], Salvagio Manta, D.[(1)], Barra M.[(2)], Filiciotto F.[(1)], Bonanno A.[(1)], Mazzola S.[(1)]

[1]*CNR - Istituto per l'Ambiente Marino Costiero, Via del Faro 4, Capo Granitola 91021, Campobello di Mazara (TP), Italy*
[2]*CNR - Istituto per l'Ambiente Marino Costiero, Calata Porta di Massa, 80133 Napoli, Italy*

Abstract

Arsenic concentrations were determined in organs and tissues (muscle, heart, kidney, lung and liver) of two cetacean species (Stenella coeruleoalba and Truncatus truncatus) stranded along the Italian coasts during the period 2000-2009. No systematic or statistically significant difference in As concentrations were found in the analysed tissues and species. Statistically significant accumulation with age was noted only in heart samples, thus suggesting a relatively constant build up of As over time in this organ. Considerable differences of As values were detected in samples from different geographical areas (Sicily Channel, Adriatic sea and Tyrrhenian sea). In particular, the highest values of As were measured in samples from the Sicily Channel. This seems to suggest that volcanic and hydrothermal activities significantly affect As content in cetaceans.

The Mapping of Clam Beds for the Fishery Assessment and Management in the Northern Part of the Gulf of Trieste

Burca M.[1,2], Del Piero D.[3], Diviacco P.[1]

[1]*Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Borgo Grotta Gigante - 34010 - Sgonico (TS), Italy*
[2]*The Abdus Salam International Centre for Theoretical Physics, Training and Research in Italian Laboratories (TRIL) fellowship*
[3]*Dipartimento di Scienze della Vita, Università di Trieste, Via Licio Giorgieri, 10 c/o Ed. M. 34127, Trieste , Italy*

Abstract

The Gulf of Trieste is characterized by quite shallow waters (less 25 meters depth, Stravisi 2003) with the most important tidal amplitude in the Mediterranean enhanced by basin geometry. The study area is located on the northern part of Adriatic Sea, between Tagliamento and Isonzo river mouths where important clam beds are exploited by local fleet armed with hydraulic dredges mainly on sandy bottom ranging from 2 till 6 meters depth.

Thanks to exhaustive geomorphological research done by Gordini et al [2003] it was possible to obtain a detailed picture of the bottom features that can also be used to improve the knowledge of 3D (Fig.1) distribution of the infaunal mollusc populations, to ameliorate the assessment and fishery management and this achievement should be obtained using the GIS tools.

Here we examine the results of the surveys conducted in August and December 2009 on the Chamelea gallina beds to support the fishermen organisation and Maritime Authority of the Monfalcone District. From August to December the numbers/m^2 of clams exhibits a general decrease even if the maximum is reached at higher level due to the recruits become vulnerable to the sampling gear.

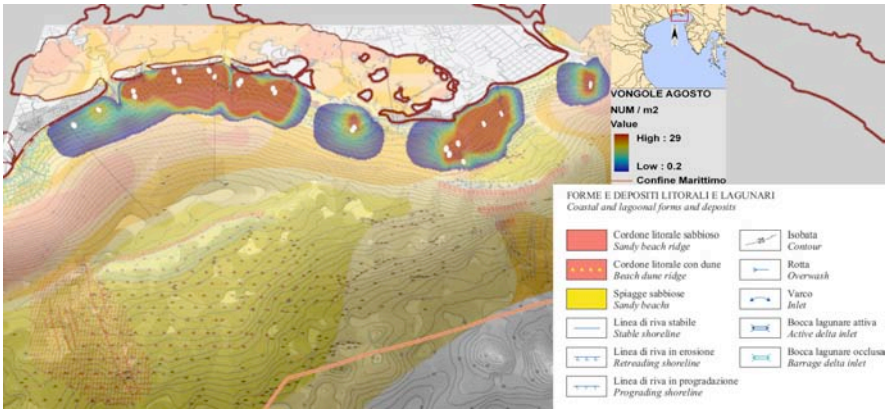


Figure 1. Example of spatial distribution of Chamelea gallina beds (numbers/m^2) in August 2009.

References

Ardron, J. (2002). *A GIS recipe for determining benthic complexity: an indicator of species richness. In: Breman, J.* (Ed.), Marine Geography: A GIS for the Oceans and Seas. ESRI Press, Redlands, California, pp. 69–175.

Del Piero, D. (2004). *Self or selfish regulation: the dilemma of clam harvesting. Workshop on Harvest Control Rules for sustainable fisheries management 13-15 September 2004* http://www.imr.no/hcr electronic repository.

Gordini, E. et al. (2003). *Nuova carta morfo-sedimentologica del Golfo di Trieste (Da Punta Tagliamento alla foce dell' Isonzo).* Gortania 25: 5-29.

Malacic, V., Petelin, B. (2001). *Gulf of Trieste, In: Cushman-Rosin B et al.* (Eds.) Physical Oceanography of the Adriatic Sea, 167-181.

Stravisi, F. (2003). *Caratteristiche meteorologiche e climatiche del Golfo di Trieste.* In: Bussani, M. & Hydrores S.A.S (eds) Manuale del conduttore-motorista alla pesca locale professionale, Trieste: 148-154.

Differences in Hydrography, Coloured Dissolved Organic Matter (CDOM), Biochemical and Biological Properties between South-western and South-eastern Adriatic Sea (Drinit and Manfredonia Gulfs)

Campanelli A.[(1)], Cabrini M.[(2)], Grilli F.[(1)], Fornasaro D.[(2)], Betti M.[(1)], Penna P.[(1)], Kljajić Z.[(3)], Marini M.[(1)]

[1]*Istituto di Scienze Marine CNR, Sede di Ancona, Ancona, Italy*
[2]*Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, OGS, Trieste, Italy*
[3]*Institute of Marine Biology Kotor, University of Montenegro, Montenegro*

Abstract

In the framework of MEDPOL and ADRICOSM-STAR projects the Drinit and Manfredonia Gulfs were investigated in May and June 2008 and May and June 2009, respectively. The gulfs are located in the South Eastern (Gulf of Drinit) and South Western (Gulf of Manfredonia) Adriatic Sea. The areas are partially interested by two main Adriatic surface currents: the Eastern Adriatic Current (EAC) that flows north-western along the eastern side, and the Western Adriatic Current (WAC) that flows south-eastern along the western side of the basin. The temporal variations of temperature, salinity, fluorescence, dissolved oxygen concentration, Coloured Dissolved Organic Matter (CDOM), nutrients, chlorophyll *a*, and phytoplankton composition parameters in the two areas were observed and compared. CDOM regulates the penetration of UV light into the sea therefore plays an important role in many hydrological and biogeochemical processes on the sea surface layer including primary productivity.

The phytoplankton specific diversity of the Gulf of Manfredonia showed, in April 2009, a typical spring community with dinoflagellates (21 taxa) as the main important fraction, coccolithophorales (6 taxa) and diatoms with 5 identified taxa. The phytoplankton temporal trend along the eastern coast during May 2008 showed a different biodiversity: a prevalent of dinophyceae with 58 taxa included harmful algal blooms such as *Alexandrium, Dinophysis* and *Lingoludinium* genus. Diatoms were less abundant, reported also *Pseudonitzschia* that including some potentially toxic species. Nanoplankton were abundant in offshore waters and a bloom of cianobacteria was registered in Boyana estuary due to strong industrial impact.

The two gulfs showed similar physical and bio-chemical characteristics despite the Western Adriatic Current carried out along the western Adriatic Sea the water rich of nutrient from the major northern Italian rivers. No correlations were found between CDOM and chlorophyll *a* in the two areas and this implied that, probably, the primary source of CDOM should come by terrestrial input otherwise by the biological production from phytoplankton. The Gulf of Drinit is impacted by runoff of the Bojana river that makes this gulf an eutrophic area despite the mostly eastern side of the Adriatic is an oligotrophic basin.

Geochemistry of Thermal Waters and Gases from the Submarine Fumarolic Field of Panarea island (Aeolian Archipelago, Italy)

Capaccioni B.[(1)], Tassi F.[(2,3)], Vaselli O.[(2,3)]

[1]*Dept. Earth and Environmental-Geological Sciences, Univ. of Bologna, Bologna, Italy*
[2]*Dept. Earth Sciences, Univ. of Florence, Florence, Italy*
[3]*CNR-IGG, Unit of Florence, Florence, Italy*

Abstract

A large submarine fumarolic field, already active in the Roman time, is present at ~3 km east of Panarea island and due to relatively easy accessibility represents an exceptional laboratory to investigate about methods of sampling of fluids in a submarine environment.

The Panarea fumarolic field is characterized by long period of continuous emission of gas and hot waters, spaced out by short, though violent, gas blasts, the last of which occurred on the 3rd of November 2002 at the depth of ~15 m. The site of such gas eruption was periodically monitored by a geochemical and isotopic point of view since a few days after the event [e.g. Caracausi et al., 2005; Capaccioni et al., 2007].

During periods of normal degassing activity, the chemical composition of gases is typical of a hydrothermal environment, i.e. rich in CO_2 and H_2S, whereas the fluids discharged during the November 2002 crisis were originated by mixing of the CO_2-dominated gas phase with droplets of water condensate, strongly acidified by dissolution of magmatic compounds, such as SO_2, HCl and HF, other than suspended sediments and colloidal sulfur. Such fluids were also characterized by He isotopic ratios higher than those of the pure hydrothermal component. The geochemical data acquired during and after the November 2002 crisis have revealed the existence, beneath the fumarolic field, of a stratified hydrothermal system whose lower part was likely fed by variable inputs from a cooling, degassing magma body. While outlet temperatures are largely buffered by seawater during period of increasing inputs, the chemistry of the gas phase shift towards higher equilibrium temperatures and more oxidizing redox conditions.

Thermal waters (up to 135 °C) locally emerging in the seafloor have revealed to be the result of a complex mixing process between three different and superimposed water reservoirs: i) normal seawater, ii) seawater concentrated by boiling and iii) deep, acid and highly-saline end-members. The chemical composition of the thermal water discharges is regulated by water-rock interactions at relatively high temperature and shows clear clues of magmatic-related inputs of gaseous acid species. Extrapolating at zero-Mg the third end -member the resulting composition appears to be equilibrated at ~300 °C and pH < 3. Among the investigated submarine hot springs, the so-called "black smoke" seems to be the most representative of the deep, acid and hot end-member. It contains relatively high concentrations of Mn and Fe, with traces of Pb, Zn, Cu, Ag and Au. The frequent occurrence of Fe-Mn deposits as primary mineralizations along faults and fractures and/or disseminated particles, clearly indicates that mineral deposition is an on-going process.

References

Capaccioni, B., Tassi, F., Vaselli, O., Tedesco, D., Poreda, R., 2007. *Submarine gas burst at Panarea Island (southern Italy) on 3 November 2002: A magmatic versus hydrothermal episode.* J. Geophys. Res., 112, B05201, doi:10.1029/2006JB004359, 2007

Caracausi, A., Ditta, M., Italiano, F., Longo, M., Nuccio, P.M., Paonita, A., Rizzo, A., 2005. *Changes in fluid geochemistry and physico- chemical conditions of geothermal systems caused by magmatic input: The recent abrupt outgassing off the island of Panarea (Aeolian Islands, Italy.,* Geochim. Cosmochim. Acta, 69, 3045–3059.

A Geochemical Study of the Monticchio Maar Lakes, Mt. Vulture Volcano (Central-southern Italy): Magmatic and Biogenic Origin of Fluids and Gas Hazard Assessment

Caracausi A.[(1)], Grassa F.[(1)], Favara R.[(1)], Nicolosi M.[(2)], Nuccio P.N.[(1,2)], Paternoster M.[(3,1)], Rosciglione A.[(2)]

[1]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Italy*
[2]*Dipartimento Chimica e Fisica della Terra e Applicazioni, Università di Palermo*
[3]*Dipartimento Scienze Geologiche, Università della Basilicata*

Abstract

Recently, several geochemical studies have been focused on gas dissolved in volcanic lakes' water highlighting new crucial insights of terrestrial degassing.

A lake acts as a collector of deep fluids and consequently can function as a storage of potentially lethal gases that can be released upon strong degassing.

Such catastrophic events occurred in two volcanic lakes along the Cameroon Volcanic Line, west Africa, Lake Monoun and along Nyos respectively the 15 of August, 1984 and the 21 of August, 1986 [Delmelle & Bernard, 2000].

During both events massive amounts of CO_2 have been expelled, causing the loss of human life and making a volcanic lake a killer [Kling et al., 1987].

Thus, several studies, from volcanism to limnology, have been carried out to understand the causes of these catastrophic events, and which is the triggering mechanism of the lethal gas burst [Kerr, 1986; Kling, 1987; Kling et al., 1987; Sano et al., 1987; Sano et al., 1990; Giggenbach, 1990].

So far the data regarding the past activity and the current status of crater lakes are few and quite often fragmentary and not conclusive.

More over, most of the studies has been developed on lakes located on active magmatic system and/or characterized by recent disastrous events of gas burst. Considering the highly hazardous nature of crater lakes, a new area of earth and environmental sciences is the mitigation of the natural hazard of gas burst .

The Monticchio maar craters are characterized by two gas-rich lakes, situated on Mt. Vulture volcano (Southern Italy), whose activity began in the middle Pleistocene and which represents the easternmost expression of the Quaternary Italian volcanism.

Monticchio's Lago Piccolo and Lago Grande, are situated in the maar explosion craters of Monte Vulture. Both the lakes maar craters have been created by an intense explosive volcanic activity (~140 000 years ago) when a relatively small volume of erupted magma sprayed out over a large area, nowadays occupied by towns.

Here we present a new view of the physical structure and dynamics of these two lakes based on the results of high resolution vertical CTD profiles between 2008 and 2009 coupled with the geochemistry of fluids (water plus dissolved gases).

We also investigated the concentrations of dissolved gases as function of depth in both the lakes and the main gaseous phases observed are carbon dioxide and methane. In both the lakes their abundances strongly increase as function of water depth. We also measured the carbon isotopic composition of CO_2 and methane in parallel with the hydrogen isotopic signature of methane. The CO_2 carbon isotopic signature is in the range of the Italian volcanoes values suggesting an inorganic origin of CO_2. On the contrary, our data suggest a biogenic origin of methane, as mixing of two sources, a CO_2 reduction methane and methyl-type fermentation methane.

Helium concentrations are higher compared to the equilibrium with atmosphere up to two order of magnitude and helium isotopic ratio, up to 6.1Ra (Ra is the $^3He/^4He$ ratio in atmosphere), is equal to the one measured in fluid inclusion of the products ejected during the last explosion of the Monticchio maars [Martelli et al., 2008], suggesting an active degassing of mantle derived helium below the lakes.

Then we estimated the equivalent volume of gases (CH_4 plus the lethal CO_2) that an hypothetical instantaneous total release of the dissolved gases could generate. These gases at atmospheric pressure, could reach a volume, of $2.3x10^5$ m^3 for LGM and of $5.8x10^5$ m^3 for LPM, which could generate a layer of this lethal gas mixture able to cover the entire surface of LGM (427,000 m^2) up to ~0.6 m. above the water, and the entire surface of LPM (172,000 m^2) up to ~ 3.5 m. above the water [Caracausi et al., 2009].

We assessed the hazard of gas burst events from the two lakes. An overturn of water's lake, produced by a landslide or a seismic swarm, triggers a tremendous release of lethal dissolved carbon dioxide from both lakes. The amounts of dissolved gases into the waters of the Mt. Vulture lakes are lower than those of other

gas rich crater lakes, such as Nyos Nevertheless Mt. Vulture lakes are a bit dangerous since they are tourist places during summertime and events of catastrophic gas release occurred up to at least two century ago.

Moreover we evaluated whether the explosive events are related to the release of accumulated carbon dioxide in shallow reservoir in the Earth's crust or to volatile degassing of ascent magmatic bodies due to a continuous depressurization.

In conclusion we hope that our results will draw attention towards all those crater lakes located in volcanic areas apparently no longer active with a special attention to those those situated in popular tourist areas, where gas risk is probably underestimated or even ignored.

Monticchio lakes are excellent examples of how gases of different origin (i.e. mantle-derived plus bacterial) can be mixed in the same system. Our research underlines that volcanic lakes store huge amount of biogenic methane indicating that also volcanic lacustrine environments has a high scientific impact due to their potential influence on global carbon cycles and climate warming.

References

Delmelle, P. & Bernard A. (2000) In: *Encyclopedia of volcanoes*, eds Sigurdsson H, (Academic Press, San Diego), pp 877-895.

Kling GW (1987) Seasonal *Mixing and catastrophic Degassing in Tropical Lakes, Cameroon, West Africa*. Nature, 237, 1022-1024.

Kerr R-A (1986) *Nyos, the Killer Lake, May Be Coming Back.* Science 233:1257-1258.

Kling G-W, Clark M-A, Compton H-R, Devine J-D, Evans W-C, Humphrey A-M, Koenigsberg E-J, Lockwood J-P, Tuttle M-L, Wagner G-N (1987) *The 1986 lake Nyos Gas disaster in Cameroon, West Africa.* Science 236:169-175.

Sano Y, Wakita H, Oshsumi T, Kusakabe M (1987) *Helium isotope evidence for magmatic gases in lake Nyos, Cameroon*. Geophys Res Lett 14:1039-1041.

Sano Y, Kusakabe M, Hirabayashi J, Nojiri Y, Shinohara H, Njine T, Tanyileke G (1990) *Helium and carbon fluxes in lake Nyos, Cameroon: constrain on next gas burst*. Earth Planet Sci Lett, 99:303-314.

Giggenbach, W.F. (1990) *Water and gas chemistry of Lake Nyos and its bearing on the eruptive process*. *J* Volcanol Geotherm Res 42:337-362.

Martelli M., Nuccio P.M., Stuart F.M., Di Liberto V., Ellam R.M., (2008).*Constrain on mantle sources and interactions from He-Sr isotope variation in Plio-Quaternary volcanism*. Geochemistry Geophysics Geosystems, Q02001, doi:10.1029/2007GC001730, vol. 9, N.2.

Caracausi A., Nuccio P.M., Favara R., Nicolosi M., Paternoster M. (2009) . *Gas hazard assessment at the Monticchio crater lakes of Mt. Vulture, a volcano in southern Italy.* TerraNova, doi: 10.1111/j.1365-3121.2008.00858;

Geochemical Investigations on Shallow Water Systems: Detection of Fresh and Thermal Waters at the Island of Salina (Aeolian Arc, Italy)

Caruso C., Italiano F., Maugeri R.

INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Italy

Abstract

Small islands are often well known tourist places, normally exploited for their valuable natural environment. Any small island, however, has two main limitations to face up: the electrical power and the fresh water.

As an example of such a situation, a volcanic island belonging to the Aeolian arc where fresh water is provided by ships from the main land and electricity comes from a small conventional diesel-engine driven, has been considered for the development of a geochemical project aimed to recover information to better understand the circulating fluids and their relationships with the natural environment and the volcanic origin of the island.

A persistent gas bubbling detected off all the coasts [Italiano F., 2009] is consistent with the recent volcanic activity of the island, considered as extinct since 1Ky [Calanchi et al., 1993]

The released gases are CO_2-dominated and marked by a high helium isotopic ratio in the range of 6Ra. In land, a thermal spring was known in past (nowadays disappeared) and apart from an old well excavated at the SE corner of the island, there are no other evidences of cold springs although the island is covered by a luxuriant vegetation.

In recent times (last 20 years), shallow boreholes (3-5 m bsl) were drilled on the eastern coast to recover low salinity water for local concrete manufactures and two deep wells were drilled on the northern coast to recover thermal waters. The shallow wells on the eastern coast display cold waters with a salinity lower than the sea-water. The two wells drilled on the northern coast found thermal waters (T=32-38°C) exploited for local spas.

The results here proposed account for the geochemical features of cold and thermal waters also including the dissolved gas phase.

Water geochemistry

A repeated sampling of the water resources was carried out over a time span of one year with the aim to evaluate either the geochemical features and their possible seasonal changes.

The results allowed to recognize the presence of high-temperature geothermal fluids, cold and fresh waters and the occurrence of Gas-Water Interaction processes

The Cl-Br relationships, for example, clear show a mixing between a low salinity component and the sea water, showing that the cold waters are fresh waters contaminated by marine waters at low extents, while the thermal waters are mainly composed by seawater.

On the other hand, the presence of a significant amount of thermal waters (revealed thanks to the drilling of two deep wells) highlights that some thermal energy is still released by the volcanic rocks of the island and dissipated to heat up marine waters that enter a relatively deep geothermal aquifer.

As the temperature and the chemical composition of the thermal waters changes with the time as a function of the draining activity (no relationships with seasonal changes), the possibility that the drained waters equilibrate in a deeper and hotter thermal aquifer has been investigated by liquid phase geothermometry. Following former experiences when a contamination by sea water occurred, three different geothermometers (Ca/Na; Ca/K; Na/K) were tested: the time they give consistent equilibrium geotemperatures for the same percentage of sea water contamination, we assume that a water body exists at the estimated equilibrium temperature [Italiano and Nuccio 1991].

On the other hand the thermal waters drained by the deep wells display also isotope composition (in terms of oxygen and deuterium stable isotopes) significantly different from the local rain waters and from the cold waters of the island. They are closely related to seawater that suffered high-temperature WRI processes as shown by the increase of the $\delta^{18}O$ values

The dissolved gases

The circulating waters (marine and fresh) normally carry a dissolved gas phase at the equilibrium with the atmosphere (Air-saturated waters, ASW and air-saturated sea waters, ASSW). The released CO_2-dominated gases interact with the water bodies allowing gases to dissolve as a function of their solubility. GWI (gas-water interaction) processes affect the composition of gases dissolved in both low-temperature and

thermal waters from the Island. The process highlights that an active degassing of magmatic CO_2 affects the island. The thermal waters from the geothermal aquifers are CO_2 saturated, while the shallow low-temperature waters exhibit variable CO_2 content as a function of the GWI intensity

A further process is shown by the variable amount of CH_4 in the dissolved gases. As CH_4 is not a major component of the upraising gases, a local production due to organic matter fermentation is considered as the most probable origin. Such a process affects only the shallow wells located on the southern coast of the Island where organic-derived carbon is recognizable

To get an insight of the origin of the gas phase the chemical composition of the dissolved gases has been coupled with the isotopic signatures of both helium and carbon. As a result, the gases are of magmatic origin, released by a cooling magma that is also the thermal source of the geothermal reservoirs located beneath the Island. Contrastingly, the low-temperature waters displaying low carbon isotopic ratios (even lower than -20‰ vs PDB), underlie how those waters bring a mixture of organic and inorganic carbon.

Conclusions

The main results can be summarized as follows:

- all the sampled waters bring a dissolved CO_2-dominated gas phase. The amount and the composition of the dissolved gases changes with the season for the cold waters and with the pumping activity for the thermal wells.
- the cold waters are a mixture of two components: a fresh, low salinity water, and seawater. The thermal waters don't show any contamination by fresh waters and are composed of thermalized sea water.
- the two thermal wells draw the thermal water from the top of a geothermal reservoir which equilibrium temperature has been estimated in the range of 120-130°C with a large contamination of sea-water in the range of 50-80%
- the cold waters are indeed "low temperature" waters showing estimated equilibrium temperatures in the range of 150-160°C and a low sea-water contamination, normally less than 20%

As a matter of fact the island of Salina has two hidden resources: fresh water and geothermal reservoirs.

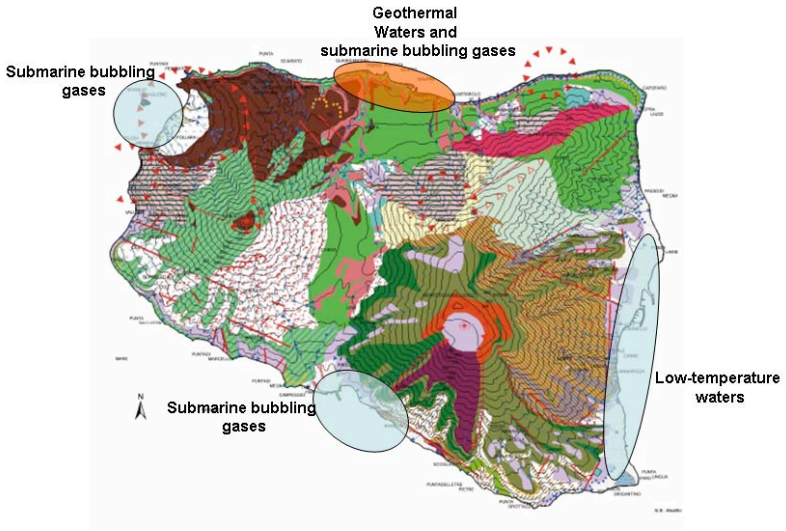


Figure 1. Distribution of the anomalous fluids (thermal and cold waters, CO_2-dominated gases) on the island of Salina.

References

Aureli A., Gottini V., Rizzo S., Torre G. (1986). *Bilancio idrico e caratteristiche delle acque dell'isola di Salina – Eolie*. Boll. Acc. Gioenia Sci. Nat. Vol. 19, n. 327, pp 413 – 449.

Calanchi, N., De Rosa, R., Mazzuoli, R., Rossi, P., Santacroce, R., Ventura, G., (1993). *Silicic magma entering a basaltic magma chamber: eruptive dynamics and magma mixing: an example from Salina (Aeolian islands, southern Tyrrhenian sea)*. Bull. Volcanol., 55, 504–522.

Italiano F. and Nuccio P.M. (1991) *Geochemical investigations on submarine volcanic exhalations to the East of Panarea, Aeolian Islands, Italy*. Jour. Volc. Geoth. Res., 46, 125-141

Italiano F. (2009) *Hydrothermal fluids vented at shallow depths at the Aeolian islands: relationships with volcanic and geothermal systems.* Proceedings International Workshop on Research In Shallow Marine And Fresh Water Systems, 39, 55-60. Freiberg, Germany, 14-16 May, 2009.

An Overview of the Worldwide Involvement of SCUBA Diver Volunteers in Scientific Research Programs

Cerrano C.[1,2], Bertolino M.[1,3], Betti F.[1,3], Palma M.[1,2], Pantaleo U.[1,2], Previati M.[1,2], Rossi G.[1], Scinto A.[1,2], Turicchia E.[1,4], Valisano L.[1,2], Ponti M.[1,4]

[1]*Reef Check Italia onlus, c/o DiSMar, Polytechnic University of Marche, Via Brecce Bianche 60131, Ancona, Italy*
[2]*DipTeRis, University of Genoa, Corso Europa 26, 16132 Genova, Italy*
[3]*DiSMar, Polytechnic University of Marche, Via Brecce Bianche 60131, Ancona, Italy*
[4]*CIRSA, University of Bologna, Via S. Alberto 163, 48123, Ravenna, Italy*

Abstract

Humans have impacted marine ecosystems for millennia and nowadays there are very few pristine systems anywhere in the world [Myers and Worm 2003].

The ongoing climatic anomaly, leading to a warmer climate at a global scale, is following a sharp trend. Increasing frequency, severity and expansion of mass mortalities related to seasonal stratification (hypoxia/anoxia) or to temperature anomalies were observed in different parts of the Mediterranean [Cerrano and Bavestrello, 2009].

Norse [cited in REEF, 1996, p.2] defines marine environmental monitoring as "the continuing observation of conditions over time" and describes the process as "a crucial tool in the conservation of marine biological diversity" providing managers with important data from which they can make informed decisions. Without accurate monitoring data, properly gathered for specific issues, it is difficult to determine either human or natural impacts on marine systems or specific sites, or how to respond accordingly.

There is almost certainly consensus that science has neither the manpower nor the financial resources to meet the demands that are being placed upon it [e.g. Hodgson, 1999]. However, much of the research that is needed to fulfil biodiversity action plans is labour intensive but technically straight-forward.

Volunteer-based monitoring is a potential solution to this problem representing a potentially huge workforce, and could supplement scarce resources [Fore et al. 2001; Lodge et al. 2006]. Public awareness of the problem of global change and of the biological response to it is also important from a cultural point of view, leading to a better appreciation of the natural environment and to the acceptance of its protection. The use of macrodescriptors, easily recordable even by non-specialists, allows the involvement of laypeople, in order to add further data to those provided by the scientific community.

Volunteers have already made significant contributions to scientific knowledge through their participation in a range of studies, particularly ones that have been guided by experienced scientists. Examples include surveys of the abundance and distribution of waders and wildfowl in British coastal waters [Prater, 1981]; beached bird surveys [Stowe, 1982]; the distribution of Australian birds [Blakers et al., 1984]; changes in benthic and pelagic communities in Jakarta Bay due to organic pollution from the city of Jakarta [Harger, 1988]; coral reef surveys in Singapore [Chou, 1994] and Belize [Mumby et al., 1995]; coastal zone management in Australia [Jacoby et al., 1997; Wescott, 1998]; North Sea pollution studies [Evans et al., 2000] and monitoring juvenile lobsters [Ellis and Cowan, 2002]; NOAA's National Marine Sanctuary volunteer programme [www.volunteer.noaa.gov/ocean_sanctuaries.html], focused on the continuous monitoring of US marine parks. In Northern Europe two relevant projects are NELOS [www.biologie.nelos.be] in the Netherlands and Belgium, and SEASEARCH [www.seasearch.org.uk] in the UK. All these projects are well established, and have developed observation protocols appropriate for their target areas and objectives. The potential of this workforce is especially well-illustrated in the coral programme 'Reef Check' [Hodgson, 1999]. Recreational divers surveyed over 300 reefs in 31 countries in a global survey that was certainly beyond the resources of conventional scientific projects.

The analysis of the distribution of species at a biogeographic scale is fundamental to answer some basic ecological questions. The management of the environment, both terrestrial and marine, requires a detailed knowledge of the distribution of the organisms present on the territory.

The only instrument to permit a right planning of interventions on protection is to know the most suitable environment for a species and its geographical distribution.

Unfortunately, as far as the marine environment is concerned, consciousness is still extremely fragmentary. The distribution of organisms is known on detail only in some zones of the Italian shoreline.

The network, coordinated by Reef Check Italia onlus, will consists on the active participation of recreational divers, who have the task to promote the project and to coordinate the activity at local level, involving others volunteers belongings to any didactic agencies.

Everybody, with experience and passion can give their own contribution. Join the project could be one of the purposes of the courses of Marine Biology for divers, but it could be also the opportunity of diving together with people having similar interests.

Volunteers conduct surveys on their own or during organized field surveys using the Coastal Environmental Monitoring protocol [CEM, Guide 2009]. During CEM surveys, divers swim freely throughout a dive site and record information on target species. At the conclusion of each survey, divers give information also on survey time, depth, temperature, and other environmental information later transferred to the web site of the project [www.reefcheckitalia.it].

Reef Check Italia standardized census method and database management system, combined with partnerships, have resulted in a successful citizen science monitoring program. Volunteer or "citizen" science allows all those who are interested in the resource to contribute to its understanding. Beyond providing valuable data, the increased stewardship that comes from participation in the surveys is vital to the protection of coastal marine resources.

Predicting Fish Assemblages and Diversity in Shallow Lakes in the Yangtze River Basin

Cheng L.[1,2,3], Lek S.[3], Loot G.[3] and Zhongjie Li[1]

[1]*State Key Laboratory of Freshwater Ecology and Biotechnology, Institute of Hydrobiology, The Chinese Academy of Sciences, 430072 Wuhan, China*
[2]*Graduate School of the Chinese Academy of Sciences, 100039 Beijing, China*
[3]*UMR 5174 EDB, CNRS-University Paul Sabatier, 118 Route de Narbonne, 31062 Toulouse Cedex, France*

Abstract

Among high biodiversity ecosystems, wetlands occupy only about 1% of the Earth's surface, but provide habitat for about 20% of the world's species (Dugan, 1993). The Yangtze River basin is especially a case. Yangtze River flows 6,300 km from Tibet Mountain to the East China Sea. It has more than 3000 tributaries and 4000 lakes. The river and its lakes are of high significance nationally and internationally, 362 fish species were found in them. However, human activities have profoundly degraded the ecosystem of lakes in the Yangtze basin, with consequences such as water quality degradation, threat to biodiversity, algae blooming, etc.. However, the integrate study of fish community in those lakes, and modeling the relationship between fish community and environments are absent. In this work, 6 lakes were considered all together to identify the importance of these predictive variables on the temporal and spatial distribution of fish assemblages in those lakes, with a conservation view to detect the relationship between fish and the habitat changes for better understanding about the fish community ecology, especially impacted by anthropogenic activities.

According to the each species' CPUE in each sampling site from 6 lakes spatially distributed in the mid-reach of Yangtze River basin, 117 sampling sites were patterned using Self-organizing map (SOM) and fish community were divided into three clusters of assemblages, spatial and temporal distributions were shown in it. Fish community seasonal changes were more obvious in vegetated habitats than unvegetated area. According to the contributions of different ecological groups of fish in each cluster in SOM, pelagic and benthopelagic fish were found having more activities in spring and winter, while more activities of demersal fish were found in summer and autumn. The total CPUE, fish diversity and species richness were significantly different among clusters using non parametric Kruskall-Wallis test ($p<0.01$). Based on the indicative value of each species in each cluster calculated in R software (in 'labdsv' package), 16 species were identified as indicators: 13 indicators in cluster G1 are pelagic or benthopelagic fish, the only one indicator species in G2 is a tolerant species, while the rest two indicator species are benthopelagic fish. Fish community assemblages, the total fish CPUE, diversity and species richness in those lakes were then predicted by 15 biotic and abiotic factors using random forest (RF) and classification and regression tree (CART) predictive models. The predicted assignment of each site unit to the correct assemblage had an average success of 74.4% and 60.7% in RF and CART models, respectively. The dominant variables for discriminating three fish assemblages were water depth, distance to the bank and total phosphorus. While the two important variables in prediction fish CPUE, diversity and species richness were lake surface area and water depth, density of rotifer and water depth, water depth and water temperature, respectively.

The Effect of Protection on Fish Populations in the "Plemmirio" Marine Protected Area (Ionian Sea, Mediterranean)

Consoli P.[(1)], Romeo T.[(1)], Incontro V.[(2)], Nicastro A.[(1)], Galfo F.[(1)], Andaloro F.[(3)]

[1]*ISPRA (Istituto Superiore per la Ricerca e la Protezione Ambientale), Via dei Mille 44, 98057 Milazzo (Messina), Italy*
[2]*Consorzio Plemmirio, Piazza Euripide 21, 96100 Siracusa, Italy*
[3]*ISPRA (Istituto Superiore per la Ricerca e la Protezione Ambientale), Via Salvatore Puglisi, 9 - 90143 Palermo, Italy*

Abstract

Fish assemblages associated with shallow (15-20 m deep) natural rocky habitats have been assessed in Summer 2009, at the marine protected area of Plemmirio and adjacent area outside the reserve (Ionian Sea). Our purpose was to assess the effects of marine protected area on reef fish assemblage detecting possible differences between "protected vs fished" areas. Reserve effectiveness was evaluated by assessing densities and size of fish by underwater visual census along transect 25 m long and 5 m wide according with the strip transect methods. Fish abundance was estimated by counting single specimens to a maximum of ten individuals, whereas classes of abundance (11-30, 31-50, 51-100, 101-200, 201-500, >500 individuals) were used for schools. Fish size was assessed by using three size categories (small, medium, large) on the basis of the maximum total length attained by each species. Fish were visually assessed inside the MPA (Zone A and B) and outside (Zone D). Four sites (with similar substrata topographic complexity) for each Zone were selected and three replicates were conducted at each site. Forty-one fish taxa were identified in this study.

The ANOVA test didn't detected significant differences in the mean species richness among the three Zone, even if this index was higher within the Zone A (integral reserve in which all fishing activities and navigation are forbidden) than the other two Zones. The mean number of specimens was significantly greater at A than B and D. Regarding the most important commercial fish species, the statistical tests showed also a greater number of large specimens in Zone A than in zone B and D. Some species such as Mycteroperca rubra, Sciaena umbra and Sphyraena viridensis were observed only inside the integral reserve. Permanova analyses, showed significant differences between fish assemblages recorded at the three areas. These preliminary results showed inside the Area A a reserve effect (larger sizes, higher abundance and species richness) when compared to the Area B or the non reserve Area. The results highlight the importance of marine reserves for the recovery of fish populations.

Optical Fibers for on Line Under Water Inspections

Cutolo A., Cusano A., Consales M., Pisco M.

Università del Sannio, Corso Garibaldi, Benevento, Italy

Abstract

Optical fiber sensor technology is receiving an increasing interest for easy handling, low cost, real time and on line operation when used for under water inspection. In this communication, after a short review of their basic properties, we intend to discuss some recent results on their applications for the construction of multiparameter optical fiber sensor suitable for underwater acoustic detection (from very low frequencies up to high frequencies), temperature measurements and impurities detection.

DNA Barcoding of Plants Inhabiting a Wetland Area in Central Italy

de Buruaga Aldave L.S., Kirin T., Laiou A., Tomasino M.P., Piredda R., Armenise L., Simeone M.C., Schirone B.

Dipartimento Ambiente e Foreste (D.A.F.), Università della Tuscia, 01100 Viterbo, Italy

Abstract

DNA barcoding is a technique in which species identification is performed using universal DNA sequences from a small fragment of the genome (Lahaye et al. 2007). Biodiversity characterization⁄conservation would be one of the main benefits of the widespread application of barcoding, in terms of speed, low cost, reliability, and improved resolution power. In combination with scuba diving, it could become a useful complement for ecological and taxonomical assesments of aquatic vegetation. Here, this method was tested for the first time on plants inhabiting a wetland area. Our objective was to provide a test for future *in situ* application of DNA Barcodes by evaluating the efficacy of species discrimination under the criteria of methods and natural co-occurrence of the species in the ecosystem. After collecting and identifying ca. 40 specimens, DNA Barcoding was performed using the three most efficient markers (trnH-psbA, rbclA, rpoC1) proposed by the Consortium for the Barcode Of Life (CBOL). Investigated plants were collected in the WWF protected wetland area "Lago di Alviano" which covers around 902 hectares of ecosystems important for migratory birds as well as many other animals and plants. Among the studied species, many are typically present in natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation in Europe. Two of them are floating on the water, five are submerged, thirteen emerged or living very close to water and five sampled species are trees closely related to water *habitats*. Nine species are also widely used for phytoremediation. Finally, we preformed DNA Barcoding of *Amorpha fructicosa*, an invasive plant nowadays becoming a serious problem in European wetlands.

References

Lahaye R., Van der Bank M., Bogarin D., Warner J., Pupulin F., Gigot G., Maurin O., Duthoit S., Barraclough T. G., V. Savolainen (2008) *DNA barcoding the floras of biodiversity hotspots*. PNAS, 105, 2923–2928.

Lake Mariut (Alexandria, Egypt) Pollution Problem, Cause and Suggested Solution/s

El-Rayis O. A., Hemada I. E., Shaaban N.

Oceanography Dept., Faculty of Science, University of Alexandria, Moharrem Bek 21511, Alexandria, Egypt

Abstract

Regarding, the recent remarkable decline in the importance of Lake Mariut, Alexandria (Egypt) as a source for the popular Tilapia fish species desired by the Alexandrian people and as a place for recreation and for nesting wild birds, several attempts were made to investigate the causes of this notice. The results showed that the lake main basin (LMMB, the main source of the fish) is fed with two water sources, one is from a polluted agricultural drain called Qalaa Drain and the other is an indirect one called Umum Drain. The first is polluted with wastewater from a primary treatment plant called East Wastewater Treatment Plant (EWTP)-the volume of the wastewater in this drain represents over than 88 % of its total discharge.

In order to solve the pollution problem of Qalaa Drainage water the wastewater from the EWTP needs further or advanced secondary treatment. This advanced treatment needs erection of suitable facilities which will take some time, years. Until then a fast solution is needed to reduce the pollutants in Qalaa Drain water. One of these is to use dilution technique. This is simply by pumping relatively clean and oxygenated water from Umum Drain to Qalaa Drain at its downstream part prior entering LMMB at its southeast part. Lake Mariut Fishery Basin (LMFB) will be used as transponder basin for the transferring of the diluting water. In order to estimate the amount of the water needed from Umum Drain to restore the polluted and anoxic water of Qalaa Drain the present work is made.

The present study therefore aims at forecasting such suggestion by investigating first the current water quality (physico-chemical, nutrients and organic matter) characteristic of the lower reach of each of Qalaa and Umum Drains, besides those in LMFB and in the south part of LMMB.

A sampling plan was designed to cover the study waters. The sampling stations were bimonthly visited during a year. The physico-chemical, nutrients and organic matter characteristics measured include temperature, transparency, pH, DO or H_2S, chlorosity, chlorophyll-a, TSM, N and P forms, COD and POC. The results showed that the Qalaa Drain water is permanently anoxic (contained H2S) exhibited the marked low transparency, pH, Clv. Regarding the nutrients it is enriched with TN and TP. Ammonia was the predominant N-form, it constitutes 99.8 % of DIN. Moreover, The DIP content constitutes the major P-form. The calculated TN and TP loadings to LMMB exceed the provisional dangerous permissible loading rate by 139.7 and 485.3 times. According to the Water Quality Index (NFS-WQI), the Qalaa Drain water is sorted as Bad condition. On the other hand, the Umum Drain waters show the other extremes of the studied parameters values.

In order to rehabilitate or restore this polluted drain improvement of the quality of the Qalaa Drain water is a must through the dilution method or if it is not practicable another alternative solution is invested diversion method.

Investigating the approach how each of the Umum and Qalaa Drains waters is suitable for reuse for irrigation or/and fish farming purposes is also assessed.

Analysis and Modelling of Contourite Drifts Off Promontories in Southern Italian Seas (Mediterranean Sea)

Falcini F.[(1)] , Martorelli E.[(2,3)], Salusti E.[(3)], Chiocci F.L.[(2)]

[1]*Dept. of Earth & Environmental Science, University of Pennsylvania, Philadelphia, USA*
[2]*Dip. Scienze della Terra, Università di Roma Sapienza, Piazzale A. Moro, 5, 00185 Rome, Italy*
[3]*INFN, Dip. Fisica, Universitài di Roma Sapienza, Piazzale Aldo Moro, 5, 00185 Rome, Italy*

Abstract

The complex relationship between currents flowing around capes and their related contourite deposits is still an interesting topic to confront, both from a sedimentologic and oceanographic perspective. We analyze here recent observations of contourite drifts, located at intermediate depths off promontories in the southern Tyrrhenian and in the southern Adriatic Sea. These contourites are located slightly upstream from the cape tip of Cape Vaticano, while they occur both upstream and downstream, in the lee wave region, of the Gargano Promontory. We therefore analyze and discuss tank and numerical simulations of contour-following flows, with particular attention to the presence of turbulent phenomena occurring in the lee region. Discussing the classical stream-tube model (i.e., a thin vein of dense water flowing around a cape) we moreover provide physical justification for some aspects we recognized in the study experiments. The comparison between bathymetric-stratigraphic data and numerical, tank and analytic results, allows investigation of the possible occurrence of sediment drifts around capes. We found that the presence of turbulence, and thus of erosive conditions for sediments in the lee of a cape, can be detected by using dimensionless numbers related to cape dimension and ocean current features. This work can be seen as a new approach to bridge the gap between marine sedimentology and physical oceanography.

Epibenthic Community Settled on Artificial Reefs in the Gulf of Trieste (Northern Adriatic Sea): A Three Years Study

Faresi L.[(1)], Bettoso N.[(1)], Rossin P.[(1)], Aleffi F.[(1)], Carulli R.[(2)], De Walderstein W.[(3)], Mattassi G.[(1)]

[1]*ARPA FVG – Osservatorio Alto Adriatico, v. Cairoli 14, 33057 Palmanova (UD), Italy*
[2]*Diving Center MisterBlu, Lignano (UD), Italy*
[3]*Ittiomar srl, Trieste, Italy*

Abstract

Adri.Blu. project (PIC Interreg IIIA - northern Adriatic) foresaw the use of areas off-limits to fisheries for the laying of submerged artificial reefs, in order to preserve marine biodiversity and fishery resources. A forbidden area to trawl, in the final stretch of the sewage duct off Lignano Sabbiadoro, was selected to realize this project. Three typologies of structures were used: Ecomar pyramids constituted of overlying corrugated polyethylene pipes, Fish Aggregating Device (FAD rows) and Tecnoreef pyramids built with assembled concrete plates. In August 2006, artificial structures were submerged in two water bodies nearby the final stretch of the sewage duct.

The monitoring of epibenthic community settled on the artificial reefs were annually conducted by scuba photographic surveys (2007, 2008 and 2009) and a 0.5 m^2 quadrant was used for faunal census. Epibenthic species were identified to the highest possible taxonomical level by photo analysis, moreover organisms of uncertain determination were collected for identification in laboratory.

After three years of investigations the number of species showed an increasing trend, although the species assemblage among structures was not homogeneus. In the first year FAD worked as substrate for settlement of juvenile scallops (mainly *Chlamys glabra* and *Aequipecten opercularis*), whereas Tecnoreef and Ecomar pyramids created fish shelters and constituted a substrate for pioneer species. In 2008 the allochtonous invasive sea squirt *Didemnun lahillei* covered structures located downstream of the sewage duct, whereas reefs located upstream showed an increase in epibenthic species, mainly porifera and other encrusting species tipical in the hard bottoms of the northern Adriatic Sea. In 2009 survey a reduction of the colonial invasive sea squirt was observed and the epibenthic community was characterized by the presence of characteristics species belonging to precoralligenus and coastal detrital biocoenoses. These observations were further confirmed by cluster analysis performed on presence-absence data. The annual monitoring by scuba photographic survey constitutes an useful method to follow the evolution of epibenthic community on artificial reefs in the long time.

Habitat Improvement in Wetland Ecosystems

Fariman M.B. and Sharifan H.R.

Islamic Azad University Science & Research Campus Tehran, Iran

Abstract

A lot of wetlands has changing toward unsustainable systems because of processes that endangered resident societies and prevented sustainable development for those areas. Since a continuous decreasing rate of wetland habitat is observed, the authors present the scientific analysis showing the circumstances that make unstable the wetland ecosystems. As a result, some guide directions for management methods in wetland sites such as wild life management, fish habitat improvements and habitat improvement for river ecosystems, have been set up. The target of the proposed guides is to provide directions and to combine methods of e.g. plant society, grazing diplomacy in wetland area besides rules and principles for wetlands restoration. Finally the needful maintenance of the water regime for many wetlands is presented and discusses as one of the cardinal management points as this topic can improve the wetland management and provide stability to aquatic ecosystems.

Scientific Activities at the NEMO-SN1 Cabled Observatory

Favali P.[(1)], Beranzoli L.[(1)], Riccobene G.[(2)], Pavan G.[(3)]

[1]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione Geomagnetismo, Aeronomia e Geofisica Ambientale, Roma, Italy*
[2]*Laboratori Nazionali del Sud - Istituto Nazionale di Fisica Nucleare (INFN), Via S. Sofia 62, 95123, Catania, Italy*
[3]*CIBRA, Università di Pavia, Via Taramelli 24, 27100, Pavia, Italy*

Abstract

NEMO-SN1, located in Western Ionian Sea off Eastern Sicily (at 2100 m depth, 25 km off the harbour of Catania), is a prototype of a cabled deep-sea multiparameter observatory, the first real-time operating in Europe since 2005. NEMO-SN1 is one of the node of the incoming European large-scale research infrastructure EMSO included in the ESFRI Roadmap (http://cordis.europa.eu/esfri/roadmap.htm). EMSO, the European Multidisciplinary Seafloor Observatory, is a network of seafloor observatories mainly cabled for long-term monitoring of environmental processes related to ecosystems, climate change and geo-hazards.

NEMO-SN1 has been implemented thanks to Italian resources and to the EC project ESONET NoE that is funding the LIDO Demonstration Mission (http://www.esonet-emso.org/esonet-noe/). NEMO-SN1 is devoted to neutrino detection, geophysical and environmental monitoring. Specifically the long-term monitoring of earthquakes and tsunamis and the characterisation of ambient noise, marine mammal sounds and anthropogenic sources.

EMSO: European Multidisciplinary Seafloor Observatory

Favali P.[(1)] and EMSO Partnership[(2)]

[1] INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione Geomagnetismo, Aeronomia e Geofisica Ambientale, Roma, Italy
[2]IFREMER-Institut Français de Recherche pour l'exploitation de la mer (France, ref. Roland Person); KDM-Konsortium Deutsche Meeresforschung e.V. (Germany, ref. Christoph Waldmann); IMI-Irish Marine Institute (Ireland, ref. Michael Gillooly); UTM-CSIC-Unidad de Tecnologia Marina - Consejo Superior de Investigaciones Cientificas (Spain, ref. Juan Jose Dañobeitia); UGOT-Goteborgs Universitet (Sweden, ref. Per Hall); HCMR-Hellenic Centre for Marine Research (Greece, ref. Vasilios Lykousis); NOCS-National Oceanography Centre Southampton (United Kingdom, ref. Henry A. Ruhl); UiT- Universitetet i Tromsø (Norway, ref. Jürgen Mienert); FFCUL-Fundação da Faculdade de Ciências da Universidade de Lisboa (Portugal, ref. Jorge Miguel Alberto de Miranda); ITU-Istanbul Teknik Universitesi (Turkey, ref. Namik Çagatay); NIOZ-Stichting Koninklijk Nederlands Instituut voor Zeeonderzoek (The Netherlands, ref. Jens Greinert)

Abstract

EMSO, an ESFRI Research Infrastructure, is the European-scale network of multidisciplinary seafloor observatories from the Arctic to the Black Sea with the scientific objective of long-term real-time monitoring of processes related to geosphere/biosphere/hydrosphere interactions. EMSO will enhance our understanding of processes through long time series appropriate to the scale of the phenomena, constituting the new frontier of studying Earth interior, deep-sea biology and chemistry and ocean processes. EMSO will reply also to the need expressed in the frame of GMES (Global Monitoring for Environment and Security) to develop a marine segment integrated in the *in situ* and satellite global monitoring system.

The EMSO infrastructure will extend the coverage to the sea of the monitoring, integrating the land-based networks with multidisciplinary seafloor measurements. EMSO is presently at the stage of Preparatory Phase, funded in the EC FP7. The EMSO status, the perspectives and relations with other existing or incoming sensor networks and data infrastructures are outlined.

Interactions between Fluids and Microorganisms at Shallow Hydrothermal Vents of Panarea Island (Italy)

Gugliandolo C.[(1)], Lentini V.[(1)], Spanò A.[(1)], Italiano F.[(2)], Maugeri T.L.[(1)]

[1]*Department of Animal Biology and Marine Ecology, University of Messina, Italy*
[2]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Italy*

Abstract

Shallow hydrothermal systems represent suitable fields for studying the interactions between fluids and microorganisms inhabiting natural thermal environments.

The Southern Tyrrhenian Sea (Italy) hosts a variety of shallow hydrothermal systems off the coastal zones at a depth allowing investigations by diving [Maugeri et al. 2010a].

The most active shallow hydrothermal system is located off the island of Panarea, where several vents are spread over the sea-bottom down to a depth of 150 metres. The area inside the islets (about 4 km^2 wide) was also impacted by a volcanic crisis on November 2, 2002, when a low-energy submarine blast generated a crater from which a huge degassing (estimated to be in the order of 10^9 litre of CO_2 per day) killed all the fish living in the area [Italiano 2009].

The venting of hydrothermal fluids at shallow depth influences the characteristics of the biological communities living in the immediate vicinity of the vents. The most evident effect of emissions on the biota is to exclude the majority of eukaryotic organisms which are less tolerant than prokaryotes [Tarasov 2006].

Microorganisms are the key elements for the functioning of the hydrothermal ecosystem as they are involved in the transformation of inorganic compounds released from vent emission and are at the basis of the hydrothermal system food web.

Four vents, with different physical and chemical properties, were investigated to elucidate the microbial community structure and composition by a combination of different methods complementing each other.

Microscopic counts were performed to evaluate the abundances of microbial cells and the autofluorescent, photosynthetic component, and to distinguish viable cells in thermal samples. Total microbial counts and their viable cell fraction were higher in thermal waters than in the local seawater of reference site. The density of photosynthetic cells in thermal samples was lower than in reference site. Photosynthetic component was mainly composed by cyanobacterial cells in both thermal vents and reference site. Chemolithoautotrophic sulphur-oxidizers of the genus *Halothiobacillus*, *Thiobacillus*, and *Thiomicrospira* were demonstrated by both culture -dependent and -independent methods. New heterotrophic thermophilic strains of *Bacillus* and *Geobacillus* were isolated from water and sediment samples [Maugeri et al. 2009, 2010, 2010a].

Molecular phylogenetic survey of naturally occurring microbial diversity was carried out by DGGE analysis of 16S rRNA amplified fragments. DGGE profiles showed that total number of bands, equivalent to the bacterial and archaeal richness, were higher in water than in sediment samples. Genetic diversity of *Bacteria* was higher than that of *Archaea*. Dominant populations of *Bacteria* belonged to uncultured members of *Proteobacteria* (mainly of the class *Gammaproteobacteria*), *Firmicutes* and *Acidobacteriaceae*.

Most of the archaeal DGGE 16S rRNA gene sequences matched with uncultivated *Archaea* and these results did not allow us to speculate about their physiology. Only two sequences were distantly affiliated (<96% similarity) with *Paleococcus helgesonii*, an obligate chemo-heterotrophic, hyperthermophilic, microaerophilic euryarcheon, isolated from a geothermal well at Vulcano Island [Amend et al. 2003].

Primary production appeared to be supported by chemosynthetic and photosynthetic bacteria. Members of *Chromatiaceae* represented dominant photosynthetic populations at the warmest vent, while those of *Chlorobiaceae* and *Synechococcaceae* were dominant at the other vents.

The low similarity levels of sequences with yet-described clones of prokaryotes suggest the presence of new indigenous phylotypes.

Geochemical conditions at the different sites have a negligible influence on total counts of prokaryotes and their viability, nevertheless they exert a strong selective pressure on the microbial structure and composition of the resident microbial community.

References

Amend JP, Meyer-Dombard DR, Sheth SN, Zolotova N, Amend AC (2003) *Palaeococcus helgesonii sp. nov., a facultatively anaerobic, hyperthermophilic archaeon from a geothermal well on Vulcano Island, Italy*. Arch Microbiol 179: 394-401

Italiano F (2009) *Hydrothermal fluids vented at shallow depths at the Aeolian islands: Relationships with volcanic and geothermal systems*. FOG-Freiberg Online Geoscience 22: 55-60
Lentini V, Gugliandolo C, Maugeri TL (2010) *Archaeal diversity at shallow hydrothermal system off Panarea (Eolian Archipelago, Italy) as revealed by 16S rDNA PCR-DGGE analysi*s. 39th CIESM Congress-Venice, Italy, 10-14 May 2010
Maugeri TL, Lentini V, Gugliandolo C, Italiano F, Cousin S, Stackebrandt E (2009) *Bacterial and archaeal populations at two shallow hydrothermal vents off Panarea Island (Eolian Islands, Italy).* Extremophiles 13: 199-212
Maugeri TL, Bianconi G., Canganella F., Danovaro R., Gugliandolo C., Italiano F., Lentini V., Manini E., Nicolaus B. (2010a) *Shallow hydrothermal vents in the southern Tyrrhenian Sea*. Chem. Ecol 26: 285-298.
Maugeri TL, Lentini V, Gugliandolo C, Cousin S, Stackebrandt E, (2010) *Microbial diversity at a hot shallow thermal vent in the Southern Tyrrhenian Sea (Italy)*. Geomicrobiol J 27: 380-390
Tarasov VG (2006) *Effects of shallow-water hydrothermal venting on biological communities of coastal marine ecosystems of the Western Pacific*. Adv Mar Biol 50:267-421

Long-Term Submarine Gas Flow Continuous Monitoring at Panarea (Aeolian Islands, Italy): Preliminary Results of The September 2008 – September 2010 Monitoring Period

Heinicke J.[(1)], Italiano F.[(2)], Maugeri R.[(2)], Merkel B.[(3)], Pohl T.[(4)], Schipek M.[(3)]

[1]*Sächsische Akademie der Wissenschaften, Dept. Freiberg, Leipziger Str. 23, 09599 Freiberg, Germany*
[2]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Italy*
[3]*TU Bergakademie Freiberg, Dept. of Geoscience, Gustav-Zeuner-Str. 12, 09599 Freiberg, Germany*
[4]*Geo-Dive, Sachsenhofstraße 10, 09599 Freiberg, Germany*

Abstract

The first long-term gas flow records at the Panarea submarine gas vents carried out between 2006 and 2007, showed disturbances to the venting of submarine hydrothermal fluids due different processes such as tides and swells during storm. Some of the observed modifications in the gas pressure and thermal waters temperature, however, were related to geodynamic processes including explosions at the nearby active volcanic island of Stromboli. The results discussed in a former paper [Heinicke et. al, 2009] highlighted a tectonic link between both volcanoes.

Long-term records of submarine hydrothermal fluids vented at shallow depths are difficult due to harsh conditions, highly corrosive water, impact of waves, tidal currents, fisher nets, anchors, and vandalism attacks. A robust device named ABCO (fig. 1) based on indirect gas flow monitoring by means of acoustic noise recording emitted during the gas emission was developed to overcome some of the above mentioned issues. This kind of acoustic "bubble counting" uses acoustic oscillations generated during the bubble forming at the vent's nozzle and the bubble stream.

The latest results collected during the period September 2008 - September 2010 confirm that a tectonic link joins together the two islands. We consider here the microseismic activity at Stromboli, recorded as VLP events, as a geodynamic parameter able to explain the anomalous fluid emission at Panarea. The contemporary occurrence of hydrostatic pressure effects during storms, VLP activity and changes of the gas flow rate at Panarea in some cases are not easy to explain and need further investigations. Following the latest results, the dominant process seems to be the static strain accumulation (long term effect) and the dynamic strain events, due to volcanic explosions or eruptions, seem to drive the observed changes.

References

Heinicke J., Italiano F., Maugeri R., Merkel B., Pohl T., Schipeck M. (2009) *Evidence of tectonic control on active arc volcanism: The Panarea-Stromboli tectonic link inferred by submarine hydrothermal vents monitoring (Aeolian arc, Italy)*, Geophys. Res. Lett., 36, L04301, doi:10.1029/2008GL036664.

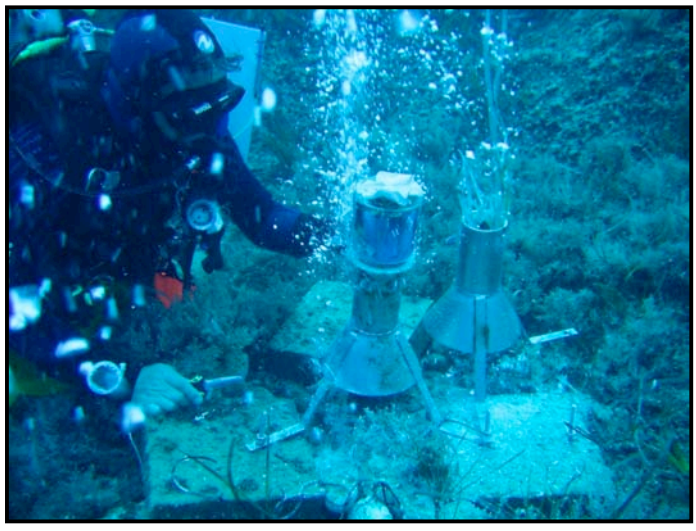


Figure 1. The ABCO system (version 1) on top of a funnel at the Black Point site.

Geomicrobiological Study at Shallow-Sea Hydrothermal Vent Site, Hot Lake, Lago Caldo, Panarea, Italy

Huang Chia-I[(1)], Schubotz F.[(2)], Price R.[(2)], Amend J.[(3)], Bach W.[(4)], Meyerdierks A.[(1)], Amann R.[(1)]

[1]*Max-Planck Institute for Marine Microbiology, Bremen, Germany*
[2]*MARUM, Center for Marine Environmental Sciences, Bremen, Germany*
[3]*Washington University, St. Louis, USA;* [4]*University of Bremen, Germany*

Abstract

In our study, we focused on one site Hot Lake (Lago Caldo) off Panarea, Italy. Its an oval-shaped (~10 by 6 meters) shallow depression covered by elemental sulfur precipitates and dead sea grass located in about 20 m water depth. The microbial communities were investigated in two sediment cores, one taken at a low temperature site, HLI (36 °C at 10 cm deep) and the other taken at a high temperature site, HLII (74 °C at 10 cm deep). Sediments were sliced for molecular and intact polar lipids (IPL) studies; pore water was sampled for chemical analysis. The highest microbial abundance (up to 6.69 X 10^8 cells/ml) was found uppermost one cm of core HLII. Catalyzed reporter deposition fluorescence in situ hybridization (CARD-FISH) revealed a dominance of Bacteria over Archaea in both cores down to 17 cm sediment depth. Archaea were detected to increase in abundance (up to 42% CARD-FISH counts) with increasing depth and temperature in HLII. Comparative archaeal 16S rRNA gene analysis showed that clones affiliated with Desulfurococcaceae and Korarchaeota, known to be hyperthermophiles, were found in the deeper layer of HLII. Thermoplasmatales were found to be dominant group in HLI. The cultured representatives grow as facultative anaerobes on molecular sulfur by sulfur respiration. Differences in the composition of the bacterial community at the two sites were reflected in bacterial 16S rRNA gene fingerprints (ARISA). The observed glycolipids and betaine lipids (BL) point to phototrophic organisms in the surface sediments and can tentatively be assigned to the Chlorobi in the clone libraries. The presence of phospholipids and ornithine lipids indicative of viable thermophilic sulfate-reducing or sulfide-oxidizing bacteria is consistent with the dominance of Delta- and Epsilonproteobacterial sequences in the clone libraries.

We propose that mixing between hydrothermal fluids and seawater causes a spatial variability of geochemical parameters in Hot Lake, leading to ecological niches, which feature life of distinctly different microbial communities based on sulfur-related metabolism.

Fluid Geochemistry of Ecuadorian Geothermal Systems: Preliminary Results

Inguaggiato S.[(1)], Beate B.[(2)], Hidalgo S.[(3)], Bourquin J.[(3)]

[1]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Italy*
[2]*Facultad de Geología - Escuela Politécnica Nacional, Ladrón de Guevara E11-253 y Andalucía, Quito-Ecuador*
[3]*Instituto Geofísico - Escuela Politécnica Nacional, Ladrón de Guevara E11-253 y Andalucía, Apartado 2759 Quito-Ecuador*

Abstract

Ecuador is a country which displays an enhanced magmatism with a volcanic arc consisting of at least 60 Quaternary edifices. This huge magmatic activity has consequences in the thermal regime enabling the presence of geothermal fields whose potential for energy production should be evaluated. With this aim several thermal waters and associated dissolved and bubbling gases were sampled during a field campaign around the whole country in 2009.

Thermal waters and gases were analysed for different geochemical parameters in order to get a proxy of the equilibrium temperatures of the deep reservoirs associated to the surface manifestations.

Most of the analysed waters are not in chemical equilibrium avoiding the use of classical cationic liquid geothermometers. Nevertheless, temperatures based on CO_2 pressure in dissolved gases give interesting results, ranging from 98 to 220 °C. The higher temperatures, above 200°C, are recorded in Guapán area, the Chacana Caldera, Pululahua, Pichincha and Tungurahua volcanoes. However, the risk related to the last three, given their current or potential volcanic activity, constitutes an important limitation for the production of geothermal energy. Other geothermal areas, like Tufiño and Chachimbiro, are also quite interesting.

More detailed geochemical and geophysical studies are required to better constrain the characteristics of these geothermal systems and their power generating potential.

Chemical and Isotopic Characterization of the Hydrothermal System of Stromboli Volcano (Aeolian Islands, Italy)

Inguaggiato S., Bellomo S., Brusca L., Liotta M., Longo M., Morici S., Rouwet D., Vita F.

INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Italy

Abstract

Stromboli, the northernmost island of the Aeolian arc in the southern Tyrrhenian Sea, represents the subaereal part of a large edifice extending from a depth of about 2500 m to 924 m a.s.l.

Stromboli volcano is famous worldwide for its persistent mildly explosive activity (e.g. "Strombolian activity"). These intermittent explosions occur usually at intervals of 10-20 minutes, throw glowing scoriae, ash and solid blocks to heights up to a few hundreds of meters.

In the last years the normal Strombolian activity was interrupted by two effusive eruptions occurred in 2002-2003 and 2007 period.

The thermal wells (Fulco, Zurro, COA, and Saibbo) located in the north-east side of the island was monthly sampled in the period 2004-2010.

The chemical and isotopic composition of these collected thermal waters was analyzed with the aim to investigate the origin of the shallow thermal waters of Stromboli and in particular to identify geochemical evidences of the presence of a deep geothermal aquifer and estimate its temperature and chemical composition.

These thermal shows outlet temperatures ranging around 40°C and a wide range of salinity that highlights a clear mixing between meteoric and marine origin waters.

Limnoecological Characteristics of Ostracods from a Shallow Freshwater Lake, Lake Çubuk (Bolu, Turkey)

Külköylüoğlu O.[(1)], Dügel M.[(1)], Sarı N.[(1)], Dere Ş.[(2)], Dalkıran N.[(2)], Karacaoğlu D.[(2)], Kayam S.[(3)], Çapar S.[(4)], Aygen C.[(5)]

[1]*Abant İzzet Baysal University, Department of Biology, Hydrobiology Division, Gölköy, 14280 Bolu, Turkey*
[2]*Uludağ University, Department of Biology, Bursa, Turkey*
[3]*DSI Bolu, Turkey*
[4]*Hacettepe University, Department of Biology, Ankara, Turkey*
[5]*Ege University, Faculty of Fisheries, İzmir, Turkey*

Abstract

Total of 17 freshwater ostracods (Candona neglecta, C. candida, C. sanociensis, C. weltneri, Pseudocandona albicans, P. sucki, P. semicognita, P.cf. eremita, Fabaeformiscandona brevicornis, F.cf. japonica, Physocypria kraepelini, Cypria ophthalmica, Cypridopsis vidua, Ilyocypris gibba, Trajancypris serrata, Prionocypris zenkeri, Limnocythere inopinata) were collected monthly from a shallow lake, Lake Çubuk (Göynük, Bolu) between July 2008 and August 2009. Of which, about 11 species (C. neglecta, C. candida, P. albicans, P. semicognita, P.cf. eremita, Ph. kraepelini, Cy. ophthalmica, Cp. vidua, I. gibba, Pr. zenkeri, L. inopinata) showed cosmopolitan characteristics, occurring all year around. According to Ostracod Watch Model, five species (C. neglecta, P. albicans, Ph. kraepelini, Cy. ophthalmica, L. inopinata) were encountered almost all year around while the rest displayed seasonal occurrences. Tolerance and optimum values of cosmopolitan species to ecological variables seems to be wider than noncosmopolitans. First axis of the Canonical Correspondence Analyses (CCA) explained more than 60% of the relationship between species and most influential five environmental variables. Lake water level changed from 5 to 8m during the study where especially bottom depending species were sensitive to such changes. Physico-chemical and biological data showed that Lake Çubuk was in the mesotrophic condition. In order to protect the lake and mitigate its current status, conservation efforts should be taken seriously.

Photosynthetic Populations in Sediment of Shallow Hydrothermal Vents of Panarea Island (Italy)

Lentini V., Gugliandolo C., Grasso M., Spanò A., Maugeri T.L.

Department of Animal Biology and Marine Ecology, University of Messina, Italy

Abstract

Shallow hydrothermal systems represent useful model for exploring how environmental parameters (temperature, pH, oxygen content etc.) influence living forms. Vent organisms display unique and highly specialized physiological adaptations to the hydrothermal physical and chemical conditions. These environments are highly productive ecosystems where minerals contained within the fluids and sunlight are utilized as energy sources by microbial community [Hirayama et al. 2007].

Microorganisms living at the shallow hydrothermal system off Panarea Island (Eolian Archipelago, Italy) are less studied than those of the near island of Vulcano, which is the most explored Eolian, hydrothermal system. Our previous studies have focused on the community structure and composition of the microbial biota living in shallow hydrothermal vents of Panarea Island [Gugliandolo et al. 2006; Maugeri et al. 2009, 2010]. Cultivation -independent analysis of 16S rRNA gene segments demonstrated that among dominant bacterial populations in water samples, those involved in the phototrophic production were members of *Chlorobium* and *Chromatium* genera [Maugeri et al. 2009, 2010].

This research focused on the cyanobacterial component of the phototrophic community living in sediments collected from six different vents close to the Panarea Island. Microscopic and molecular approaches were used to determine the abundance and the diversity of Cyanobacteria, respectively.

Microscopic counts revealed that the contribution of cyanobacterial cells to total cell counts ranged from 1.17 to 6.80 %. The diversity of Cyanobacteria was studied by PCR-DGGE fingerprinting method, using a group-specific primer set [Muhling et al. 2008]. The cyanobacterial richness, evaluated by number of bands, was highest in the sediment sample of the coldest vent. Comparison among the DGGE profiles, performed on the basis of Bray-Curtis similarity coefficient, showed high similarity level among the six vents. A non-metric multidimensional scaling diagram, constructed on the similarity matrices, showed that the cyanobacterial populations were distributed according to the physico-chemical parameters and depth of the sediment samples. Phylogenetic analysis, based on the partial 16S rDNA gene sequencing of DGGE fragments, revealed that sequences matched at low levels of similarity with Cyanobacteria yet deposited in databases. Only three sequences, were distantly affiliated (<92% similarity) with different cultivated species of *Synechococcus* demonstrating the occurrence of new phylotypes of this genus. These findings suggest that new ecotypes of Cyanobacteria inhabit the shallow hydrothermal vents of Panarea Island.

References

Gugliandolo C, Italiano F, Maugeri TL (2006) *The submarine hydrothermal system of Panarea (Southern Italy): biogeochemical processes at the thermal fluids sea bottom interface.* Ann Geophys 49: 783-792

Hirayama H, Sunamura M, Takai K, Nunoura T, Noguchi T, Oida H, Furushima Y, Yamamoto H, Oomori T, Horikoshi K (2007) *Culture-dependent and independent characterization of microbial communities associated with a shallow submarine hydrothermal system occurring within a coral Reef off Taketomi Island, Japan*. Appl Environ Microbiol 73: 7642-7656

Maugeri TL Lentini V, Gugliandolo C, Italiano F, Cousin S, Stackebrandt E (2009) *Bacterial and archaeal populations at two shallow hydrothermal vents off Panarea Island (Eolian Islands, Italy).* Extremophiles 13: 199-212

Maugeri TL, Lentini V, Gugliandolo C, Cousin S, Stackebrandt E (2010) *Microbial diversity at a hot shallow thermal vent in the Southern Tyrrhenian Sea (Italy).* Geomicrobiol J 27: 380-390

Muhling M, Allen JW, Murrel C, Joint I (2008) *Improved group-specific PCR primers for denaturating gradient gel electrophoresis analysis of the genetic diversity of complex microbial communities*. The ISME J 2: 379-392

Bacteria and *Archaea* in the Meromictic Lake Faro (Italy) as Determined by Fluorescent *in situ* Hybridization

Lentini V., Gugliandolo C., Vadalà M., Spanò A., Maugeri T.L.

Department of Animal Biology and Marine Ecology, University of Messina, Italy

Abstract

Meromictic lakes are very peculiar biotopes and represent less than 1% of total world lakes. They are interesting model systems for research in aquatic biology for the high physical stability of water masses, with clearly separated oxic and anoxic zones, and a relatively constant vertical stratification in microbial populations. Lake Faro (Messina, Italy) is a coastal, meromictic basin, with a salinity that seasonally varies from 34 to 38‰. Water stratification depends on the limited supply of oxygenated seawater from the channels that connect the lake to the sea.

The variation in vertical distribution and composition of *Bacteria* in the meromictic Lake Faro has been previously studied by using culture-independent methods. Results indicated that specific members of Proteobacteria (α-, γ-, δ- and ε subclass), *Cytophaga–Flavobacter–Bacteroides*, green sulphur bacteria and Cyanobacteria were dominant phylotypes of the bacterial community [Gugliandolo et al. 2010].

The relative abundance of *Bacteria* and *Archaea* in the water column of the Lake Faro by fluorescent in situ hybridization technique is here reported. To enumerate *Bacteria*, Cyanobacteria, green sulphur bacteria and *Archaea (Euryarchaeota* and *Crenoarchaeota*) in water samples, groups-specific probes binding to 16S rRNA were used [Daims et al. 2004].

Total prokaryotic abundance (*Bacteria* and *Archaea*), determined using DAPI (4',6-diamidino-2-phenylindole) staining method, ranged from 1.10×10^6 cells ml^{-1} (30 m depth) to 2.29×10^6 cells ml^{-1} (15 m depth).

Cells hybridizing with *Bacteria* probe reached 44% of DAPI-stained cells in the well oxigenated layer (5 m depth). Cyanobacteria (0.5-1.7% of DAPI cells) and green sulphur bacteria (1.5-26.2% of DAPI cells) increased with depth.

The *Archaea* abundance in the lake, in contrast to that of *Bacteria*, increased with depth and reached the maximum value at the bottom. The sum of detectable *Crenarcheaota* and *Euryarchaeota* ranged from 35.52 to 79.57% of the total archaeal cells. The two major archaeal lineages showed an opposite tendency: *Crenarcheaota* increased with depth, while *Euryarchaeota* decreased.

Our results indicate that *Archaea* constitute a minor fraction of the bacterioplankton in the meromictic Lake Faro. Nevertheless, *Archaea* contain appreciable amounts of rRNA and therefore may be active contributors to the meromictic ecosystem [Karner et al. 2001].

References

Daims H, Stoecker K, Wagner M (2004) *Fluorescence in situ hybridisation for the detection of Prokaryotes*. BIOS Scientific 6-39

Gugliandolo C, Lentini V, Maugeri TL (2010) *Distribution and diversity of Bacteria in a saline meromictic lake as determined by PCR-DGGE of 16S rRNA gene fragments*. Curr Microbiol DOI 10.1007/s00284-010-9688-0

Karner MB, Delong EF, Karl DM (2001) *Archaeal dominance in the mesopelagic zone of the Pacific Ocean.* Nature 409:507-510

SMM: A New Submarine Monitoring Module for Real-Time Data Transmission from the Seafloor

Maugeri R.[(1)], Mastrolia A.[(1)], Italiano F.[(1)], Favali P.[(2)]

[1]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Italy*
[2]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione Geomagnetismo, Aeronomia e Geofisica Ambientale, Roma, Italy*

Abstract

In the mainframe of the PEGASO project funded by European Structural Funds via the Regione Siciliana government, submarine monitoring module able to automatically record multidisciplinary data and perform a sea-floor real-time data transmission was developed. The monitoring system was tested offshore the island of Panarea (Aeolian islands) for two years. The Panarea test site was selected because of its submarine extreme environmental conditions where high temperatures, low pH hydrothermal fluids (gases and waters) are constantly released at a depth of 22m.

The whole system is composed by two main parts, a buoy (Fig. 1a) and the SMM connected by a cable. The buoy (composed of a large steel chassis of 2.4m in diameter, weight 1.6 tons and coated by a plastic film) provides power and communications for itself and the submarine module.It is equipped with four photovoltaic solar cells and three batteries, a control unit and a meteorological station.

The control unit monitors the power of the other modules thus they can be switched on ad off remotely. The meteorological station, in addition to meteorological data, records the buoy position and movements by a GPS unit and three accelerometers. The GPS modem provides direct access to the control unit and the meteorological station and it is used to send SMS alarms like buoy disengagement or high power consumption of some modules. The buoy carries also a GPRS modem/router used for communications with the submarine module always connected to the net.

A cable joins the buoy and the SMM providing ethernet communication with the GPRS modem router.

The SMM - submarine monitoring module

The hearth of the SMM (Fig. 1b) is made of a miniPC and a datalogger. The datalogger collects many different kind of data depending on the probe connected to the module and by its electronic configuration. The module tested at Panarea island was equipped by probes for water temperature, pressure and acoustic noise [Heinicke et al., 2009]. The miniPC collects also frames from a webcam and sample the submarine noise using a hydrophone. We used a mini PC based on EPIA-PX Pico ITX mainboard made by VIA technologies, an SSD device as hard disk and Windows XP as operating system. The PC turns on once per hour, it records data from hydrophone and webcam, downloads and records data from the datalogger and then turns off again. It is possible to avoid this last phase in order to download data, install new programs or for maintenance. The PC is connected to internet by the GPRS modem/router, as such all the communication are internet-based by a friendly-user software interface (fig. 2)

The software is organised in independent modules so they can be easily replaced and errors or crashes of one of them don't stop the other modules. After booting the Monitor module automatically starts. It adjusts the system time using one internet time server and then starts the acquisition modules. Finally, the monitor module checks for any special message in the server. If any message is found it stays awake, otherwise it shuts down until the next awakening. Figure 3 shows an example of rough acoustic data collected over a mid-term monitoring, where periodical oscillations, external disturbance, electronic noises are all recorded and transmitted to be submitted to further data analysis.

All the electronics and the miniPC are assembled in a vessel (nylon made) equipped with the connectors for the submarine cable and the probes. Those connectors can be operated underwater so there is no need to bring the unit to the surface for probes maintenance. Although the monitoring module has an operating depth of more than 250m, it is small and light enough to be handled or removed by only one diver or a small ROV.

The long-term tests were useful to find solutions for several issues related to shallow waters submarine observatories management (e.g. the buoy anchorage) and showed how new technological improvements allow the SMM observatories to be adopted for several different purposes such as environmental or natural and anthropogenic risks monitoring activity. Due to their handiness and easy management the SMM can be

adopted to built submarine networks and because of their chemical inertness they can be adopted for hydrothermal activity monitoring.

References

Heinicke J., Italiano F., Maugeri R., Merkel B., Pohl T., Schipeck M. (2009) *Evidence of tectonic control on active arc volcanism: The Panarea-Stromboli tectonic link inferred by submarine hydrothermal vents monitoring (Aeolian arc, Italy)*, Geophys. Res. Lett., 36, L04301, doi:10.1029/2008GL036664.

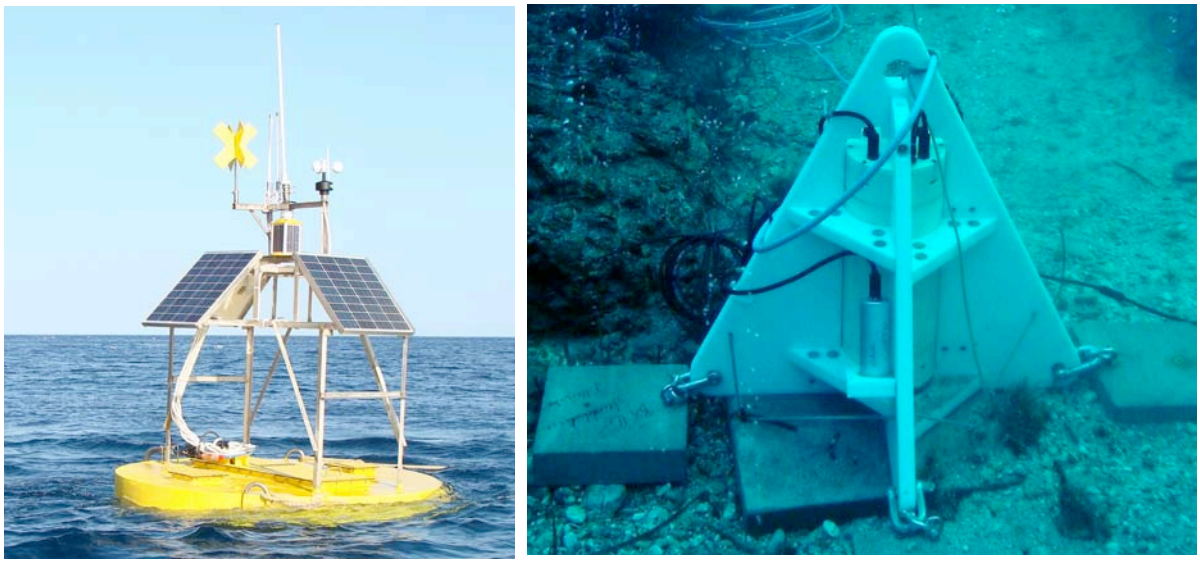


Figure 1. a) The buoy and b) the Submarine Monitoring Module off Panarea island (Aeolian islands).

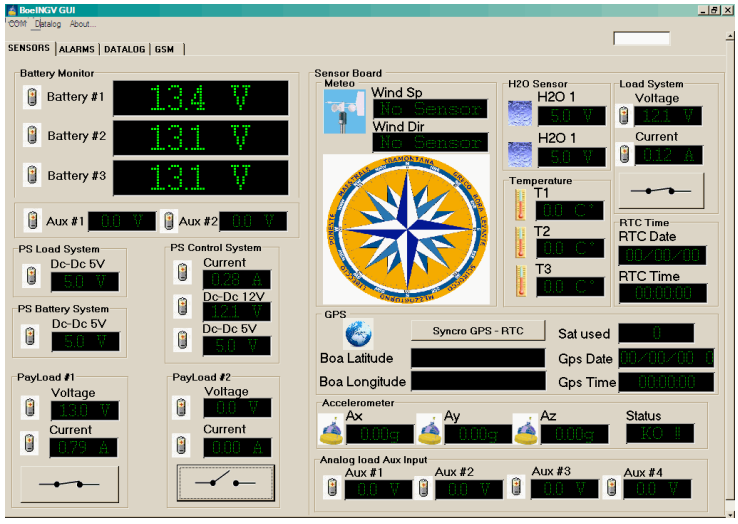


Figure 2. The monitoring system dialog interface.

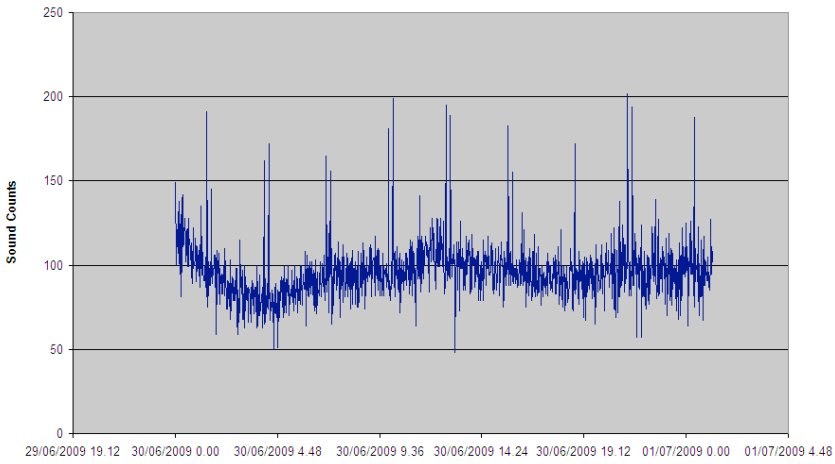


Figure 3. Example of acoustic data acquisition of the SMM.

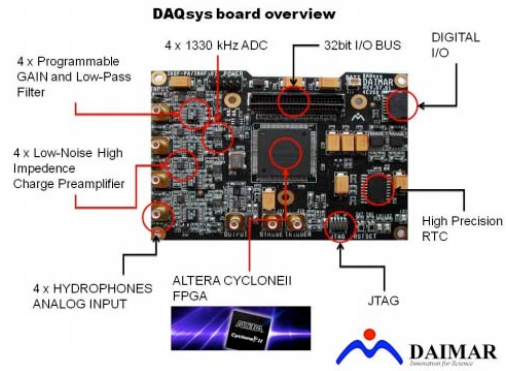
Laboratory for Innovation and Technology Transfer IAMC-IBF

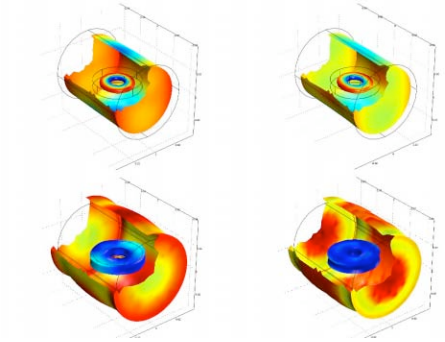
Mazzola S.[(1)], San Biagio P.L.[(2)], Zora M.[(1,3)], D'Anca F.[(2)], Lupo D.[(4)], Sottile G.[(3)], Gallì N.G.[(3)]

[1]*IAMC-CNR U.O.S. Capo Granitola (Tp)*
[2]*IBF-CNR U.O.S. Palermo*
[3]*DAIMAR S.r.l. innovation for science*
[4]*DIEET, Università degli studi di Palermo*

Abstract

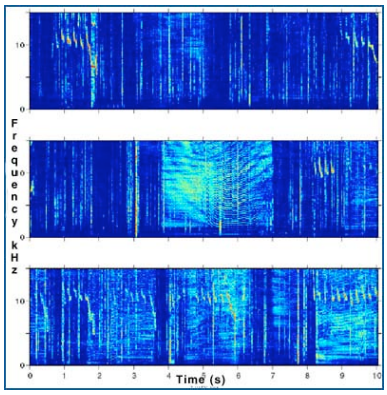
The Innovation and Technology Transfer Laboratory (LITT) is the result of a collaboration between the IAMC and the IBF Institutes of CNR. It's a multidisciplinary workgroup with experience in different fields, i.e. microelectronics, piezoelectric materials for marine and nano-positioner applications, multi-physics F.E.M. simulations, and optics applications. The principal activities of the laboratory concern hardware and software design of innovative instruments for underwater systems, characterization of piezoelectric acoustic transducers, and design of atomic microscopy. LITT laboratory also develops products designed by institutes that have shown a good potential in technology innovation and that can be developed to an industrial level.





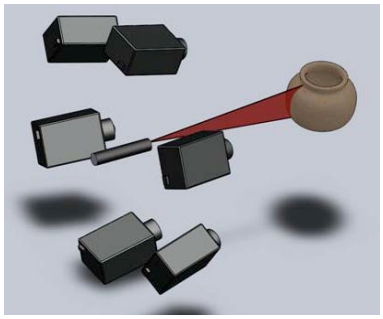
The following projects are partially promoted by Ministero dello Sviluppo Economico (CIPE N°8, 01/29/2004).

Zigguratt



Innovative software for web diffusion of high-quality acoustic data, coming from data capture sessions in marine environment. The main idea consists in the conversion of acoustic data from a standard acoustic format (Wav, Flac, etc.) to a new visual format, using image compression algorithms that are more efficient than those used in audio one's, for example using Jpeg or Wavelet algorithms, using Java and Ajax libraries that allow to create web services oriented to analyze and select only data of most interest. Acoustic data coding in an innovative format reduce also the bandwidth necessary to download them, to allow simple Java applications to visualize and analyze a big quantity of information remotely stored.

DeepScan 3D

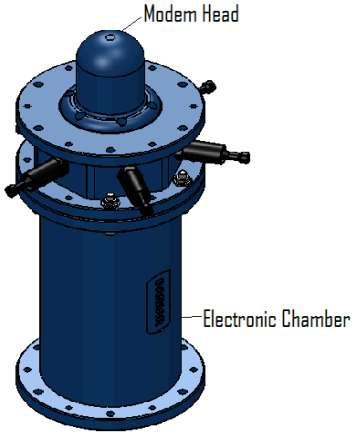


The main scope of this project consists in the union of two different 3D scanning techniques, line laser scanning and photogrammetry, to design an innovative instrument for 3D scanning of ocean floor. Using a specific laser pattern and some videocameras, it's possible to create a three-dimensional scan of an object situated on the ocean floor. This is possible because we use both

photogrammetry and laser scan advantages, creating an high-precision scan without necessity to have the instrument fixed respect to the object that must be scanned, requisite that is not possible to be given in aquatic environment. The using of a relatively high number of cameras, permits us to solve fundamentals problems in three-dimensional scanning in marine environment.

AcuLink

A new system of underwater communication that uses advanced electronics and innovative piezoelectric transducers for acoustic links. AcuLink's main advantage consists in a peer-to-peer communication between different electronic devices like sensors, data acquisition instruments etc., to create a underwater data net that allow instruments to communicate each other's without the necessity to use an host. This allows, for example, to receive data from an instrument that's located too far for direct acoustic link. The protocol used is a simplified version of the TCP/IP.



Partners:

- DAIMAR S.r.l. IAMC-Spin-off;
- Officine Meccaniche ENEA;
- SA.NI.CO. S.r.l.

Development of a Gas Sampling Technique for Determining Trace Elements in Submarine Volcanic Exhalations

Merkel B.[(1)], Planer-Friedrich B.[(2)], Pohl T.[(3)], Schipek M.[(1)]

[1]*TU Bergakademie Freiberg, Gustav Zeunerstr.12, 09599 Freiberg*
[2]*University Bayreuth, Universitätsstrasse 30, 95440 Bayreuth*
[3]*Geo-Dive, Sachsenhofstr. 10, 09599 Freiberg*

Abstract

Panarea is a submarine volcanic caldera between the active volcanoes Stromboli and Vulcano, Aeolian Islands, Italy. Many locations within the caldera at a water depth between 10 and 30 m are characterized by emissions of hot water (partly boiling) and gases (fumaroles). The fumarole gas consists mainly of CO_2 (96 to 99.5%) with H_2S being the second abundant gas. To investigate trace gases and in particular aerosols and volatile metals and metalloids like arsenic a technique was used which allows sampling tens and even hundreds liters of fumarole gas. The sampling system is rather simple: a stainless steel funnel, a 100 m long PE hose with an inner diameter of 4 mm and a gas bag (10 to 80 liter). After sampling the gas is pumped into a PTFE washing bottle containing NaOCl in supra pure water which is effectively oxidizing organic compounds like methylated metals and other reduced species. Determination of trace elements follows by ICP-MS. First results show a huge variety of elements present in the submarine volcanic gases of Panarea.

Method

Gases escaping under water are commonly sampled by scuba divers using a funnel to capture the emitting gas [Italiano and Nuccio, 1991]. A hand-held funnel made of stainless steel with a diameter of 20 cm, a height of 50 cm and a transparent gas trapping chamber made of PMMA (Acryl-glass) with a volume of 300 mL (Figure 1) served for several years for gas sampling by the CMAS scientific diving center of TU Bergakademie Freiberg. A bypass below the trapping chamber allows surplus gas to escape. For low amounts of gas the bypass can be closed. On top of the gas trapping chamber the gas flow to the sampling unit can be controlled by a 3-way valve made from PP and PE. The transparent gas trapping chamber has the advantage that the scuba diver can visually control the gas water separation. By this it can be avoided to sample a gas-water mixture.

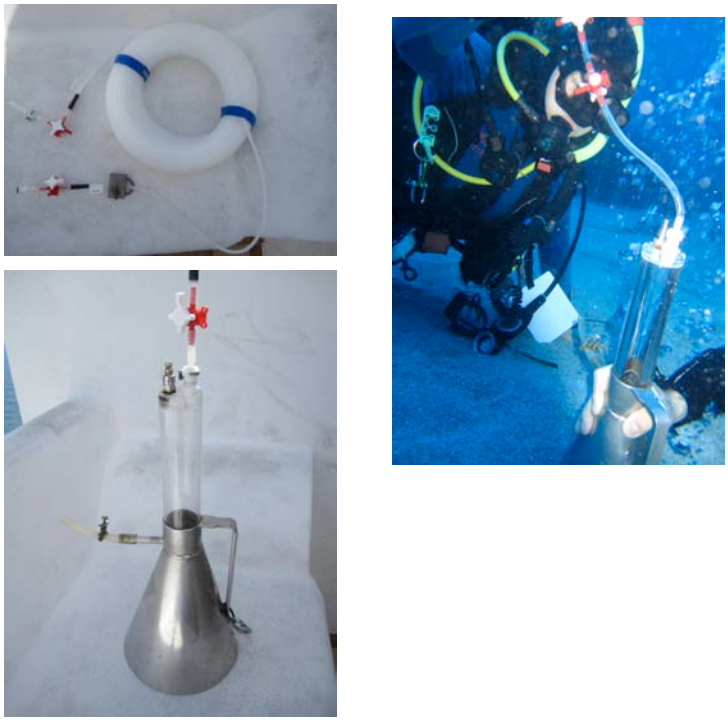


Figure 1. Stainless steel funnel with gas separation chamber, gas hose with 3-way valve, and funnel during sampling.

Gas containers can be made from different materials e.g. stainless steel, glass, or PPMA. Glass containers are commonly used for gas analysis but have the disadvantage of being rather brittle and not robust. Due to the buoyancy effect sample volumes can not exceed the range of 1-2 liter or would require the utilization of counterweights. It has to be taken into account that the gas in the bottle has an excess pressure of 0.1 MPa for each 10 m depth: a gas sample taken at 40 meters will have a pressure of 0.5 MPa at the surface and a bottle with a volume of 1 Liter will contain 5 Liter of gas. Via a valve the gas can be refilled in gas bags or in evacuated Giggenbach bottles [Giggenbach 1975].

For sampling aerosols,volatile metals and metalloids a sample volume of several tens of liters of gas is required due to the very low aerosol concentrations. Thus, we utilize a sampling technique by means of connecting a 100 m hose (4 mm inner diameter, PE) to the funnel and a gas bag (10 to 80 Liters) on board of the diving boat. We have tested several types of automatic hose couplers, but we found that all of them were not tight with respect to the surrounding water pressure. Thus more or less small amounts of seawater entered the hose. Only by using screw connections we could maintain a dry gas sampling. Both sides of the hose carry a 3-way valve to avoid water entering the hose before the hose is connected to the funnel at the gas sampling site. Instead of a gas bag a trapping unit can be connected directly to the hose on board of the diving boat. In this case it is recommended to use as well a gas flow meter calibrated to CO_2.

Gas volumes sampled at Panarea by this method were between 1 and 10 Liter per minute depending on the amount of gas of the fumaroles and water depth. Two to four gas samples can be taken with one dive depending on distance of fumaroles and depth. Communication between the scuba divers and the person on board can be easily done by using the hose as signal line (e.g. three pulls means that the gas bag is filled). This sampling technique can be used not only for aerosol sampling but as well for any other gas analysis (e.g. Giggenbach bottles, gas chromatography, isotope analysis, etc.).

Volatile trace elements and aerosols were trapped by using a PTFE washing bottle filled with PTFE Raschig rings containing 100 ml of a NaOCl solution (diluted 1:10 with supra pure water) as strong oxidant (Planer-Friedrich et al., 2002) to transform reduced species (e.g. methylated species) into oxidized elements. The gas flow was maintained to be ~100 ml per minute. By the smell of it, it was found that H_2S as a major component (between 0.5 and 4 Vol%) was not completely transformed into its oxidized form. Trace elements were determined by ICP-MS.

Results

In the following some results from sampling campaigns at the shallow submarine caldera Panarea (Aeolian Islands, Italy) in the period from 2006 to 2009 are presented. Diving sites are described by Sieland et al (2009).

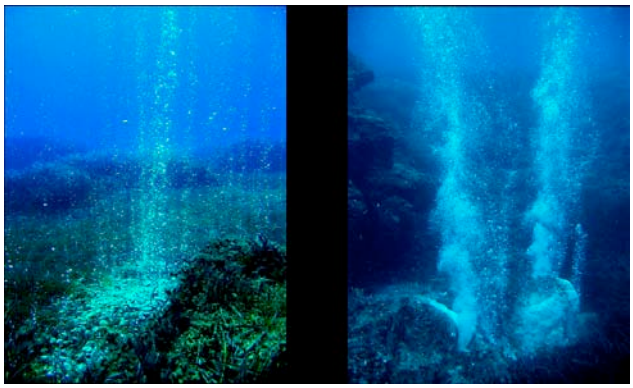


Figure 2. Two fumaroles from Panarea with rather different gas volumes.

The concentrations of volcanic gases vary considerably from one volcano to the other. Water vapor is typically the most abundant gas, followed by carbon dioxide and sulfur dioxide. Volcanic gases include as well hydrogen sulfide, hydrogen chloride, and hydrogen fluoride. Trace gases are also found in volcanic emissions, such as hydrogen, noble gases, methane, alkenes, carbon-monoxide, and volatile metal chlorides and methylated metals and metalloids. However, in submarine fumaroles of Panarea water vapor is scavenged by seawater and thus CO_2 is the most abundant gas with 95 to 99 % and H_2S the second most abundant [Italiano 2009, Capaccioni et al. 2005]. Table 1 displays the minima and maxima of major and minor gas concentrations from different sites of Panarea. Methane and alkenes (C_2H_6 and C_3H_8) were found at concentrations below 1 Vol.%. Oxygen concentrations between 0.1 and 0.3 Mol.%. may be due to

contamination during sampling. All gases shown in Table 1 could have been sampled by routine sampling with glass bottles directly connected to the funnel.

Table 1. Minima and maxima of major and minor gas components at submarine fumaroles of Panarea (2006 – 2009).

		Minima	Maxima	Method
CO_2	Mol.%	96.0	99.5	GC (TCD)
H_2S	Vol.%	0.2	4.0	Dräger tube
CO	Ppm	10	80	Dräger tube
O_2	Mol.%	0.1	0.3	GC (TCD)
CH_4	Vol%	0.1	0.9	GC (FID)
C_2H_6	Vol%	0.2	0.9	GC (FID)
C_3H_8	Vol%	0.2	0.7	GC (FID)
Rn	Bq/L	1.3	24.0	Alpha-spectrometer

Table 2 displays the minima and maxima of trace gases and aerosols from different submarine sites of Panarea. The concentration found in the NaOCl trapping solutions was used to calculate air concentrations in $\mu g/m^3$ by means of the amount of gas trapped. The gas amount was determined with a precision of about ± 5%. Taking into account different time for gas treatment after sampling and therefore different photochemical decay of volatile species a total precision of ± 30% is estimated.

Table 2. Minima and Maxima of major and minor gas components at 5 submarine fumaroles of Panarea (2006 – 2009).

Element	Unit	Mini	Max	Element	unit	Min	Max
Li	µg/m³	4.0	79.5	Cd	µg/m³	4.0	28.0
Be	µg/m³	0.4	0.4	In	µg/m³	0.4	0.6
B	µg/m³	0.5	93.8	Sn	µg/m³	0.2	10.0
Na	µg/m³	14.0	14.0	Sb	µg/m³	1.5	4.2
Mg	µg/m³	18.0	296.0	Te	µg/m³	0.4	3.4
Al	µg/m³	54.7	495.5	I	µg/m³	14.0	436.0
Si	µg/m³	36.0	36.0	Cs	µg/m³	0.2	5.1
K	µg/m³	125.0	7687.5	Ba	µg/m³	27.3	6636.0
Ca	µg/m³	26.0	727.2	La	µg/m³	0.3	6.4
P	ppm	0.1	0.1	Ce	µg/m³	0.3	18.0
Sc	µg/m³	2.0	2.0	Pr	µg/m³	0.4	2.1
Ti	µg/m³	2.0	74.0	Nd	µg/m³	0.1	1.8
V	µg/m³	2.0	2.2	Sm	µg/m³	0.2	0.7
Cr	µg/m³	4.0	26.0	Eu	µg/m³	0.1	0.8
Mn	µg/m³	4.8	34.0	Gd	µg/m³	0.4	0.5
Fe	µg/m³	18.0	2492.8	Tb	µg/m³	0.2	0.2
Co	µg/m³	0.2	62.0	Dy	µg/m³	0.1	0.1
Ni	µg/m³	25.0	19984.0	Ho	µg/m³	0.9	0.9
Cu	µg/m³	7.9	3928.0	Er	µg/m³	0.1	0.8
Zn	µg/m³	27.3	684.0	Tm	µg/m³	0.4	0.4
Ga	µg/m³	1.2	1.2	Yb	µg/m³	0.4	0.4
Ge	µg/m³	0.8	8.0	Lu	µg/m³	0.4	0.8
As	µg/m³	9.2	9.2	Hf	µg/m³	0.4	1.2
Se	µg/m³	23.0	23.0	Ta	µg/m³	0.4	0.6
Br	µg/m³	473.0	4166.7	W	µg/m³	0.2	3.0
Rb	µg/m³	0.2	8.2	Re	µg/m³	0.1	0.4
Sr	µg/m³	1.9	1389.8	Os	µg/m³	0.6	0.8
Y	µg/m³	0.2	2.0	Pt	µg/m³	1.2	27.5
Zr	µg/m³	0.8	87.6	Au	µg/m³	0.1	7.4
Nb	µg/m³	0.2	0.4	Hg	µg/m³	0.8	0.8
Mo	µg/m³	2.0	15.0	Pb	µg/m³	0.5	458.0

Ru	µg/m³	0.2	1.4	Bi	µg/m³	1.2	1.2
Pd	µg/m³	0.6	16.2	Th	µg/m³	0.2	0.2
Ag	µg/m³	1.2	3.0	U	µg/m³	0.3	0.8

Contamination by seawater can be excluded by comparing the concentrations of the elements found in the gas trapping solutions with their respective concentrations in seawater. The results, however, do not allow any conclusions about the original speciation of the respective elements in the gas phase.

All values in table 1 are corrected by the background value of the NaOCL. Depending on the total gas volume trapped for some elements only on value out of 15 samples was well above the background: e.g. for Th, Bi, Ga, Ge and others. Rather high concentrations were found for Pb, but only at the vents of "Bottaro Nord". On contrary Pt was detected only at "Black Point". The highest concentrations were detected for Ni, Fe, Cu, K, Zn, and Ba while As, Se and Sb are found only at trace levels. Investigations using an increased gas volume to evaluate the pattern of occurrence are on the way.

References

Capaccioni, B., Tassi, F., Vaselli, O., Tedesco, D. and Rossi, P.L., 2005. *The November 2002 degassing event at Panarea Island (Italy): Five months of geochemical monitoring.* Annals of Geophysics, 48(4-5): 755.

Giggenbach, W.F., 1975. *A simple method for the collection and analysis of volcanic gas samples.* Bulletin Volcanologique, 39: 132.

Italiano, F. (2009): *Hydrothermal fluids vented at shallow depths at the Aeolian Islands: Relationships with volcanic and geothermal systems*. FOG - Freiberg Online Geoscience, 22, pp. 55-60.

Italiano, F. and Nuccio, P.M., 1991. *Geochemical Investigations of Submarine Volcanic Exhalations to the East of Panarea, Aeolian Islands, Italy.* Journal of Volcanology and Geothermal Research, 46(1-2): 125-141.

Planer-Friedrich, B., Matschullat, J., Merkel, B.J., Roewer, G. and Volke, P., 2002. *Development of a robust technique for sampling volatile metal(loid)s in wetlands.* Analytical and Bioanalytical Chemistry, 374(7-8): 1191-1198.

Sieland, R., Steinbrückner, D., Hamel, M., Merkel, B., Schipek, M. (2009). *Geochemical investigations and gas quantification of submarine fluid discharges in the hydrothermal system of Panarea (Aeolian Islands, Italy).* FOG - Freiberg Online Geoscience, 22, pp. 87-93.

Trace Element Hydrochemistry of Thermomineral Waters Located at Northwest of Karakoçan (Elazığ), Eastern Turkey

Öztekin Okan Ö., Kalender L., İnceöz M., Çetindağ B.

Fırat University, Faculty of Engineering, Geological Engineering Department 23119, Elazığ, Turkey

Abstract

The trace element distribution of cold waters and thermomineral waters has been investigated in this study. The aim of the study is to correlate the cold waters with thermomineral waters; to define the water-rock interaction mechanism and the source processes of thermomineral waters by trace element hydrochemistry. The effects of thermomineral waters to Peri creek has been investigated in this study, too.

In the investigated area from bottom to top Permo-Trias Keban Metamorphites, Lower Miocene Alibonca Formation, Upper Miocene- Lower Pliocene Karabakır Formation and Quaternary alluvium and travertines are present. The aquifer formation of thermomineral waters is the recrystallized limestones of Keban Metamorphites.

Kolan, Bağın, Sülüklü and Ilıca thermomineral springs have been investigated in this study. The temperature, pH and electrical conductivity (EC) of the thermomineral springs range from 17.2 to 45^{o}C; 5.86 to 6.48 and 1020 to 4953 µS/cm, respectively. The temperature of Sülüklü spring is 17.2 ^{o}C. This spring is investigated as thermal spring, because according to IAH (International Association of Hydrogeologists) if the temperature of a spring is upper 6^{o}C than the annual average temperature of the region its named as thermal spring and the temperature of Sülüklü spring is 6^{o}C upper than the annual average temperature (11.1^{o}C) of Karakoçan region.

In general, As, B, Br, Fe, Li, P, Rb, Sc, Si, Sr concentrations are higher; Al, Be, Co, Cs, Cu, Ge, Mn, Pb, Te, U, V, Zn and Zr concentrations are lower than 100 ppb in thermomineral waters. Te, U, V, Zr concentrations are lower than 1 ppb in investigated waters. B concentration reachs up to 10503 ppb in some thermomineral waters. The high concentrations of B should be derived from the dissolution of borate minerals of andesite and basalts of Karabakır formation. Boron and the other ion concentrations of Sülüklü thermomineral water is high but its temperature is low, relatively. The reason of this low temperature might be the mixture of Ohi creeks cold water to Sülüklü thermomineral water. The As concentration of thermomineral waters range from 84.2 ppb to 5933.3 ppb and much higher than the cold waters. The As, Sb and Pb concentrations of thermomineral waters are higher than the maximum limits of The Regulation of Natural Mineral Water Standarts of Turkey (2004) and WHO (World Health Organization)'s mineral water standarts. The thermomineral waters of Karakoçan are mostly appropriate for bathing, swimming and balneological purposes. But, they are not appropriate to be used for drinking.due to the higher concentrations of As, Sb and Pb.

The concentrations of Al, As, B, Br, Co, Cu, Fe, Li, Mn, Si,Sr, V, Sn, Cs, Zr of Peri creek increase at the points that thermomineral waters discharge to the creek, but these concentrations don't exceed the maximum limits of the Regulation of Surface Water Standarts of Turkey (2004) .

The Weddell Seal's (Leptonychotes Weddellii) Underwater Vocalizations in Shallow Water beneath the Ross Sea Fast Ice (Antarctica) during Lactation

Palozzi R.[1,3], Buscaino G.[2], Quartararo M[1]

[1]*Dipartimento di Biologia, Università di Roma "Tor Vergata"*
[2]*Istituto Ambiente Marino Costiero di Capo Granitola, CNR*
[3]*Dipartimento di Tecnologie, Ingegneria e Scienze dell'Ambiente e delle Foreste (DAF), Università della Tuscia*

Abstract

The Weddell seal's (Leptonychotes weddellii) underwater vocalizations have been the subject of several scientific papers since '70s, but very few of them dealt with the sounds given out by these pinnipeds beneath the ice during the critical period from the parturition to the weaning of the newborns (lactation). In particular this study tried to give the first quantitative description of the Weddell seal's vocalizations in the first 15 meters of water beneath the Ross Sea fast Ice (Antarctica) during lactation. The vocalizations were recorded on professional HDV tapes by an hydrophone positioned in several breathing holes of a large breeding colony, from the first to the fifth weeks of lactation in October/November 2007. Acoustic data were processed by both a traditional methodology using the Avisoft Bioacoustics sound analysis software and an innovative approach based on an unsupervised neural network, the Kohonen Self-Organizing Map (SOM). Signals ranged between 0.1 and 20 kHz and have different types of structures, from impulsive to whistle, that indicated a great complexity in the intra-specific behavioural relationships of the Weddell seals. Moreover these quantitative results were coupled with the diving data of 16 lactating females and 8 dependent pups recorded by Time Depth Recorderds (TDRs) in the same breeding colony during lactation in the australis summers 2006 and 2007. They showed that vocalizations played a major role in the development of the mum-pup pair behavioural dynamics and in the breeding interactions among adults, but also a lesser importance in the underwater mum-pup's recognition and in the foraging activity. This study began to shed light on the behavioural significance of the Weddell seal vocalizations and their ecological role in such a specific and topical period (lactation) for the newborns survival.

The Underwater Ecological Survey of a Historic Sink-Hole in the Central Italy by Means of Stable Isotope Analysis and Scientific Diving Techniques

Palozzi R.[1,2], Congestri R.[2], Quartararo M.[2], Marcelli M.[3], Sprovieri M.[4], Rumolo P.[4], Kirin T.[1], Laiou A.[1], Tomasino M.P.[1] and Schirone B.[1]

[1]*Dipartimento di Tecnologie, Ingegneria e Scienze dell'Ambiente e delle Foreste (DAF), Università della Tuscia*
[2]*Dipartimento di Biologia, Università di Roma "Tor Vergata"*
[3]*Dipartimento di Biologia Animale e dell'Uomo, Università di Roma "Sapienza"*
[4]*Istituto Ambiente Marino Costiero – CNR Napoli*

Abstract

Lake Paterno is a 54 m deep karstic sink-hole located in the Central Italy within the San Vittorino plane (Rieti Province), a 7 km^2 depression characterized by a complex system of active fault lines and massive springs. Unlike other sink-holes that opened more recently in the plane, lake Paterno is very well known since pre-roman age and it has been documented by several classical authors who defined it "Umbilicus Italiae". The Roman emperor Flavio Vespasiano (the Colosseum builder) died for an illness contracted after a swim in its waters. Even so the ecology and the biology of this ecosystem, as peculiar as affected by human activities, were never detected and described before. This study began to fill this gap by an extensive underwater ecological survey led by scientific divers from the surface to the bottom of the sink-hole during the summer 2010. Researches reported a euphotic layer from surface to 14-16 m (depending on weather condition) and two clear thermo-clines in the first 8 m of depth, with a sharp temperature drop and no life forms visible by naked eye beyond them. The only exception were some biological theca (not determined yet) which were collected in a small ledge on the vertical limestone wall at 16 m. The first thermo-cline (at about 4.5 m) seemed to define the lower limit of the portion of water column used by the fish and macro-invertebrate populations, while the second one (at about 8 m) represented the lower bound of the macrophytes (above all Myriophyllum verticillatum L. – predominant -, Utricularia vulgaris L. and Ceratophyllum demersum L.). The macroflora and microalgal determination as well as stable Carbon – Nitrogen isotope analyses supported the underwater observations, contributing to better describe the overall spatial use by fish populations and to preliminarily build a trophic web for lake Paterno, that resulted to be dominated by alien fish species and deeply affected by the anthropic interferences. In particular, the phytoplanktic assemblage at surface was dominated by few species of thecate dinoflagellates and green algae, both unicellular colonial and filamentous forms. 5 aquatic plant species were recorded on the water surface and the terrestrial flora surrounding the lake included 52 species. A modified visual census (VC) technique – integrated by High Definition video census – was carried out on 6 different fixed transects (each 50 meters long), in the depth range of 0-4.5 m both during morning and afternoon. Data were first statistically analyzed by traditional univariate and multivariate methods and then processed by artificial intelligence or machine learning methods (namely, supervised and unsupervised neural networks), to determine the fish habitat preferences within the lake. The analyses revealed a very depleted fish specific diversity, with the predominant presence of the invasive species Rutilus rutilus L. (never reported before in this lake), that could probably be the major cause of the almost complete decline of all the other species of cyprinids. VC also showed a clear preferential distribution of the three most numerous species (R. rutilus L., Micropterus salmoides Lac. and Lepomis gibbosus L.) along the transects. Tinca tinca L. and the freshwater crab Potamon fluviatile Herbst were observed sporadically. The multidisciplinary approach of this study seemed to highlight that the direct and indirect impacts of the summer tourism and the recreational fishing activities are among the main causes of the heavy and worryingly loss of biodiversity in lake Paterno. That is why this preliminary ecological survey wants to be the first step of a multi-seasonal scientific project aimed at writing a thorough and effective ecological restoration and management plan of the sink-hole and the surrounding area.

Geothermal Energy from Offshore Resources: The Marsili Seamount Project Becomes Reality

Paltrinieri D.

EUROBUILDING SpA, via dell'Artigianato n. 6 Servigliano, 63029, Fermo, Italy

Abstract

At the present, the exploration and exploitation of geothermal reservoirs for power generation in Italy is focused in two main areas located in the Tyrrhenian pre-Apennine volcanic district of Southern Tuscany: Larderello and Mt. Amiata. Geothermal exploration was performed in Latium, Campania and Sicily by a joint-venture ENEL-AGIP in the '70s and '80s; great geothermal potential was discovered but the high salinity of the geothermal fluids hindered the development of these areas. In order to improve the Italian geothermal power generation, Southern Tyrrhenian volcanic district is now considered the new target of geothermal exploration and exploitation programs in Italy. Numerous submarine volcanic centers are present in this area (Figure 1, up-right), providing important heat sources; heat flow anomalies (Figure 1, up-left) are comparable to those of onshore geothermal fields. Fractured basaltic rocks facilitate seawater infiltration and consequent circulation of hot water chemically altered by rock/water interactions, as evidenced by the diffused presence of hydrothermal deposits in the whole area. In this context, a geothermal exploration program of the Marsili seamount, the largest submarine volcano in Tyrrhenian sea, started in 2006. Multibeam swath bathymetry, magnetic and gravity surveys, seismic and acoustic monitoring by means of OBS/H, water and bottom sampling were performed, providind more geological, geophysical and petrological data towards the geothermal potential characterization of the submarine volcano.

Results can be summarized as follows:

1) Marsili seamount is a shallow and intense heat source, supplied by hot magmatic bodies (see heat flow anomalies in comparison with magnetic anomaly map, Figure 1, down-left);
2) Marsili can be expected to possess an intense geothermal fluid circulation, as evidenced by trectonic activity (seismological data) and the new gravity data (Figure 1, down-right);
3) The present state of Marsili volcano is still controversial, i.e. active vs quiescent, although several data indicate extremely recent magmatic and related processes (possibly thousands of years before Present).

Further research is foreseen to better characterize the whole volcanic-geothermal system. Localization of active venting sites and hydrothermal fluid release with physical and chemical characterization must be performed; this is one of the main purposes of a future cruise on Marsili submarine volcano. If strong evidences of exploitable geothermal reservoirs are found, the Marsili seamount will become an important and long-lasting offshore geothermal energy resource, capable to double the Italian onshore geothermal power generation. Moreover, this will open a new scenario in the exploration and exploitation of geothermal energy resources, representing the first potential pilot experiment for offshore geothermal power generation in Italy and significantly contributing to the research of new energy resources worldwide.

References.

Caso, C., Signanini, P., Desantis, A., Favali, P., Iezzi, G., Marani, M.P., Paltrinieri, D., Rainone, M.L., Di Sabatino, B., 2010. *Submarine Geothermal Systems in Southern Tyrrhenian Sea as Future Energy Resource: the Example of Marsili Seamount.* Proceedings World Geothermal Congress 2010, Bali, Indonesia, 25-29 April 2010.

Della Vedova, B., Bellani, S., Pellis, G., Squarci, P., 2001. *Deep temperatures and surface heat flow distribution.* In: Vai, G.B., Martini, I.P. (eds.), "Anatomy of an Orogen: the Appennines and adjacent Mediterranean basin", Kluwer Academic Publishers, Great Britain, 65-76.

Marani, M.P., Gamberi, F., 2004. *Distibution and nature of submarine volcanic landforms in the Tyrrhenian Sea: the arc vs the backarc*. Mem. Descr. Carta Geol. D'It., XLIV, 109-126.

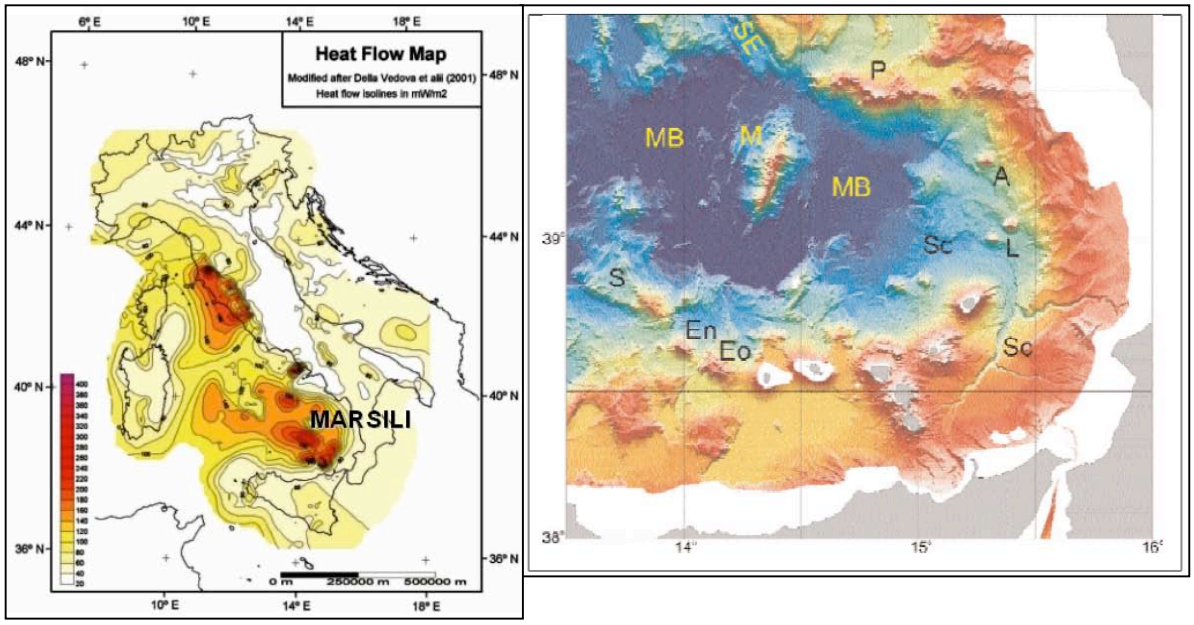


Figure 1. (left) heat flow map of Italy and offshore areas (modified after Della Vedova et al., 2001). (right) Bathimetric map of South-Eastern Tyrrhenian Sea. MB: Marsili Basin; M: Marsili seamount; P: Palinuro; A: Alcione; L: Lametini; Sc: Stromboly canyon; Eo: Eolo; En: Enarete; S: Sisifo (modified after Marani and Gamberi, 2004).

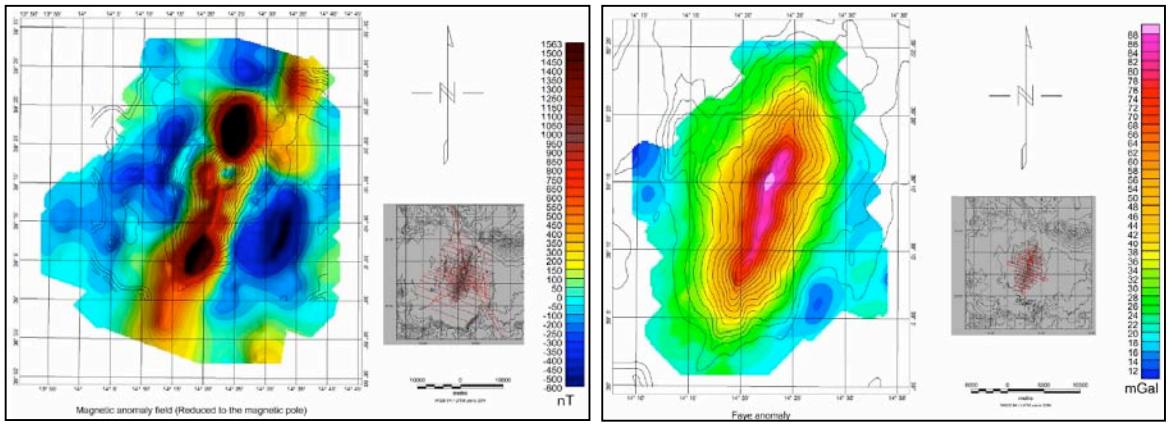


Figure 2. (left) Magnetic anomaly map of Marsili seamount (modified after Caso er al., 2010): the observed anomalies are related to basaltic rocks, hydrothermal alteration and shallow magmatic bodies. (up-right) Gravity anomaly map of Marsili seamount (modified after Caso er al., 2010): the anomaly field fit with low-density bodies, supporting the presence of fractured rocks filled with fluids.

Arsenic-biogeochemical Cycle in Aerobic Heterotrophic As(V)-reducing and Anaerobic Dissimilatory As(V)-respiring Bacteria Isolated from Sediments of Orbetello Lagoon, Italy

Pepi M.[(1)], Focardi S.[(2)], Ruta M.[(1)], Bernardini E.[(1)], Gasperini S.[(1)], Focardi S.E.[(1)]

[1]*Department of Environmental Sciences, University of Siena, Via P.A. Mattioli, 4 - 53100, Siena, Italy*
[2]*Department of Chemistry, University of Siena, Via A. Moro, 2; 53100, Siena, Italy*

Abstract

Sediments of the Orbetello Lagoon showed contamination by arsenic as consequence of anthropogenic activities and geological reasons. Arsenic toxicity and its mutagenic potential have been extensively studied. Different bacterial strains are well known for arsenic-resistance and capability to growth in the presence of this toxic element. Ten arsenic-resistant bacterial strains, aerobic and heterotrophic, were previously isolated from polluted sediments and assigned to the genera *Bacillus*, *Aeromonas* and *Pseudomonas*. Kinetics of As(V)-reduction, with production of As(III), were tested according to the molibdenium colorimetric method. At the same time, growth of the bacterial strains was revealed by measuring the optical density at a wavelength of 600 nm. As(V) reduction in the bacterial cultures, with the concomitant production of As(III), was pointed out in the cultures of the isolated bacterial strains. Two millimolar of As(V) added as $NaAsO_4.7H_2O$ were reduced to As(III) within 24 to 48 hours of incubation at 28°C, depending on the biomass increase of the different arsenic -resistant bacterial strains. From each bacterial strain, chromosomal DNA was extracted according to the phenol method, and plasmid DNA was extracted according to alkaline lysis. Primers for *arsA*, *arsB* and for *arsC* forward and reverse genes were used to amplify the *ars* operon genes in the ten arsenic-resistant bacterial strains. From the same sediments an anaerobic bacterial strain was isolated from the deeper portion, showing the ability to respire arsenate As(V) and sulphate (SO_4^{2-}), using lactate as an electron donor, with production of an yellow precipitates observed around colonies. The isolated bacterial strain was previously assigned to the genus *Desulfosporosinus*. The precipitate was analyzed by scanning electron microscopy (SEM) revealing rod-shaped bacterial cells inside of the precipitate, with net-like formations strictly adhered to the bacterial cells. Transmission electron microscopy (TEM) also highlighted precipitates inside the bacterial cells and on their surface. EDX analyses of the precipitate showed the presence of arsenic and sulphur in it. The study of the features of the different isolates, both arsenic-resistant and arsenic-respiring bacteria provides novel insight for their possible role in arsenic biogeochemical cycle in sediments of the Orbetello Lagoon.

Arsenic is a toxic element widespread in the environment, released both from natural and anthropogenic sources, from the weathering of rocks or by mining industries and agricultural practices. This metalloid is found in the oxidation states +5 (arsenate), +3 (arsenite), 0 (elemental arsenic), and -3 (arsine). Arsenic has been classified as a human carcinogen by the International Agency for Research on Cancer (IARC 1987). The two most common oxidation states of arsenic in the environment are the pentavalent As(V) and trivalent As(III) forms (Cullen and Reimer 1989). As(III) is more toxic and can inhibit various dehydrogenases (*e.g.*, pyruvate, α-ketoglutarate, and dihydrolipolate) (Ehrlich 1996), arsenite (AsO^{2-} or AsO_3^{2-}) is able to bind sulfhydryl groups of proteins and dithiols such as glutaredoxin. On the other hand, arsenate (AsO_4^{3-}) acts as a structural analogue of phosphate and inhibits oxidative phosphorylation by producing unstable arsenylated derivatives (Da Costa 1972). The arsenic biogeochemical cycle strongly depends on transformations by microorganisms, which affects the mobility and the distribution of arsenic species in the environment (Mukhopadhyay *et al.* 2002). While arsenic is generally toxic to life, it has been demonstrated that microorganisms can use arsenic compounds as electron donors, electron acceptors, or possess arsenic detoxification mechanisms (Stolz et al. 2002). Resistance to arsenic and metabolizing systems occur in three patterns, the widely-found *ars* operon present in most bacterial genomes and many plasmids, the more recently recognized *arr* genes for the periplasmic arsenate reductase functioning in anaerobic respiration as a terminal electron acceptor, and the *aso* genes for the periplasmic arsenite oxidase functioning as an initial electron donor in aerobic resistance to arsenite (Silver and Phung 2005).

The anaerobic respiration of arsenate involves its dissimilatory reduction as terminal electrons acceptor. This bacterial metabolism is widespread and metabolically active in nature. One of the first report of an arsenic-respiring bacterial strain concerned the strain MIT-13, a microorganism with the shape of a vibrio (Ahmann et al. 1994), subsequently named *Geospirillum arsenophilus* (Lovley and Coates 1997). The

reduction of sulphate concomitant to that of arsenate is not frequent. This combined reduction resulting in the generation of sulphide is an effective mechanism for the precipitation of toxic elements, including arsenic, reducing mobility and risk (Newman et al. 1997).

Arsenic contamination in the Orbetello Lagoon is mainly due to ash, dust, and debris, originating from a fertilizer production plant located on a bank of this lagoon. The fertilizer production plant, closed down in the late 1980's, used pyrite (FeS_2) containing high concentrations of As and other impurities like Zn, and Pb, as a raw material for the sulphuric acid production. The pyrite was extracted from the Colline Metallifere, a chain of hills located in an internal area of Tuscany, not far from the Orbetello Lagoon, which show anomalies in arsenic concentrations (Donati et al. 2005).

The aim of this work was to describe the role of arsenic-resistant and arsenic-respiring bacterial strains in the biogeochemical cycle of this metalloid. The microbiology of a shallow marine system related to the presence of a toxic elements could then gain insights, highlighting the different microbial metabolisms involved in arsenic transformation.

References

Ahmann D, Roberts AL, Krumholz LR, Morel FM (1994). *Microbe grows by reducing arsenic*. Nature 371, 750.

Cullen WR, Reimer KJ (1989). *Arsenic speciation in the environment*. Chem Rev 89, 713-764.

Da Costa EWB (1972). *Variation in the toxicity of arsenic compounds to microorganisms and the suppression of the inhibitory effects of phosphate*. Appl Environ Microbiol 23, 46-53.

Donati A., Pulselli F.M., Riccobono F., Dallai L., Francovich R. and Tiezzi E. (2005). *Origin of arsenic pollution in Southwest Tuscany: comparison of fluvial sediments. A*nn Chim 95, 161-166.

Ehrlich HL (1996). *Geomicrobiology, 3rd ed., revised and expanded.* Marcel Dekker, Inc., New York, NY: 276-294.

IARC (1987) International Agency for Research on Cancer (IARC) (1987) *Monographs on the evaluation of the carcinogenic risk to humans: arsenic and arsenic compounds (group I*). International Agency for Research on Cancer, Lyon 23, 100-103.

Lovley DR, Coates JD (1997). *Bioremediation of metal contamination*. Curr Opin Biotechnol 8, 285-289.

Mukhopadhyay R, Rosen BP, Phung LT, Silver S (2002) *Microbial arsenic: from geocycles to genes and enzymes.* FEMS Microbiol Rev 26, 311-325.

Newmann D.K., Kennedy E.K., Coates J.D., Ahmann D., Ellis D.J., Lovley D.R. and Morel F.M.M. (1997). *Dissimilatory arsenate and sulphate reduction in Desulfotomaculum auripigmentum sp. nov*. Arch Microbiol 168, 380-388.

Sambrook J, Fritsch EF, Maniatis T (1989). *Molecular cloning.* A laboratory manual, Second Edition., Laboratory Press, Cold Spring Harbour.

Silver S, Phung LT (2005) *A bacterial view of the periodic table: genes and proteins for toxic inorganic ions*. J Ind Microbiol Biotechnol 17, 1-19.

Stolz J, Basu P, Oremland R (2002) *Microbial transformation of elements: the case of arsenic and selenium*. Internat Microbiol 5, 201-207.

Water Chemistry, Carbon Isotopic Characterisation, Fluid-Rock Interaction Processes and New Estimates of Deep Temperatures in the Alban Hills Volcano, Central Italy

Pizzino L., Cinti D., Sciarra A., Quattrocchi F.

INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Sismologia e Tettonofisica, Roma, Italy

Abstract

Abstract. In the framework of a two-years (2005-2007) multidisciplinary project funded by the Italian "Dipartimento della Protezione Civile", a detailed geochemical survey in groundwater was carried out in the Alban Hills volcanic district (central Italy), sampling a total of 184 water sites (springs and wells). Physical-chemical parameters, main chemistry, minor and trace element contents, as well as dissolved gases, were analyzed. Moreover, isotopic analysis on dissolved carbon were performed. The study had the main goals to: i) characterise the chemical background of the discharging fluids, gathered in a period with low seismicity; ii) define the main gas-water-rock interaction processes presently ongoing, iii) discriminate the different origin of the dissolved carbon and iv) give reliable estimates of the deep aquifer temperatures, never performed till now.

The bulk of the samples fall in the field of the earth (alkaline)- bicarbonate waters, while some of them show alkaline-bicarbonate and acid-sulphate chemistry. Earth (alkaline)-bicarbonate waters have a relatively fast circulation in and a limited interaction with the shallow volcanic rocks in a low temperature environment; in some sectors of the volcano they receive a huge gas input from depth (mainly CO_2), increasing their salinity. Waters with longer interaction with volcanic rocks and/or clays, in presence of CO_2, evolve towards the alkaline-bicarbonate field. Acid-sulphate waters are formed by dissolution of acid and reducing gases (CO_2, H_2S) into oxygen-rich shallow aquifers and pools fed by rainwater. CO_2 and N_2 are the principal dissolved gases. Nitrogen, in particular, characterises shallow waters (atmospheric component), while calculated carbon dioxide isotope composition points out either an organic or a high-temperature deep origin. H_2S, He and H_2 show very low contents, while methane was found both in same CO_2-rich waters and shallow samples.

The main gas-water-rock interaction processes and their extent were assessed by means of activity plots. Waters can be divided into two main groups: i) earth (alkaline)- bicarbonate waters fall in the field of kaolinite, representing the early stage of the silicate weathering. They show undersaturation with respect to the main rock-forming minerals, and are considered as "immature"; ii) alkaline-bicarbonate waters show a partial equilibrium with the main clay minerals, representing an evolution towards more "mature" terms. Acid-sulphate waters are out of any equilibrium with the host rocks and were not considered. Physical-chemical parameters and observed chemistry fully fit this chemical scenario.

The estimate of deep temperatures, based on the applications of solute geothermometers, allowed to define the geothermal system beneath the volcano as characterised by a medium-low enthalpy, with temperatures comprised in the range 110-140°C.

Submarine thermal water and gas discharges from the Island of Panarea (Aeolian Archipelago, Italy): a geochemical and isotopic overview

New Polymeric Products Funcionalized for Oil Spill Cleanup: Polysolver

Plescia P.[(1)], Reale M.[(2)]

[1]*CNR IGAG Area della Ricerca di Roma 1, Via Salaria Km 29,300, 00016 Monterotondo Stazione, Roma, Italy*
[2]*GTA Srl – III strada Zona industriale, 7 - 95121 Catania, Italy*

Abstract

Different kinds of solutions have been offered and applied for oil spill cleanup in the Gulf of Mexico these last months, after the huge explosion in BP's Deepwater Horizon oil rig in the Gulf of Mexico on the night of 20th April 2010. As the platform collapsed into the sea, the environmental catastrophe made itself clear with vast amounts of crude oil gushing from the broken wellhead. Unfortunately, all efforts (barriers, dispersant and mechanical recovery) have resulted in modest results which were not yet sufficient to solve the problem. To effectively absorb oil from water is necessary to use raw materials that absorb large volumes of hydrocarbons and low volumes of water, and that can float and be easily retrieved. Among the materials suitable for this purpose there are the polyurethanes, sold normally in the form of foams. In this study we have modified the surfaces of the polymer chains of polyurethane foams to increase the absorption surface over the absorption volume. This will get oil absorption for more than 300 times the weight of the product. This paper presents how POLYSOLVER, a polymeric material with polyurethane powder can operate like a barrier and easily recover the oil spilt with an eco-friendly approach.

Small Scale Recent Sulfide Mineralization in a Shallow Submarine Environment

Pohl T.[(1)], Becke R [(2)], Ganß R.[(3)], Stanulla R.[(3)], Merkel B.[(3)]

[1]*GEO-Dive, Sachsenhofstraße 10, 09599 Freiberg, Germany*
[2]*Universität Bremen, Bremen,Germany*
[3]*TU Bergakademie Freiberg, 09599 Freiberg, Germany*

Abstract

During investigations of the shallow submarine hydrothermal system of Panarea, Eolian Island, Italy [Italiano & Nuccio1991, Italiano 2009, Sieland et al. 2009, Esposito et al. 2010, Hamel 2009], between the islets Dattilo, Lisca Nera, Bottaro, Lisca Bianca and Panarelli massive hydrothermal sulfide precipitation along gas exhalations and hydrothermal water vents were found. To gain a better understanding of the shallow-water massive sulfide deposits the location "Black point" and other sites (Point 21, Bottaro and Area 26) were mapped and sampled for mineralogical and geological evaluation.

An increasing number of sulfide precipitate aggregates were detected mostly rather close to small gas fumaroles in some cases without evidence of hydrothermal water. Galena, sphalerite, pyrite, and baryte are the most common minerals in these hydrothermal settings. They occur in form of porous sulphide crusts, but in the most cases as sediment-hosted, disseminated ore aggregates. Furthermore the appearance of Pb-As-sulfosalts was proved. Iron- and manganese-rich crusts were as well detected.

The dominant regional fault system is characterized by NNE-SSW trending extensional faults, often formed as small subsidence features with structured hot water flow channels and fumaroles (Fig. 1). The minor fracture system is SW-NE striking and often very poorly mineralized with elemental sulphur. The location Area 26 is characterised by a flat morphology in volcano-clastic rocks with different scaled xenoliths. These xenoliths are composites of laminated ore complexes, various volcanic rocks and a highly alterated sulphur matrix. The more than 60 cm deep structure of Fig. 1 was filled with coarse grained soft sediment which was removed for the documentation.

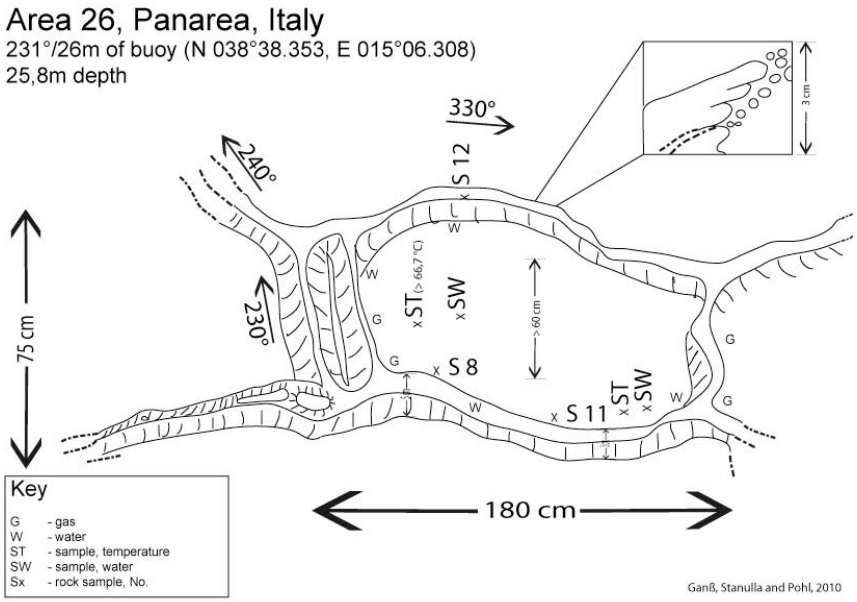


Figure 1. Mineralized extensional fracture at Area 26 with massive sulfide mineral pieces in soft sediment depressions at the NNW trending facture with significant hot water flow (W) and small fumaroles (G).

Zn, Pb, Ba, As, and Sr are dominant for the sulphide crusts while Fe and Mn are the most abundant elements in the iron- and manganese crusts [Becke 2009, Becke et al. 2009]. Furthermore at Area 26 several small scale porous sulphide crusts and disseminated ore aggregates in different morphological forms were detected: on the one side both tiny active fumaroles and clogged fumaroles (sealed by precipitates) within ore aggregates and on the other side obviously rather new fumaroles just starting to precipitate small chimneys without ore aggregates (Fig. 2). All deposits are apparently linked to the adjacent fracture zone. Because no hot water flow could be detected at this type of structures, it can be speculated that volatile metals or aerosols in the gas-phase are the key to understand the formation of this ore aggregates. This is in

accordance with the finding of volatile metals and/or aerosols (in particular Ni, Cu, Zn, Fe, and Ba) in some fumaroles of Panarea [Merkel et al. 2010]. However, this is in contradiction to the general assumption that besides the exception of Hg metals and metalloids in the vapor phase are negligible [Barnes and Seward 1997]. On contrary, experiments reported by Kruszewski & Wood (2009) suggest that significant Bi transport is possible in the vapor phase at temperatures of 220°C.

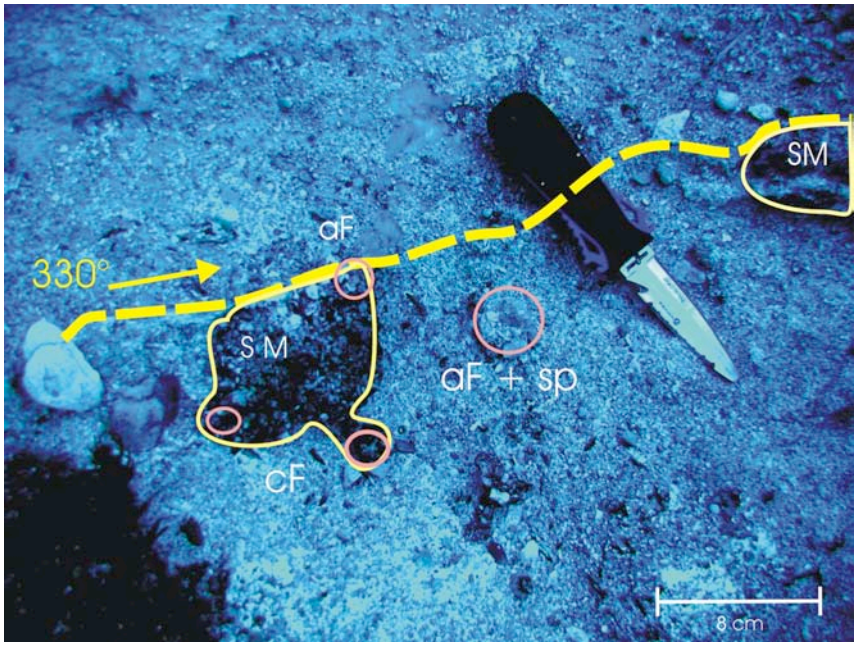


Figure 2. Sulfide mineralization (SM) at the NNW trending facture (yellow line) with an active small fumarole (aF), a clogged fumarole pipe (cF), and an active fumarole forming recently a new pipe (sp).

References

Barnes HL, Seward TM (1997). *Geothermal systems and mercury deposits*. *In* Geochemistry of *HydrothermalOre Deposits*. Barnes HL (ed.), Wiley, p 699-736

Becke, R., Merkel, B., Pohl, T. (2009). *Mineralogical and geochemical characteristics of the shallow water massive sulfide precipitates of Panarea, Aeolian Islands, Italy*. FOG - Freiberg Online Geoscience, 22, pp. 93-100.

Becke, R. (2009). *Mineralogische & Geochemische Untersuchung von submarinen, vulkanogen-hydrothermalen Mineralpräzipitaten im back-arc-basin des Tyrrhenischen Meeres am Beispiel von Panarea, Äolischer Inselbogen, Italien.* Diploma-Thesis (unpublished). 172

Esposito, A., Anzidei, M., Atzori, S., Devoti, R., Giordano, G., Pietrantonio, G. (2010). *Modeling ground deformations of Panarea volcano hydrothermal/geothermal system (Aeolian Islands, Italy) from GPS data.* Bull Volcanol, 72:609–621.

Hamel, M. (2010): *Investigation and modelling of the geochemical processes in the hydrothermal system of Panarea, Italy.* FOG - Freiberg Online Geoscience, 25, pp. 115.

Italiano, F. (2009): *Hydrothermal fluids vented at shallow depths at the Aeolian Islands: Relationships with volcanic and geothermal systems*. FOG - Freiberg Online Geoscience, 22, pp. 55-60.

Italiano, F. and Nuccio, P.M., (1991): *Geochemical Investigations of Submarine Volcanic Exhalations to the East of Panarea, Aeolian Islands, Italy.* Journal of Volcanology and Geothermal Research, 46(1-2): 125-141.

Merkel B., Planer-Friedrich B., Pohl T., Schipek M (2010): *Development of a gas sampling technique for determining trace elements in submarine volcanic exhalations.* This issue

Sieland, R., Steinbrückner, D., Hamel, M., Merkel, B., Schipek, M. (2009): *Geochemical investigations and gas quantification of submarine fluid discharges in the hydrothermal system of Panarea (Aeolian Islands, Italy).* FOG - Freiberg Online Geoscience, 22, pp. 87-93.

Discharge Measuring of Massive Gas Emissions at Panarea, Italy

Ponepal M.[(1)], Barth G.[(1)], Fütterer W.[(2)], Schipek M.[(1)], Merkel B.J.[(1)]

[1]*TU Bergakademie Freiberg, Gustav-Zeuner-Str. 7, 09599 Freiberg, Germany*
[2]*TU Bergakademie Freiberg, Leipziger Str. 23, 09599 Freiberg, Germany*

Abstract

Measuring the amount and variations of submarine gas exhalations in volcanic and geothermal systems in the long term is a challenge. Scientists and students of the TU Bergakademie Freiberg are working since 2006 to develop a so-called FSVG (Flow-meter for submarine volcanic gas emissions). A complete redesign was realized in 2010. In September 2010 for the first time ever it was possible to get reliable readings for a couple of days at Point 21, Panarea, Italy.

Introduction

The Aeolian Islands, located in the north of Sicily, Italy, consist of seven major islands and several associated seamounts [Chiodini et al. 2006; Gugliandolo et al. 1999]. The mainly submerged Panarea volcanic complex is composed of a wide (70 km²), near-circular platform bounded by a shelf break at a depth of 120 – 130 m (Marani et al. 1997).

Hydrothermal activity in the Panarea area is reported since 2000 years, however the first scientific report is from 1991 [Italiano and Nuccio 1991] investigating gas vents and hot brines. The last crises with a massive increase of the exhalations in November 2002 were reported in detail by Caracausi et al. (2005), Esposito et al. (2006), and Chiodini et al. (2006). At Panarea, submarine exhalations of magmatic CO_2 are located to the east of the island – mainly along a NE-SW strike direction [Chiodini et al. 2006]. The most intensive exhalations are located at the sea-bottom among some islets which represent the subaerial remnant of an old caldera.

Motivation

So far no approved standard method is known for online monitoring of submarine gas exhalations. Quantification of submarine gas exhalations is amongst others based on rare measurements by scuba divers. Detecting submarine gas vents by means of ultra sounding is a common technique [Dando et al. 1995; Etiope et al 2000, Schroot and Schuttenhelm 2003] but attempts using ultra sounding to quantify gas exhalations yielded so far with poor results [Dando et al 1995]. An acoustic scintillation counter was used to monitor submarine geothermal fluids [Di Lorio et al. 2005, Heinicke et al. 2009]. Scientific divers have used flipped over buckets or bottles counting after how many seconds water was replaced by gas for small and medium sized gas vents [Dando et al 1995, Italiano and Nuccio 1991, Steinbrückner 2009] but this technique does not provide data over time and is not suitable for massive gas emissions. In most cases results are based on projection from random readings [Caliro et al 2004, Italiano and Nuccio 1991].

Long-term recording of submarine gas exhalations at shallow depths are difficult due to harsh conditions, highly corrosive water, impact of waves, tidal currents, fishering nets, anchors, and vandalism attacks. Low power consumption, non mechanical probes and large data memories are the basic constrains for long-term records. A special problem is faced in case of hot fumaroles due to fast and intensive growth of bacterial mats One goal of the research presented here was to validate a simple and robust technique having a potential for continuous monitoring of submarine gas vents taking into account vents of different size. Submarine gas vents may change in intensity for different reasons like tide, current, geothermal, volcanic, or tectonic activities in the underlying water bodies or the magma. Therefore detection of changes in the flow of submarine gas vents must be sensitive in order to be able to distinguish between the possible reasons. This requires amongst others the monitoring of parameters like current of seawater and tides and data about seismic, tectonic, and volcanic activities.

Methodology

The basic working principle of the FSVG was already tested and used since 2006 [Bauer et al. 2009]. Nevertheless to improve reproducibility and refractiveness the whole device was newly engineered and built (Fig.1). A gas funnel with an inlet diameter of 40 cm made from soft polyvinylchloride (PVC) sheet was directly placed on the top of a fumarole by a ring of concrete. To fix the measuring device on the sea bottom a mass of about 90 kg of concrete is needed. Divided into three parts of 120 degrees, it was possible to transport every unit by a scuba diver with a lift bag. Under water, the three parts were connected with each other by special cable ties. For production of these parts a high performance concrete BETEC® Multiflow 600 from Grace Construction Products, Germany, was used.

All pipes and pipe connecting parts were made from PVC-U which is very resistant against acids and withstand permanent temperatures until 60 °C. Furthermore PVC parts are well known in plant engineering in the chemical industry. Thereby a large range of pipe fittings like angles and screw joints is available. The application of these parts allowed a construction nearly without metallic components, which wouldn't be corrosion resistant in long-term application.

Once flowing through the funnel the gas enters the central main pipe. This pipe works as gas buffer and first gas-water separation facility. From the top of the main pipe the gas flows through a second pipe construction with much smaller diameter as second gas-water separation facility before reaching the measuring section. This section consists of two impeller fixed on a shaft made from polyoxymethylene (POM). Synthetic bearings xiros® B180 from igus® allow bedding without metallic parts and lubricants. The only metallic part in the section of measurements is a neodymium magnet in form of a ring. To avoid corrosion, this part is completely jacketed by acid resistant epoxy casting resin. The last section where the gas needs to flow through is the exhalation pipe to generate the gas pressure for filling the main pipe and thereby allowing a permanent gas flow through the device.

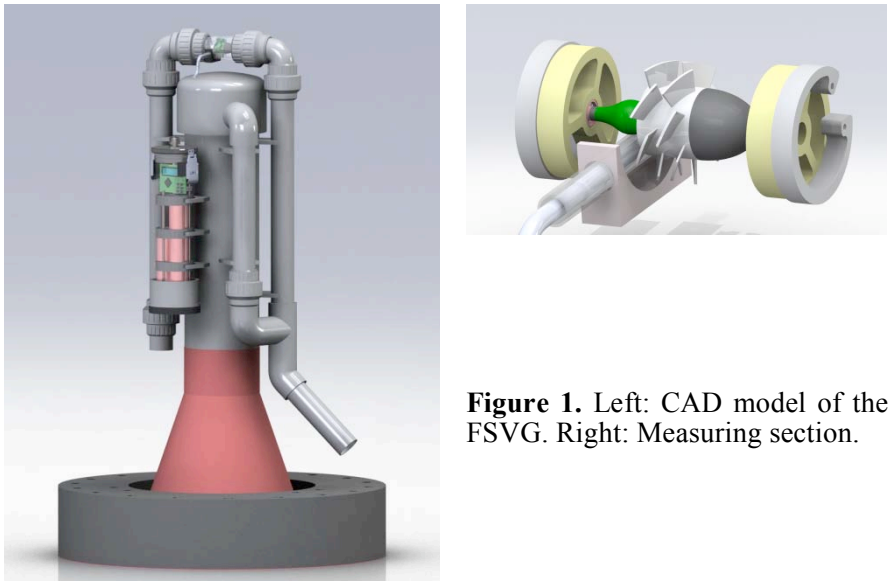


Figure 1. Left: CAD model of the FSVG. Right: Measuring section.

Using a small pipe of 10 mm diameter as sensor housing allows building a device which is next (< 5 mm) to the rotating magnet in the measuring section. By this, it is possible to remove the sensor unit with data logger without disturbing the gas flow. To protect the hall-sensor and temperature sensor from sea water and moisture, the whole housing was filled with polyurethane potting compound. The signals collected by the sensor are read by the electronics board which is placed in the electronics box mounted parallel to the main pipe. Six readings are logged per sampling interval (30 seconds), between the measurements the sensor is in sleep-mode.

Additional to rpm (revolution per minute) the temperature in the sensor and the temperature at the board are logged in the same interval. In this way the temperature at the flow metering point and the temperature of the surrounding water are known. For further evaluation of the sampled data the median of the six readings per interval is calculated and transformed with calibration coefficients into volume flow. The power supply and the capacity of the data logger allows an operation time of more than one year.

First tests

The flow rate measuring system was successfully applied to record variations in gas emissions in the submarine hydrothermal system of Panarea at “Point 21” (Fig. 2).

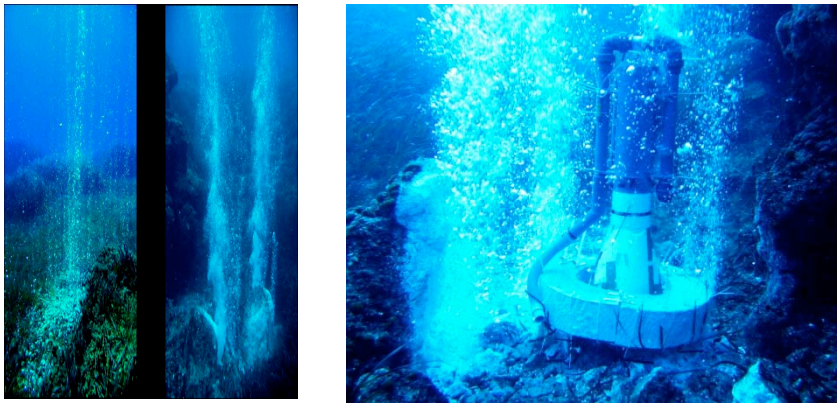


Figure 2. Point 21. Before the 2002 event Point 21 has been described as the main exhalation point. Maximum depth is 21 m and five big fumaroles are sitting in an area of less than 40 m².

Figure 3 displays monitored gas flow (09/05/2010 – 09/07/2010) as well as tidal data (water pressure) and temperatures. Sampling point was one out of five massive gas emissions at the location Point 21, Panarea (water depth 21 m). Tidal data were obtained by the use of a MCTD-Diver (Van Essen Instruments, range 0 – 100 m).

All data were smoothed by using a FFT filter (Low Pass, cutoff percentage 3). The flow rate was varying between 50 l/min during high tide and 80 l/min during low tide.

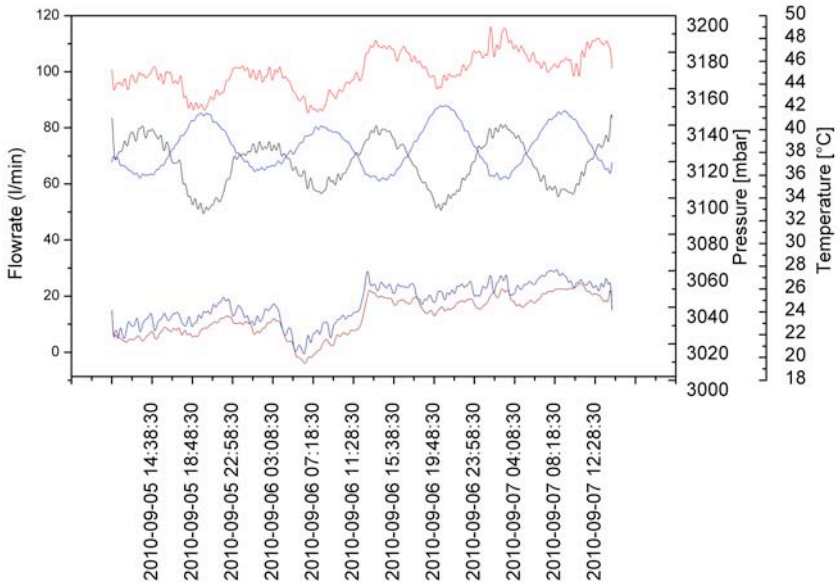


Figure 3. Flow rate variations (black) recorded from 09/07/2009 – 09/11/2009, Point 21, Panarea. Blue curve represents tidal waves. Red curve represents temperature within the measuring section. Purple / Blue curve represent recorded temperatures of surrounding water/ electronic housing.

Tidal influences are obviously, gas emissions are inversely correlated with tidal water level (Pearson Correlation Coefficient -0.96546, Figure 4). Additionally, the gas emission is positively correlated with the temperature inside the measuring housing (Temperature $_{impeller}$) showing a Pearson correlation coefficient of 0.62333 (Figure 5).

The convective heat transfer is described by $q = \alpha \cdot (t_{fluid} - t_{wall})$. Because the heat-transfer coefficient is depending on the gas velocity this coefficient is changing as well as the temperature at the gas outlet with varying gas flow. Thus on contrary knowing the Inlet-, outlet-, and the surrounding temperature it is possible to calculate the gas volume without an impeller. Further test in this direction are under investigation.

Besides the major impact by tidal waves, smaller variations are visible in Figure 3. It must be considered that other, complex factors such as weather influence and currents affect the quantity of gas emissions at the sea bottom. During our investigations stormy weather occurred from 09/04/2010 to

09/05/2010, a period not shown in Figure 3. However, one can see from figure 3 that with weather calming the temperature in the surrounding sea water increased by ~2°C. Additional, due to less wind induced waves the unfiltered signal (data not shown here) were significant less noisy.

.

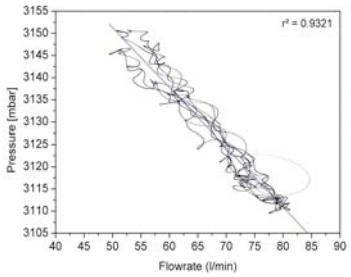


Figure 4. Tidal waves (pressure variations in mbar) vs. flowrate (in l/min). Blue line represents linear fitting.

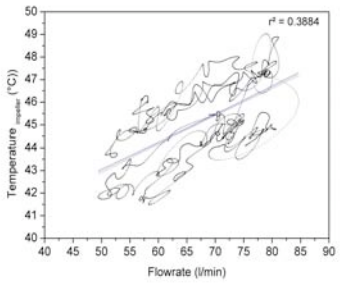


Figure 5. Temperature impeller (in °C) vs. flowrate (in l/min). Blue line represents linear fitting.

Outlook

Long-term records of variations in the flow rates of submarine volcanic gas emission are rarely presented in literature. A first application at Panarea provides an important insight into short-term variations of gas discharge. Besides influence by earth tides, fluctuations can be monitored by long-term records. In future, flow rate measurements will be combined with CO_2 and H_2S measurements [see Schipek et al. 2010]. First results will be available by October 2010.

References

Bauer, K., Bauer, D., Fütterer, W. and Kleutges, J., 2009. *Flow rate measurements at submarine volcanic gas emissions*. FOG Freiberg Online Geology, Vol. 22, pp. 112-117

Caliro S., Caracausi A., Chiodini G., Ditta M., Italiano F., Longo M., Minopoli C., Nuccio P.M., Paonita A., Rizzo A., 2004. *Evidence of a recent input of magmatic gases into the quiescent volcanic edifice of Panarea, Aeolian Islands, Italy*. Geophys. Res. Lett., 31, 7, doi: 10.1029/2003GLO19359

Caracausi A., Ditta M., Italiano F., Longo M., Nuccio P.M., Paonita A. (2005) *Massive submarine gas output during the volcanic unrest off Panarea Island (Aeolian arc, Italy): inferences for explosive conditions*. Geochemical Journal, 39, 5, 449-467

Chiodini G, Caliro S, Caramanna G, Granierei D, Minopoli C, Moretti R, Perotta L, Ventura G (2006) *Geochemistry of the Submarine Gaseous Emissions of Panarea (Aeolian Islands, Southern Italy): Magmatic vs. Hydrothermal Origin and Implications for Volcanic Surveillance*. Pure appl. geophys. 163, 759–780

Dando, P.R., Hughes, J.A., Leahy, Y., Niven, S.J., Taylor, L.J. and Smith, C., 1995. *Gas Venting Rates from Submarine Hydrothermal Areas around the Island of Milos, Hellenic Volcanic Arc.* Continental Shelf Research, 15(8): 913-929

Di Lorio, D., Lemon, D. and Chave, R., 2005. *A self-contained acoustic scintillation instrument for path-averaged measurements of flow and turbulence with application to hydrothermal vent and bottom boundary layer dynamics*. Journal of Atmospheric and Oceanic Technology, 22(10): 1602.

Esposito, A., Giordano, G. and Anzidei, M., 2006. *The 2002-2003 submarine gas eruption at Panarea volcano (Aeolian Islands, Italy): Volcanology of the seafloor and implications for the hazard scenario*. Marine Geology, 227(1-2): 119-134.

Etiope, G., Italiano, F., Fuda, J.L., Favalli, P., Frugoni, F., Calcara, M., Smriglio, G., Gamberi, F. and Marani, M., 2000. *Deep submarine gas vents in the Aeolian offshore*. Physics and Chemistry of the Earth Part B-Hydrology Oceans and Atmosphere, 25(1): 25-28.

Gabbianelli, G., Gillot, P.Y., Lanzafame, G., Romagnoli, C. and Rossi, P.L., 1990. *Tectonic and volcanic evolution of Panarea (Aeolian Islands, Italy)*. Marine Geology, 92(3-4): 313-326.

Gugliandolo, C. et al., 1999. *Submarine hydrothermal vents of the Aeolian Islands: Relationship between microbial communities and thermal fluids*. Geomicrobiology Journal, 16(1): 105-117.

Heinicke, J, Italiano, F., Maugeri, R., Merkel, B., Pohl, T., Schipek, M. and Braun, T., 2009. *Evidence of tectonic control on active arc volcanism: The Panarea-Stromboli tectonic link inferred by submarine*

hydrothermal vents monitoring (Aeolian arc, Italy); Geophysical Research Letters, 36. 36, L04301, doi:10.1029/2008GL036664.
Italiano, F. and Nuccio, P.M., 1991. *Geochemical Investigations of Submarine Volcanic Exhalations to the East of Panarea, Aeolian Islands, Italy*. Journal of Volcanology and Geothermal Research, 46(1-2): 125-141.
Marani, M.P., Gamberi, F. and Savelli, C., 1997. *Shallow-water polymetallic sulfide deposits in the Aeolian island arc*. Geology, 25(9): 815-818.
Schipek, M, Schulz, S. and Merkel, B.J. (2010): *Continuous monitoring of dissolved CO_2 and H_2S: Technical application in the submarine hydrothermal system of Panarea, Italy.* This issue
Schroot, B.M. and Schuttenhelm, R.T.E., 2003. *Shallow gas and gas seepage: expressions on seismic and other acoustic data from the Netherlands North Sea.* J Geochem Explor, 78-9: 305-309.
Steinbrücker D. (2009): *Quantification of submarine degassing of Panarea Volcano in the Aeolian archipelago, Italy* . FOG Freiberg Online Geology, Vol. 23, pp 1-113

AIOSS and the Italian Route for the Professional Scientific Diving Recognition within the EU Framework

Ponti M.[(1)], Acunto S.[(2)], Terlizzi A.[(3)], Caramanna G.[(4)], Cerrano C.[(5)]

[1]*CIRSA, University of Bologna, Via S. Alberto 163, 48123, Ravenna, Italy*
[2]*MaREA, via Fagiana, 3, 56121 Pisa, Italy*
[3]*DiSTeBA, University of Lecce, V.le Gallipoli 49, 73100 Lecce, Italy*
[4]*CICCS, University of Nottingham, Nottingham NG7 2R, UK*
[5]*DipTeRis, University of Genoa, Corso Europa 26, 16132 Genova, Italy*

Abstract

Since 50's the scientific diving community has endeavoured to promote safe, effective diving through self- imposed diver training and education programs. In the last few decades in some countries the Government exempted scientific diving from commercial diving regulations, recognizing its peculiarity and specific requirements.

In Italy there is a long tradition concerning scientific diving and in May 1997 an European Scientific Diving Course was held at Elba Island (Italy) giving one of the first impulse to the strategy of the European Scientific Diving Committee (ESDC) and suggesting a draft standards for European Scientific Divers and Advanced European Scientific Divers formalized during the workshop of the ESDC held at *Banyules sur mer* (France) the 24th of October 2000.

The ESDC was set up as interim commission based on a meeting of experts in scientific diving and underwater sciences held in *Berlin* (Germany) at the 25th-26th June 2007. Thereafter, the official ESDC was established during the 1st International Symposium on Occupational Scientific Diving in *Bremerhaven* (Germany) 15th-16th October 2007. In the year 2009, ESDC was adopted as a panel to European Science Foundation Marine Board, and was named European Scientific Diving Panel (ESDP). The main objectives of the ESDP are:

- To encourage international mobility in the European scientific diving community through the implementation of a practical support framework
- To promote safety in scientific diving across Europe
- To advance underwater scientific excellence in Europe

Among the European countries, Belgium, U.K., Finland, France, Germany, and Sweden have specific national regulation concerning scientific dive and are full member of the ESDP. Italy has become a full member of the ESDP in 2010 by establishing a national scientific diving steering body. Although the lack of national regulation concerning scientific dive, AIOSS (formally Associazione Italiana Operatori Scientifici Subacquei, http://www.aioss.info/) represents the scientific diving community through a number of major institutions of the country. AIOSS is a 'no profit' professional association. Among the individual members there are technicians, researchers and academics from universities, research institutes and public agencies, operators and managers of Marine Protected Areas, Nature Reserves, Marine Archaeological Sites and Aquariums, employees of private studies of environmental consulting, engineers and doctors. AIOSS liaise with the Working Committee of the Chamber of Deputies and other associations to promote legal recognition of scientific diving.

We define Scientific Diving as: *"diving performed solely as part of scientific research, conservation and protection as well as training, whose only goal is to achieve scientific, educational, informational, and safeguarding the environmental heritage and / or historical and archaeological through such sampling, measurements, surveys, experimentation, exploration, stratigraphic excavations, surveys and recoveries. Scientific Divers are those in possession of appropriate qualification stating the specific training required by the operating environment and perform Scientific Diving, including students in their scientific diver training."*

Continuous Monitoring of Dissolved CO_2 and H_2S: Technical Application in The Submarine Hydrothermal System of Panarea, Italy

Schipek M., Schulz S., Merkel B.J.

TU Bergakademie Freiberg, Gustav-Zeuner-Str. 12, 09599 Freiberg, Germany

Abstract

Additionally to flow rate measurements of fluid discharges in submarine hydrothermal systems, in-situ-measurements of concentrations of dissolved gases like CO_2 and H_2S can provide important information about the state of a hydrothermal system. Sampling and following laboratory methods are costly and not sufficient with respect to sampling intervals. Commercial sensors to monitor dissolved CO_2 and H_2S in seawater are so far unavailable. Therefore a sensor array was designed, build, and tested based on commercially available sensors for gas monitoring. The sensor array was tested in the submarine hydrothermal system of Panarea. The first application provided important insight into variations of CO_2 and H_2S concentrations. Besides influences by earth tides, also additional fluctuations can be monitored by long term records.

Introduction

Global ocean water currently absorbs over 25 million tons of CO_2 every day (Hall-Spencer & Rodolfo-Metalpa 2009). Long-term ocean acidification has been published by different authors (e.g. Guinotte et al., 2006; Hall-Spencer et al., 2008). Besides long-term changes in pH, there is also scientific interest in monitoring variations of flow rates in submarine gas emissions and their influence on surrounding waters. Periodic sampling is one option to show changes in fluid geochemistry and in the flow rate of venting hydrothermal fluids. Usually, there is a need for water sampling to get information about dissolved gases like CO_2 and H_2S. After sampling the determination of e.g. CO_2 in submarine hydrothermal systems can be done according to ISO standards (DIN 38409). Commercially available CO_2 meters [e.g. Model 503 pH / CO_2 Analyzer, Royce Instrument Cooperation, New Orleans, LA 70 129, USA] provide a direct reading of pH and temperature, while alkalinity of the water must be determined independently and provided as additional information. Sampling has to be at short intervals to evaluate short time-scale temporal modifications. But this may be tedious and costly if the sampling intervals are getting in the range of hours and minutes.

Direct determination of TDIC (total dissolved inorganic carbon) can be done by the conversion of dissolved carbonate species in CO_2 by acidification. CO_2 can be separated by stripping or gas diffusion in an acceptor solution. CO_2 in the aqueous or gaseous phase can be determined by gas chromatography (GC), spectrometry, non-dispersive (IR) spectrometry, coulometric, potentiometric or conductometric methods.

Potentiometric electrochemical sensors are based on two membranes separating liquids (1 - sample solution, 2 - HCO_3^- containing solution). Due to diffusion of CO_2 pH-changes in the electrolyte solution occur. The corresponding voltage of the sensor is proportional to the CO_2 concentration in the measured sample. Advantages of electrochemical sensors over other analytical methods are the easy use, low interferences with other ions, and in-situ determination in liquids. A disadvantage of electrochemical sensors is the need of regular calibration in order to avoid a drift of the sensor's signal.

Spectrometric measurements using fiber optic sensors have the advantage to be suitable for in-situ measurement, high sensitivity, accuracy, and low energy consumption. The principle is based on the detection of changes in an indicator solution within a membrane cell by fiber optic fibers. Major disadvantages are large sample amounts to reach equilibrium state, and the non-applicability for long-term readings.

Methods

Because the above mentioned sensors appeared to be not feasible for long term monitoring of geothermal impacted seawater a novel sensor system for online measurement of CO_2 and H_2S based on commercially available gas sensors was designed. The sensor setup used is shown in Figure 1: separation of the aqueous solution (1) from the dissolved gas (3) using a gas-permeable membrane (silicon tube, outer diameter 4.0 mm, thickness 0.5 mm, Lindemann, Germany; (2)). Thus water (and solids) cannot enter the sensor system itself. CO_2 and H_2S molecules present in the water migrate by diffusion through the membrane reaching an equilibrium between the surrounding water and the gas phase within the hose. The gas phase in this tube is continuously pumped (pump: type SP 135 FZ Fa., Schwarzer Precision, Germany; (4)) through the sensor array in order to accelerate the sensor's reaction and response time.

CO_2 is detected by a non-dispersive infrared two channel detector (NDIR CO_2-Sensor Model 400, Digital Control Systems, (5)). This sensor emits two pulsed infrared signals which are absorbed by CO_2 molecules. The intensity of the two beams reaching the detector is processed and expressed as CO_2 concentrations. H_2S is detected with an electrochemical H_2S gas sensor (3001 SI, Analox Sensor Technology, 0 – 100 ppm), (6)). The data from both sensors are visible on a digital display. Due to the existence of pH-dependent species (CO_2 or H_2CO_3 / HCO_3^- / CO_3^{2-}; H_2S / HS^- / S^{2-}), a pH probe (7) is integrated in the sensor arrangement. All values are processed (9) and stored in a low cost datalogger (Tinytag Plus Re-Ed Voltage Input Logger (TGPR-0704), (10)).

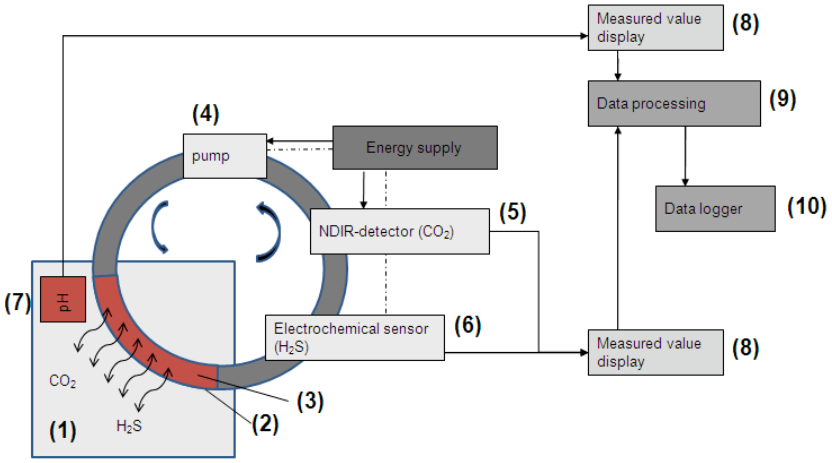


Figure 1. Schematic sketch of the sensor set-up.

Power supply is provided by a rechargeable battery (12 V/ 20 Ah). The whole device was capsulated water tight as can be seen in Figure 2. Compression springs (VKM-13604, company Gutekunst &Co, Germany) were used to stabilize the semi-permeable membrane in the submarine environment and protected by an acryl-glass perforated pipe. Installation of the sensor can be easily maintained by one diver. At the sea bottom, the sensor system has to be fixed e.g. by some weights.

Compared to prior setups, the combination of 2 or more commercial available gas sensors in combination with a gas-sensitive membrane and a pump in the array is an essential improvement because pumping the gas in the array improves the response time of the sensor by far. Compared to an application without pump, a 50 – 60 times higher response time was reached. Furthermore, by choosing a suitable membrane an enrichment of gas is reached in the membrane. Thus an overall faster transport of the gas from the liquid to the gas phase takes place. Other advantages are the relatively simple construction, the possibility to combine different sensors, and the suitability for short- and long-term monitoring of fluids.

In regard to the field of application, the sensor was calibrated in different chemical/environmental conditions. The calibration showed no significant differences and interactions in pure 5 mM $NaHCO_3$ solutions, in solutions with higher ionic strength (5 mmol/L compared to 44 mmol/L), and with particular reference to other IR-sensitive gases (e.g. H_2S). During calibration pH was adjusted with 1 M HCl. The depending aquatic species of C and S were modeled by the hydrochemical code PhreeqC (Parkhurst & Appelo 1999) (database: wateq4f.dat).

First tests

The in-situ measuring system was successfully applied to record variations in dissolved CO_2 and H_2S concentrations in the submarine hydrothermal system of Panarea (2009 – 2010).

Figure 2. Installation of the CO_2/H_2S sensor by divers.

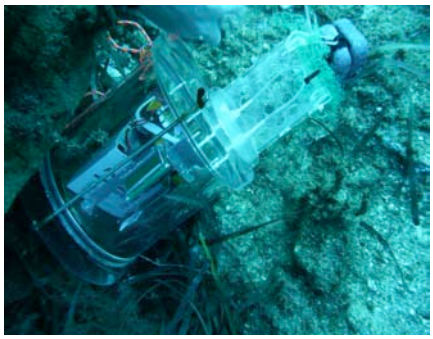


Figure 3. CO_2/H_2S sensor at Black Point, Panarea.

Figure 4 shows monitored data (09/07/2009 – 09/11/2009) for CO_2 in comparison to tidal data. Sampling point was a small fumarole at the location Black Point, Panarea (water depth 21 m). Tidal data were calculated by means of WXTide24. No data for H_2S are available for this period, because the H_2S-sensor used has a detection range from 0.1 to 100 ppm and was thus much too low for monitoring water in the direct contact with fumaroles (up to 4000 ppm H_2S).

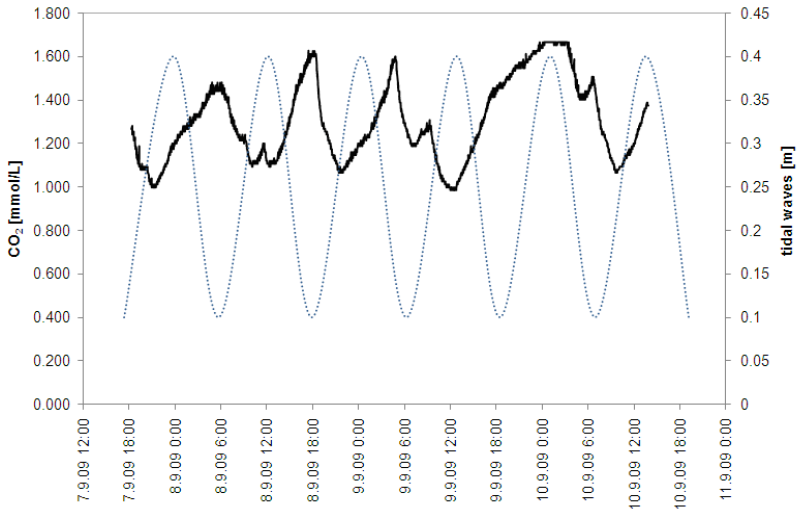


Figure 4. Dissolved CO_2 concentration recorded from 09/07/2009 – 09/11/2009 (black). Dotted, blue curve represents calculated tidal waves (WXTide24).

Tidal influences are obviously. Besides this main behavior, smaller variations in CO_2 concentrations are visible in Fig. 4. Additionally, it must be considered that other, complex factors such as weather influence and currents affect the quantity and quality of fluid discharges and thus influence the CO_2 concentration in water surrounding fumaroles.

A further sampling campaign took place for nearly 24 hours (09/12/2010 – 09/13/2010) at the location "fumarolic field" (water depth 16 m). The sensor was positioned on the sea bottom on a very weak fumarole in the north eastern part of the location. H_2S and CO_2 concentration in this case are inverse correlated with tidal data. Additionally investigations are under way to proof the statistical correlation. The inverse correlation of CO_2 and H_2S concentration with tidal waves can be mainly reasoned by earth tides. Besides this well-known parameter, waves (water level variations = pressure variations, ca. 0.1 bar) and local weather conditions (barometric pressure variations, estimated 0.01 bar) may influence the gas discharge and CO_2 and H_2S concentration. Such effects on flow rates were already recorded additionally to the typical tide-dependent variations in submarine environments (i.e. Heinicke et al., 2006; Aliani et al, 2004; Chen et al., 2005; Sohn, 2007).

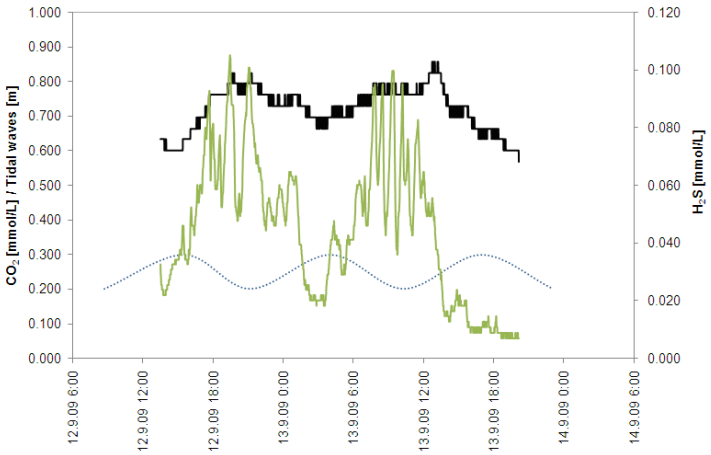


Figure 5. Dissolved CO_2 /H_2S concentration recorded from 09/07/2009 – 09/11/2009 (black). Black line: CO_2, green line: H_2S; dotted, blue curve represents calculated tidal waves (WXTide24).

Outlook

Long-term records of variations in the chemical composition of submarine fluid discharges are rarely presented in literature. A first application at Panarea provides an important insight into short term variations of gas composition. Besides influences by earth tides, also unpredicted fluctuations may be shown by long term records. In future, CO_2 and H_2S measurements will be combined with flow rate measurements by a flow meter for submarine volcanic gas emissions (Bauer et al. 2009). First results will be available by October 2010.

References

Aliani, S., R. Meloni, and P. R. Dando (2004). *Periodicities in sediment temperature time-series at a marine shallow water hydrothermal vent in Milos Island (Aegean Volcanic arc, eastern Mediterranean), J*. Mar. Syst., 46, 109– 119.

Bauer, K.; Bauer, D.; Fütterer, W.; Kleutges, J. (2009). *Flow rate measurement at submarine volcanic gas emissions*. FOG - Freiberg Online Geoscience, 22, pp. 112-117.

Chen, C.-T. A., Z. Zeng, F.-W. Kuo, T. F. Yang, B.-J. Wang, and Y.-Y. Tu (2005). Tide-*influenced acidic hydrothermal system offshore NE Taiwan, Chem*. Geol., 224, 69– 81.

Guinotte J.M., Orr J., Cairns S., Freiwald A., Morgan L.& George R., 2006. Will *human-induced changes in seawater chemistry alter the distribution of deep-sea scleractinian corals*? Front. Ecol. Environ. 4: 141-146.

Hall-Spencer J.M., Rodolfo-Metalpa R., Martin S., Ransome E., Fine M., Turner SM., Rowley S., Tedesco D. & Buia M.-C. , 2008. *Volcanic carbon dioxide vents reveal ecosystem effects of ocean acidification*. Nature 454: 96-99.

Hall-Spencer J.M. & Rodolfo-Metalpa R., 2009. *Using scientific diving to investigate the long-term effects of ocean acidification at CO_2 vents*. FOG 22: 69 – 73.

Heinicke, J, Italiano, F., Maugeri, R., Merkel, B., Pohl, T., Schipek, M. and Braun, T., 2009. *Evidence of tectonic control on active arc volcanism: The Panarea-Stromboli tectonic link inferred by submarine hydrothermal vents monitoring (Aeolian arc, Italy).* Geophysical Research Letters, 36. 36, L04301, doi:10.1029/2008GL036664.

Parkhurst, D.L. and Appelo, C.A.J., 1999. *User's guide to PHREEQC (Version 2) – a computer program for speciation, batch reaction, one-dimensional transport, and inverse geochemical calculations*. 99-4259, U S Geological Survey.

Sohn, R. A. (2007). *Stochastic analysis of exit fluid temperature records from the active TAG hydrothermal mound (Mid-Atlantic Ridge, 26_N): 1. Modes of variability and implications for subsurface flow, J.* Geophys. Res., 112, B07101, doi:10.1029/2006JB004435.

Study of Water Resources System of Zayanderud Dam on Ecosystem Sustainability, Isfahan Province, Iran

Shafiee A., Safamehr M.

Member of Young Researchers Club, Islamic Azad University Ardestan, Branch, Esfahan, Iran

Abstract

Zayandehrud dam's lake with the capacity of 1.6 *109 CM is located in 115 Km from Isfahan city at the center of Iran. The dam adopts water resources of Zayandehrud River which originates from western hill slopes of Isfahan Province. The aims of the dam are to provide the drinking water for Isfahan Province, water for agriculture and industry of the province and conservation of historical buildings on the river such as old bridges. At the present time, dam's lake is also used for different tourism purposes. However, the occurrence of drought in recent years reduced the capacity to 150 MCM and had harmful impacts on different water resources system of the area such as dryness of Gavkhooni swamp, reduction of agricultural and industrial water availability. In this study, the different aspects of Zayandehrud dam's lake utilization and the impact of climate fluctuation of its water supply and demand to give a decision system of the proper utilization of the reservoir are evaluated.

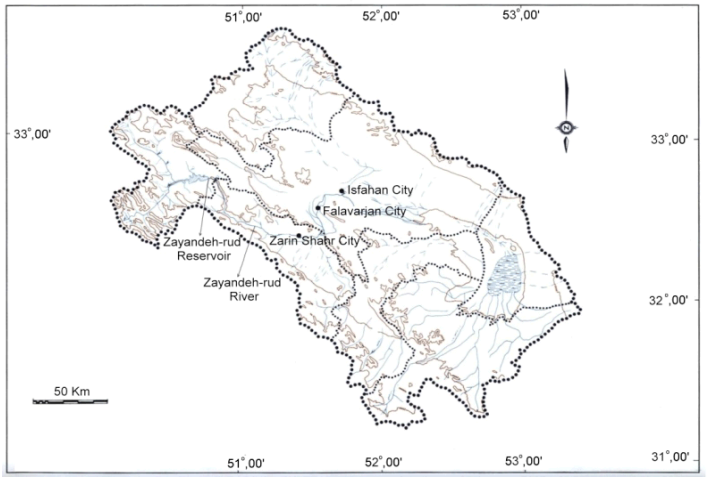


Figure 1. Location of the dam lake and the main cities.

Fisheries Status and Major Threats to Marine Biodiversity of Pakistan

Sher Khan P.[1] and Shabir A.A.[2]

[1]*Centre of Excellence in Marine Biology University of Karachi*
[2]*Pakistan Natural History Museum Islamabad*

Abstract

Fishing is an important social and economic activity among coastal fishermen of Pakistan. Over 100,000 coastal inhabitants are diretly or indirectly involved in with fishery and its related activities. The coastal fishery of Pakistan may be categorized as small scale and artisnal, majority of fish landing come through small scale activities. The commercially important marine fisheries resources of Pakistan comprises of about 70 species including sardine, shark, mackerel, butter fish, pomfret, sole, tuna, seabream, Jew fish, catfish and eels. The representatives of five demersal fish families viz. Schnidae, Humilidae, Sparidae, Sillaginidae and pomacentridae contributing more than 50% of the total catch in fish landing at Karachi harbour. Pakistan fishery industry is based on demersal resources shrimp and finfish. These resources have already overexploited in the coastal areas of Sindh through operation of non-selective fishing gears (trawl and seine nets) without noticing their effect on the marine environment e.g. ecosystem and biodiversity.

The registered fishing crafts are 34,058 among them 15,754 (73%) are registered in Sindh coast and 5,795 (27%) in Balochistan. The annual landing of 2002 was 139821.353 metric tons (mt) comprising 64455.76 mt (46%) of fishmeal landing, 55026.203 mt (39.35%) of finfish and 18750.809 mt (13%) of shrimp landing. A sharp decline observed during June and July due to harsh weather condition in Arabian Sea and ban imposed on fishing by Government. Following the month of August to November were observed as rich months for fishing in our coastal waters. The contribution of estuarine set bed net (Katra) and trawler nets were high in the months of October and December while in other months trawlers landing were high. Both trawlers and Katra boats operators are contributing nearly same in fishmeal landing. The commercially important size and high value shrimps were only 26% and rests of the 74% of the catch were low value shrimps known Kiddi includes juveniles of high value shrimps and small size shrimps.

Possible Tsunamis Signatures from an Integrated Study in the Augusta Bay Offshore (Eastern Sicily–Italy)

Smedile A.[(1)], De Martini P.M.[(1)], Pantosti D.[(1)], Bellucci L.[(2)], Del Carlo P.[(3)], Gasperini L.[(2)], Pirrotta C.[(4)], Polonia A. [(2)], Boschi E.[(1)]

[1]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione Sismologia e Tettonofisica, Roma, Italy*
[2]*CNR - ISMAR - Sede di Bologna - Geologia Marina, Italy*
[3]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Pisa, Italy*
[4]*Dipartimento di Scienze Geologiche, Università di Catania, Italy*

Abstract

Research focusing on geological evidence for tsunamis carried out worldwide, have shown a broad variety of tsunami depositional traces inland. However, very little has been done to study the effect of sediment transport and deposition due to a tsunami in the near offshore.

With the aim of exploring new offshore approaches for the paleotsunami research, we started an investigation in the Augusta Bay offshore. In the selection of this test-site we took into account the following available information: (i) at least 3 large tsunamis (1908, 1693 and 1169) affected this area during the past millennium; (ii) there is onshore evidence for tsunami deposits associated to historical and prehistorical events (De Martini et al. 2010). Moreover, the Augusta Bay area, hosting Sicily's major harbor and large petrochemical industries, has been recognized as a site with high environmental risk both by the World Health Organization and by the Italian Government.

This paper presents new data from a 6.7 m-long core sampled in the northern part of the bay, in the recent shelf mud sequence, where no evidence for anthropogenic disturbance, both in terms of quality of sediment and of local sedimentation rate (due to dumping), was found.

Our approach involved the study of geophysical data (morphobathymetry, seismic reflection, seafloor reflectivity) and sediment samples, including X-ray imaging, physical properties, isotopic dating, tephrochronology, grain-size and micropaleontology. Eleven anomalous layers marked by high concentration of displaced epiphytic foraminifera (species growing in vegetated substrates like the Posidonia oceanica) and subtle grain size changes were found in a 6.7 m long, fine sediment core (MS-06), sampled 2 km offshore the Augusta harbor (Eastern Sicily) at 72 m water depth and recording the past 4500 yrs of deposition. Because concentrations of epiphytic foraminifera are quite common in infralittoral zones, but not expected at -70 m, we propose that these anomalous layers might be related to the occurrence of tsunamis causing substantial uprooting and seaward displacement of P. oceanica blades with their benthic biota.

Correlations between anomalous layers and tsunami events have been supported by a multivariate analysis on benthic foraminifera assemblage and ages of historical tsunamis record. We found that four out of the eleven layers were embedded in age intervals encompassing the date of major tsunamis that hit eastern Sicily (1908, 1693, 1169) and the broader Eastern Mediterranean (Santorini at about BP 3600). One more layer, even if less distinct than the others, was also defined and may be the evidence for the AD 365 Crete tsunami.

References

De Martini, P.M., Barbano, M.S., Smedile, A., Gerardi, F., Pantosti, D., Del Carlo, P., Pirrotta, C (2010). *A 4000 yrs long record of tsunami deposits along the coast of the Augusta Bay (eastern Sicily, Italy): paleoseismological implications.* Mar.Geol. doi: 10.1016/j.margeo.2010.07.005 (in press).

Geological Evidence of Paleotsunamis at Torre degli Inglesi (Northeastern Sicily)

Smedile A.[(1)], Pantosti D.[(1)], Barbano M.S.[(2)], De Martini P.M.[(1)], Tigano G.[(3)]

[1]*INGV - Istituto Nazionale di Geofisica e Vulcanologia, Sezione Sismologia e Tettonofisica, Roma, Italy*
[2]*Dipartimento di Scienze Geologiche, Università di Catania, Catania, Italy*
[3]*Soprintendenza Beni Culturali ed Ambientali di Messina, Sezione Archeologica, Italy*

Abstract

During the past millennium Eastern Sicily was frequently hit by large tsunamis that inundated coastal areas, plains and towns. The best known tsunamis are those that followed the 1169, 1693, 6 Feb 1783, and 1908 local earthquakes. At Capo Peloro there are descriptions for only the two most recent tsunamis but with reference to the village of Torre Faro along the southern coast.

The purpose of this study is to find further evidence of these earthquakes in the Messina area by a multi-disciplinary study aimed to recognize and date historical and paleo-earthquakes evidence, including secondary effects as tsunamis. For this goal we have analyzed historical, archaeological and geological information of excavations performed at Capo Peloro near Torre del Faro village at the Torre degli Inglesi site (English Tower), built on an abandoned Roman tower. According to archaeological evidence collected by the Superintendence of the Archaeological heritage of Messina, the main building phases of the Torre degli Inglesi can be summarized as follows: (i) between the 1st century BC and 1st century AD, construction of the Roman Tower; (ii) between 3rd-16th century, destruction (by an earthquake? a fire?), abandonment and rebuilt of a new undefined structure; (iii) 16th century, construction of the Torre degli Inglesi; (iv) end of 19th century, construction of facing walls. Finally, the tower was restored after the 1908 earthquake.

On the basis of detailed survey of the deposits exposed in the archaeological excavation, we found two distinct layers completely different from the deposits exposed at this site or outcropping nearby. In fact, they are likely of marine origin as highlighted by micropaleontological analyses. The nature of these layers, coupled with their sharp erosional contacts and their relative infrequency, allow us to interpret these layers as paleotsunami deposits [Pantosti et al., 2008]. Radiocarbon dating was performed on 6 charcoals, sampled in the lower bioclastic sandy layer and in the deposits just below and above, to constrain the age of the lowermost tsunami sand [Pantosti et al., 2008]; while some C14 samples collected in the artificial leveling deposits well predate the younger tsunami deposit, that underlies the facing walls of the 19th century.

Combining archeological, historical and radiocarbon data we may associate the oldest tsunami layer to the 17 AD earthquake, for which no knowledge and information based on historical sources exist about tsunamis till now. Conversely, the youngest layer is likely related to the 1783 Feb. 6 earthquake for which the triggered tsunami is well known [Pantosti et al., 2008). No evidence for the famous 1908 Messina tsunami was found.

References

Pantosti, D., Barbano, M.S.,. Smedile, A, De Martini, P.M., Tigano, G. (2008). *Geological Evidence of Paleotsunamis at Torre degli Inglesi (northeast Sicily).* Geophys. Res. Lett., 35, L05311, doi:0.029/2007GL032935.

Chemical and Isotopic Features of Waters and Dissolved Gases along Vertical Profiles at Albano, Averno and Monticchio Volcanic Lakes (Italy)

Tassi F.[1,2], Vaselli O.[1,2], Fiebig J.[3], Cabassi J.[1], Nocentini M.[1], Delgado Huertas A.[4]

[1]*Deptartment of Earth Sciences, Via G. La Pira, 4, 50121 Florence, Italy*
[2]*CNR – Institute Geosciences and Earth Resources, Via G. La Pira, 4, 50121 Florence, Italy*
[3]*Institute for Geology and Paleontology, Bio-INCREMENTS Research Group, Goethe University, Senckenberganlage 32–34, 60325 Frankfurt/Main, Germany*
[4]*CSIC – Estacion Experimental de Zaidin, Prof. Albareda 1, 18008 Granada, Spain*

Abstract

Dissolved CO_2 and CH_4 from sub-lacustrine fluid vents and/or bacterial-related processes commonly constitute relevant reservoirs in crater lakes hosted in non-active volcanoes. In these systems, an external perturbation (i.e. earthquakes, landslides, heavy rains) affecting the stability of deep lake strata may produce the abrupt release of a relevant amount of gases, as occurred at Monoun and Nyos lakes (Cameroon) in 1984 and 1986, respectively [Sigurdsson et al. 1987, Evans et al. 1993, 1994]. Such events, the so-called "limnic eruptions" [Kusakabe 1996 and references therein], may represent a severe hazard, especially when occurring in the proximity of densely populated areas.

In central-southern Italy, four volcanic lakes, i.e. Albano (Alban Hills volcanic complex; Central Italy), Averno (Phlegrean Fields; southern Italy), Monticchio Grande and Monticchio Piccolo (Vulture volcano; southern Italy), show a marked chemical and thermal stratification and presence of non-atmospheric gas species at depth. Water rollover episodes have occasionally affected these lakes in historical times. This study investigates the chemical-physical features of water and dissolved gases along the lake vertical profiles, with a special focus on the distribution of the $\delta^{13}C$ values in CO_2 and CH_4 with depth.

Generally speaking, all the investigated lakes display a significant chemical stratification, mainly consisting of an increase of the HCO_3^- and Ca^{2+} concentrations. The dissolved gas composition is dominated by N_2 in the oxic epilimnion, whereas CO_2 is the main gas compound in the anoxic hypolimnion. The vertical patterns of CH_4 concentrations resemble those of CO_2, since both compounds show an increase from the surface to the bottom of 3-4 orders of magnitude. The $\delta\ ^{13}C$-CH_4 and δ D-CH_4 values (down to -67 ‰ V-PDB and -283 V-SMOW, respectively) suggest that the bacterial activity is basically the main responsible of CH_4 production. On the contrary, the $\delta\ ^{13}C$-CO_2 values of Monticchio Grande, Monticchio Piccolo and Albano lakes (ranging between -5.8 and -0.4 ‰ V-PDB) are consistent with those of mantle-derived CO_2, whereas, at Averno, where the $\delta\ ^{13}C$-CO_2 values range between -13.4 and -8.2 ‰ V-PDB, CO_2 seems to be prevalently organic. The carbon isotopic signature of the two main dissolved gas species along the vertical profiles seems to depend, besides of their origin, on 1) CO_2-CH_4 isotopic exchange, 2) CO_2 reduction to CH_4 at reducing conditions, 2) CH_4 oxidation to CO_2 at oxidizing conditions. The $\delta\ ^{13}C$-CO_2 values are indeed progressively more positive at increasing depth, whereas an opposite trend is shown by the $\delta\ ^{13}C$-CH_4 values.

These results show that, although the morphometric features (water volumes of Monticchio Grande, Monticchio Piccolo, Averno and Albano lakes are 3.3 $x10^6$, 4 $x10^6$, 6 $x10^6$ and 450 $x10^6$ m^3, respectively) and the relatively low gas concentrations (max 19.4 mmol/L at a depth of 39 m in the Monticchio Piccolo lake) the gas reservoirs of these lakes cannot presently represent a serious hazard for limnic eruptions, the vertical patterns of the CO_2/CH_4 ratio and the $\delta\ ^{13}C$-CO_2 and $\delta\ ^{13}C$-CH_4 values are to be considered useful monitoring tools to control the rate of fluids discharged from the lake bottoms.

References

Evans, W.C., Kling, G.W., Tuttle, M.L., Tanyileke, G., White, L.D. (1993). *Gas buildup in Lake Nyos, Cameroon: The recharge process and its consequences*. Appl Geochem, pp 8: 207-221.

Evans, W.C., White, L.D., Tuttle, M.L., Kling, G.W., Tanyileke, G., Michel, R.L. (1994). *Six years of changes at Lake Nyos, Cameroon yield clues to the past and cautions for the future*. Geochem J, pp 28: 139-162

Kusakabe, M. (1996). *Hazardous crater lakes. In: R Scarpa and RI Tilling (Eds), Monitoring and mitigation of volcano hazards. Springer-Verlag, Berlin*: 573-598 pp.

Sigurdsson, H., Devince, J.D., Tchoua, F.M., Presser, T.S., Pringle, M.K.W., Evans, W.C. (1987). *Origin of the lethal gas burst from Lake Monoun, Cameroon. J Volcanol.* Geotherm Res 31: 1-16

Fluid Geochemistry of Submarine Fumaroles from the Pozzuoli Bay (Naples, Italy): Hints for Spatial Distribution of Hydrothermal vs. Magmatic Compounds

Tassi F.[1,2], Vaselli O. [1,2], Tedesco D.[3], Poreda R.[4]

[1]*Department of Earth Science, University of Florence, Via La Pira 4, 50121 Florence, Italy*
[2]*CNR - Institute of Geosciences and Earth Resources, Via La Pira 4, 50121 Florence, Italy*
[3]*Department of Environmental Sciences, 2nd University of Naples, Via Vivaldi 43, 81100, Caserta, Italy*
[4]*Environmental and Earth Sciences Department, University of Rochester, 227 Hutchison Hall, NY 14627 Rochester, USA*

Abstract

A geochemical and geophysical surveillance of Phlegrean Fields (Pozzuoli, Italy), an active volcanic district that covers ~80 km^2, has been carried out since early '80's, in response of the bradyseismic crisis occurred in 1982-1984 in order to forecast eventual phreatic and phreatomagmatic events in a such densely populated area [e.g. Martini et al., 1991; Bonafede and Mazzanti 1998, Tedesco and Scarsi 1999]. These studies were mainly focused on fumaroles and boiling pools discharging at the Agnano and Solfatara craters, the latter being periodically monitored in the last two decades [Chiodini et al. 1996, 2003], and have shown that the evolution of the caldera depends on a pulsating magmatic source, periodically discharging CO_2-enriched fluids into a shallow hydrothermal system.

The present study concerns a detailed geochemical investigation on submarine gas discharges seeping out from the sea bottom in the Pozzuoli Bay [Tonani 1972, Tedesco et al. 1990]. The main aim is to investigate the processes regulating the chemical and isotopic features of these emissions and their relation with the fumarolic system of the inland discharges.

Four distinct fumarolic fields were identified: Mar Morto, Pozzuoli Porto, Secca Caruso and Fumose. The chemical composition of all the sampled gases is dominated by CO_2 (up to 985,755 mol/mol) and show relatively high concentrations of N_2 and CH_4 (up to 15,927 and 5,884 mol/mol). Magmatic-derived fluid compounds, i.e. SO_2, HF and HCl, were not detected, likely because they are almost completely buffered by the hydrothermal system. The concentrations of temperature- and redox-sensitive gas species, such as H_2S, H_2, and CO, in the Fumose fumaroles, which have the highest outlet temperature (up to 93 °C), are significantly higher, up to two-three orders of magnitude, with respect to those measured in Nisida and Mar Morto gas discharges. The R/R_a values show similar variations, being up to 2.6 at the Fumose fumaroles and 2.2-2.3 at Mar Morto and Nisida. On the contrary, the concentrations of CH_4 and atmospheric-related compounds (N_2, O_2, Ar and Ne) show an opposite trend. Via Erculanea and Mercato ittico gas emissions are characterized by an intermediate composition, likely due to degradation of organic matter contained in sea bottom sediments and degassing of air saturated seawater, respectively. The Phlegrean Fields submarine gases seem to be fed by a fluid source common to that feeding the fumaroles discharging inland, i.e. an extended boiling hydrothermal reservoir. However, the spatial distribution of their chemical-physical features suggests that the temperature of hydrothermal fluids decreases at the periphery of the caldera.

A periodical geochemical monitoring of the Pozzuoli Bay submarine fumaroles is highly recommended in order to minimize the possible risk of a gas blast as that occurred in 2002 at Panarea Island (Aeolian Archipelago, Sicily). No data were available before this explosive event, although the successive geochemical monitoring [Capaccioni et al. 2004, 2007] has allowed to follow the evolution of the submarine fumaroles responsible of the gas burst, indicating the end of this volcanic crisis. This means that gas geochemistry is an important and relatively cheap tool that can successfully applied also in marine environment.

References

Bonafede, M., Mazzanti, M. (1998). *Modelling gravity variations consistent with ground deformation in the Campi Flegrei caldera (Italy).* J Volcanol Geotherm Res, pp 81: 137-157.

Capaccioni, B., Tassi, F., Vaselli, O., Tedesco, D., Poreda, R. (2007). *Submarine gas burst at Panarea Island (southern Italy) on November 3, 2002: a magmatic versus hydrothermal episode.* J Geophys Res 112: B05201, doi: 10,1029/2006JB0044359

Capaccioni, B., Tassi, F., Vaselli, O., Tedesco, D., Rossi, P.M.L. (2005). *The November 2002 degassing event at Panarea Island (Italy): five months of geochemical monitoring.* Ann Geophys, pp 48: 755-765

Chiodini, G., Cioni, R., Magro, G., Marini, L., Panichi, C., Raco, B., Russo, M., Taddeucci, G. (1996). *Chemical and isotopic variation of Bocca Grande Fumarole (Solfatara Volcano, Phlegrean Fields).* Acta Volcanol, pp 8: 129-138

Chiodini, G., Todesco, M., Caliro, S., Del Gaudio, C., Macedonio, G., Russo, M. (2003). *Magma degassing as a trigger of braydseismic events: the case of Phlegrean Fields (Italy).* Geophys Res Lett 38: 1434-1438
Martini, M., Giannini, G., Buccianti, A., Prati, F., Cellini Legittimo, P., Bozzelli, P., Capaccioni, B. (1991). *Ten years of geochemical investigation at Phlegrean Fields (Italy).* J Volcanol Geotherm Res 48: 161-171
Tedesco, D., Allard, P., Sano, Y., Wakita, H., Pece, R. (1990). *Helium-3 in subaerial fumaroles of Campi Flegrei caldera, Italy.* Geochim Cosmochim Acta 54: 1105-1116
Tedesco, D., Scarsi, P. (1999). *Chemical (He, H_2, CH_4, Ne, Ar, N_2) and isotopic (He, Ne, Ar, C) variations at the Solfatara crater (southern Italy): mixing of different sources in relation to seismic activity.* Earth Planet Sci Lett 171: 465-480
Tonani, F. (1972). *Rilevamento geochimico delle emanazioni vulcaniche nella Baia di Pozzuoli*. Quad Ric Scient CNR 83: 113-136

Design and Implementation of a Platform in Shallow Waters Acquiring Radon Progeny and Acoustic Waves: Applications Using the in situ Autonomous Sensors KATERINA and PAL

Tsabaris C.[(1)], Anagnostou M.N.[(2,3)], Dakladas Th.[(1)], Patiris D.L.[(1)], Anagnostou E.N.[(1,4,5)], Nystuen J. A.[(1,4,6)]

[1]*Hellenic Centre for Marine Research, Institute of Oceanography P.O. BOX 712, Anavyssos, GR-19013, Greece*
[2]*Department of Electronic Engineering, Sapienza University of Rome, Rome, Italy*
[3]*Institute of Environmental Research and Sustainable Development, National Observatory of Athens, Athens, Greece*
[4]*Institute of Inland Waters, Hellenic Centre for Marine Research, Anavissos, Greece*
[5]*Department of Civil and Environmental Engineering, University of Connecticut, Storrs, CT, USA*
[6]*Applied Physics Laboratory, University of Washington, Seattle, WA, USA*

Abstract

This work describes the combination of two autonomous detection in-situ systems for rainfall monitoring in shallow water environment and presents a deployment of the two systems 1.5m above the seabed. The article also discusses the impact of this technology on oceanographic surveys and meteorological interpretation.

The KATERINA system consist of a 3"x3" NaI crystal with built in photomultiplier tube, preamplifier, an analog-digital converter, a high voltage controller and electronic modules for data acquisition, storage and transmission. The sensor housing size was kept small (84 x 550 mm) due to the high density electronics modules that were fitted inside the sensor. The power unit filters and distributes input voltage (12 - 15 V DC) to independent modules. The input voltage is supplied by an underwater battery with specifications for 2000m depth. The electronic designs allow keeping power consumption around 1.2-1.4 W.

The PAL system is an autonomous passive system that identifies, classifies and records different sound sources generated underwater and/or in the ocean surface. Features of sound source spectra that can be used to identify the sources include spectral levels at various frequencies, ratios of these levels, spectral slopes, and the temporal persistence of the sound source.

In order to apply the systems for radon and acoustic measurements the sensors have been calibrated and tested for its stability and optimal operation. After the various settings and calibrations the sensors were installed on a platform and were deployed in Saronikos gulf - Attica region. The whole system is operated in autonomous mode logging on its internal datalogger.

The combinations of in-situ and fully autonomous sensors are likely to be utilized as a tool for studying complex effects in the shallow marine environment. Long term monitoring of radiation as well acoustic measurements could be provided by the application of the developed system. The measuring device combines radiation and acoustics and can be easily applied for oceanographic activities like monitoring of gases and fluxes on submarine groundwater discharges, on submarine faults as well as in rainfall waters.

Methods of Under Water Work – a HYDRA Student Field Course

Unger B., Lott C., Pfannschmidt S., Werner A., Schneider M., Weber M.

HYDRA Institute for Marine Sciences, Elba Field Station, Via del Forno 80, 57034 Campo nell'Elba (LI), Italy

Abstract

A team of experienced scuba diving scientists and instructors designed and progressed this field course of ten days during the last 15 years. The goal was to cover the need of a shortterm, low budget and easy access class, where students can learn first steps of under water research methods. Superordinated are the safety and legal issues of recreational scuba diving. The participants are working at a field station in Italy with unlimited access to scuba diving in shallow waters, and learn from experienced scuba diving scientist under the supervision of scuba diving instructors. They learn to work in a small team, to use simple sampling gear such as hand corer, sieves, transects, lifting gear, submersible vacuum cleaner, under water photo and video camera for documentation, and if available to use full-face masks, rebreathers, and ROVs. At the end of the course remain two days where the participants can design and carry out their own project. The regular feedback discussions are an important part in the learning process to improve the project design, individual skills and teamwork. After joining this field class the participants are capable to carry out their own projects in shallow waters under recreational scuba diving safety rules. Yet 170 participants in total have joined this field course at the HYDRA Institute for Marine Sciences on Elba.

SEDCOR – How Sediment Influence Coral Calcification

Weber M.[1,2,3], Humphrey C.[1], Glas M[2], De Beer D.[2], Fabricius K.[1]

[1]*Australian Institute of Marine Science, PMB No 3, Townsville, QLD 4810, Australia*
[2]*Max Planck Institute for Marine Microbiology, Celsiusstrasse 1, 28359 Bremen, Germany*
[3]*HYDRA Institute for Marine Sciences, Elba Field Station, Via del Forno 80, 57034 Campo nell'Elba (LI), Italy*

Abstract

The basis of coral reefs is the rapid growth of calcifying organisms. This process depends on various surrounding water parameters such as for example temperature and pH. Estuarine waters are known to have relatively low pH and carbonate saturation state, however some of them do house coral reefs. Further it is known that organic matter in sediments can reduce the pH depending on the total of biogeochemical processes within this sediment. Here we suggested that organic matter from terrestrial runoff does also reduce the pH, oxygen saturation and carbonate saturation in the boundary layers of terrigenous sediments on coastal reefs. And we hypothesised that calcifying organisms, such as scleractinian corals, and crustose coralline algae living surrounded by such sediments are affected in their ability to calcify.

We conducted microsensor measurements on sediments at four inshore reefs of the Great Barrier Reef. The investigated reefs are directly affected or not by the import of organic rich sediment from the close land. Our field data show that the boundary layers above organically enriched sediments can have a reduced pH, possibly from microbial activities and/or from metal geochemistry. However the reduction of pH seems to be related to the sediment organic content and to photosynthetic activity of organisms living at the sediment surface. A consecutive laboratory experiment was conducted to investigate rates of calcification of two species each of coral, and crustose coralline algae situated within the boundary layer above the three different sediments. The data show that sediments with increased organic content do negatively affect the growth of all tested organisms.

Our mesocosm experiment and field data suggest that we found a key process how nearshore organisms are affected in their calcification rates, and implications can be made how coral reefs will look in the future if the global seawater pH decreases further.

Acknowledgements

The organizer and the scientific committee are indebted with the World Events Cultural Association and wish to thank it for the help in the local events organization and the workshop's secretary management.

Coordinamento editoriale e impaginazione
Centro Editoriale Nazionale | INGV

Progetto grafico e redazionale
Laboratorio Grafica e Immagini | INGV Roma

Via di Vigna Murata, 605
00143 Roma
Tel. +39 06518601 Fax +39 065041181

http://www.ingv.it

Istituto Nazionale di Geofisica e Vulcanologia