TEMPO: A NEW ECOLOGICAL MODULE FOR STUDYING DEEP-SEA COMMUNITY DYNAMICS AT HYDROTHERMAL VENTS

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1. Introduction

There is world-wide recognition for the need of long term in situ monitoring of the marine environment. Particularly lacking in the study of abyssal benthic communities are time-series data. Time-series studies provide a means of studying organism growth, faunal succession, biological interactions and the response of species and communities to environmental changes [1]. Understanding community dynamics is also an important prerequisite for management, conservation and protection of natural ecosystems. A great effort is now being invested by the international scientific community into developing new ways to study the temporal aspect of both environmental and biotic factors in abyssal zones. The goal of networked seafloor observatories (c.f. ESONET, NEPTUNE) is to develop multidisciplinary long-term experiments for observations and monitoring of seafloor active processes. The development of new scientific tools, suited for long-term deployment, is an essential step to insure the success of these future observatories.

The major goal of this project, elaborated in the frame of the EXOCET/D European project [2], was to design a first autonomous long-term imaging module for studying deep-sea community dynamics at hydrothermal vents.

2. Results and discussion

This autonomous module called TEMPO is built around 2 main structures. The first one hosts the energy container, the COSTOF (SEAMON master electronics) and a junction box. The dimensions of this structure are 110*110*100 cm. During the mooring, it held the sensor module and the 15m connection cable. The sensor module (0.85*0.70*0.65cm) includes the camera and lights (AIM), autonomous temperature probes, and a CHEMINI Fe analyzer with its reagents. This frame can be handled by underwater vehicles and is equipped with 2 adjustable feet.

2.1 Camera and lights

The AIM is composed of a color video camera SONY EX980 (18x zoom lens, ¼" super HAD CCD). The zoom, iris and focus, can be controlled via an RS232C serial link during the deployment by the submersible. A low power digital video recorder based on a MPEG2 compression module acquires, encodes and stores the digital signal on a 40 Gigabyte compact hard disk. A low power controller schedules the operations of the different parts of the AIM (camera, recorder, lighting, remote links). A 38,4kbds CLSI (Contact Less Serial Inductive Link, NKE/Ifremer) allows activation of the camera, control of the settings, and the streaming of a lower resolution image during the deployment. The light is provided by two 35W LEDs projectors (DYNASUB, Fr).

2.2 Anti-fouling system

Biofouling is a major issue in the vent ecosystem. Biofilms form on every available surfaces and trap the mineral particles produced by the hot fluids. Localized microchloration is used for preventing biofouling. The portholes of the video camera and projectors were coated with a thin conductive and transparent film of metallic oxide. The application of a defined potential allows sea water electrolysis generating hypochlorite on the surfaces. This method does not modify the image and the concentrations of chemicals released are negligible.

2.3 Chemical analyser

The development of in situ analysers to make chemical measurements in marine environment is essential to allow the chemical characterisation of habitats prevailing in vent ecosystems. CHEMINI allows the in situ calibration and determination of iron using flow injection analysis and colorimetric detection [3].

The hydraulic module is a pressure-balanced tank filled with dielectric oil. Peristaltic pumps and SMC solenoid valves are used for circulation of the different fluids. Most of the manifold tubing is replaced by an engraved circuit in PMMA, integrating directly pumps and valves to limit the use of tubing and connecting parts. The detection module holds the electronic cards and the colorimeter in a pressure tank. The quartz flow cell, manufactured by HELLMA (France), is placed outside this tank. The light is emitted by LED to the external quartz flow cell and returns to the detector via optic fibres and special waterproof titanium optic pass through (SEDI, France). The final signal is obtained using synchronous detection. A low consumption board (ATMEL Atmega) pilots the electronic part of CHEMINI.

2.4 Power and controls

TEMPO is powered by a set of lithium cells that will provide 4 kW per hour during one year. The measurement sequencing and data acquisition are performed by a COSTOF (Communication and STOrage Front-end). It includes a series of simple, identical and low power electronic boards, each dedicated to one sensor and communicating through a CAN (Controller Area Network) field bus, providing maximum modularity and reliability to TEMPO. Both the power and control subsets are generic components from the so-called SEAMON technology, developed by Ifremer for non cabled long term observatories [4]. Two Contact Less Serial Inductive links were used to control and adjust the settings.

2.5 At sea trials

The MoMARETO cruise was held from August 6 to September 6, 2006 on the new French oceanographic vessel Pourquoi pas?, with the ROV Victor 6000. The main objective of this cruise was to study the spatial and temporal dynamics of hydrothermal communities colonizing the MoMAR zone, located on the Azores Triple Junction [5].

TEMPO was deployed at the base of an active hydrothermal edifice at 1700m depth on the Lucky Strike vent field. The system was moored from the vessel by free falling mode. On the bottom, the ROV Victor deployed TEMPO close to the targeted study site. The sensor module was extracted from the main structure and the submersible precisely positioned it near a Bathymodiolus azoricus mussel assemblage located at the base of the Tour Eiffel edifice. The CHEMINI sample inlet, associated to two autonomous temperature probes (NKE), was deployed within the target mussel assemblage. To check the point of view of the camera, a low-resolution still image was brought to the surface via a CLSI link. The module will record 2 x 3 minutes of high-quality video footage and take four in situ Fe measurements per day during one year. Temperature will be continuously recorded every 15 minutes in the vicinity of the assemblage.

3. Conclusion

TEMPO will be hopefully recovered during summer 2007. Acquired imagery and environmental data will be analyzed to study the links between environmental changes and biotic factors, including composition, density, biomass and growth of visible species (mussels, shrimps, crabs), behaviour and, biological interactions such as predation.

4. Acknowledgements

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5. References

[1] Sarradin, PM, and EXOCET/D consortium. InterRidge News. 12: 11, 2003.
[2] Sarrazin J., V. Robigou, S. K. Juniper and J. R. Delaney. MEPS, 153, 5-24, 1997.
[3] Sarradin, P.M., N. Le Bris, C. Le Gall and P. Rodier. Talanta 66: 1131-1138, 2005.
[4] Blandin J. and J.F. Rolin. Sea Tech., 46: 33-36, 2005.
[5] Sarrazin J., P.M. Sarradin and the MoMARETO cruise participants. InterRidge News, 24-33, 2006.

THE NEMO PROJECT: DEVELOPMENT OF PHASE 2

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1. Introduction

The detection of high-energy neutrinos coming from the deep universe is considered by the Astrophysics and Particle-Physics community one of the main scientific goals of the next years.

The Infn, (Istituto Nazionale di Fisica Nucleare), after the realization of a technological demonstrator (the NeMO Phase 1 project), at 2.000 m depth, has under way an advanced R&D program, the NeMO Phase 2, that include long term exploration close to the Sicilian coast for the installation of the detector.

The Phase 2 consist of a new electro-optical cabled facility at 3.500 m depth at 50 nautical miles from the south-east coast of Sicily.

This infrastructure it's also used for others scientific applications, (Acoustics, Geophysics, etc.) and operate as a multidisciplinary underwater laboratory.

2. Results and Discussion

Technical aspects under realisation will be presented with particular attention to:

- Cable Backbone
- Sub-sea Distribution Network
- Power and Data Transmission
- Connection System

3. Conclusions

An underwater infrastructure is under realization on the deep sea site selected by the NeMO collaboration as a candidate for the installation of the km3 neutrino telescope.
The infrastructure includes a 100 km long electro-optical cable, a shore station in Portopalo di Capo Passero and the power feeding and control equipments.
The installation of the backbone cable and power systems has started. The plant will be installed by the end of spring 2008.

4. References

[1] E. Migneco et al., Nucl. Phys. B, Proc. Suppl. 136 (2004) 61.
[2] E. Migneco et al., Status of NEMO, Nucl. Instr. And Methods in Physics Research, Proceed. of the 2nd Intern. Workshop on Very Large Volume Neutrino Telescope. Catania, Italy, Nov. 8-11, 2005
[3] Alcatel Submarine Network
[4] M. Sedita, Electro-optical cable and power feeding system for the NEMO Phase-2 project. Nucl. Instr. And Methods in Physics Research, Proceed. of the 2nd Intern. Workshop on Very Large Volume Neutrino Telescope. Catania, Italy, Nov. 8-11, 2005.

AN INFORMATION MODEL FOR A POLICY BASED MAGAMENT. EXTENSIONS TO MARINE SENSOR NETWORKS AND OCEAN OBSERVATORIES

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1. Introduction

Sensor networks for environmental data acquisition will play an important role in the development of future large data acquisition systems, particularly in oceanographic observation and operational oceanography.

This paper will show the application of Policy Based Network Management (PBNM) on Marine Sensor Networks (MSN) and Networked Ocean Observatories aiming to overcome the lack of flexibility imposed by more traditional network management paradigms.

The development of MSNs must deal with several technical challenges focused mainly on the management of the heterogeneity (equipment and data) and on the extension of the operational time. Different systems and technologies are concurrent in the same network, forced to share hardware resources and exchange data. At same time many acquisition devices, and the network itself, have limited resources that must be well managed. Their multidisciplinary