ESO NEWS
The Newsletter of the European Sea Observatory Network

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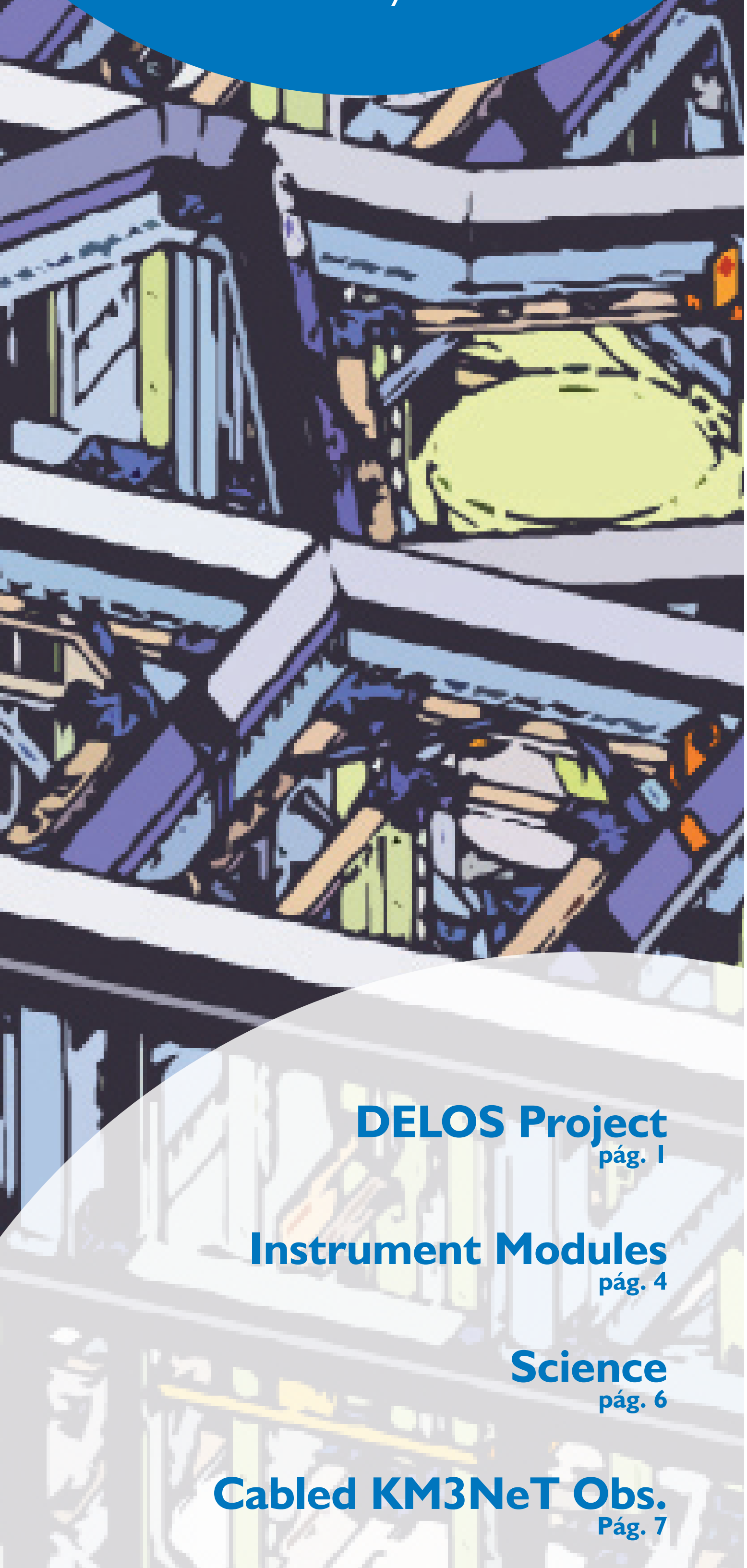
ESONET NOE



DEEP-OCEAN ENVIRONMENTAL LONG-TERM OBSERVATORY SYSTEM

Oceanlab

Oceanlab is the sub-sea research facility of the University of Aberdeen. It was commissioned in 2001.
Oceanlab 1 was the first purpose-built ocean lander laboratory in the world, located close to the centre of the North Sea oil industry with direct access to the most sophisticated sub-sea industry suppliers in Europe.
The 1100 m^2 building has a large assembly area within which complete sub sea instrument modules can be integrated and tested. A 125 m^3 immersion tank is used as an acoustic and camera test tank. A 800 litre pressure vessel is capable of testing components and sub-assemblies to 600 bar and a sea-water observation tank allows evaluation of systems in a controlled environment.

Oceanlab II is currently under construction and will be commissioned in May 2009.

Environmental and vibration test rigs provide comprehensive testing of systems. A notable recent success of Oceanlab was the deployment and recovery of free-fall platforms to over 10.000 m depth, and capturing moving images of the world's deepest fishes.

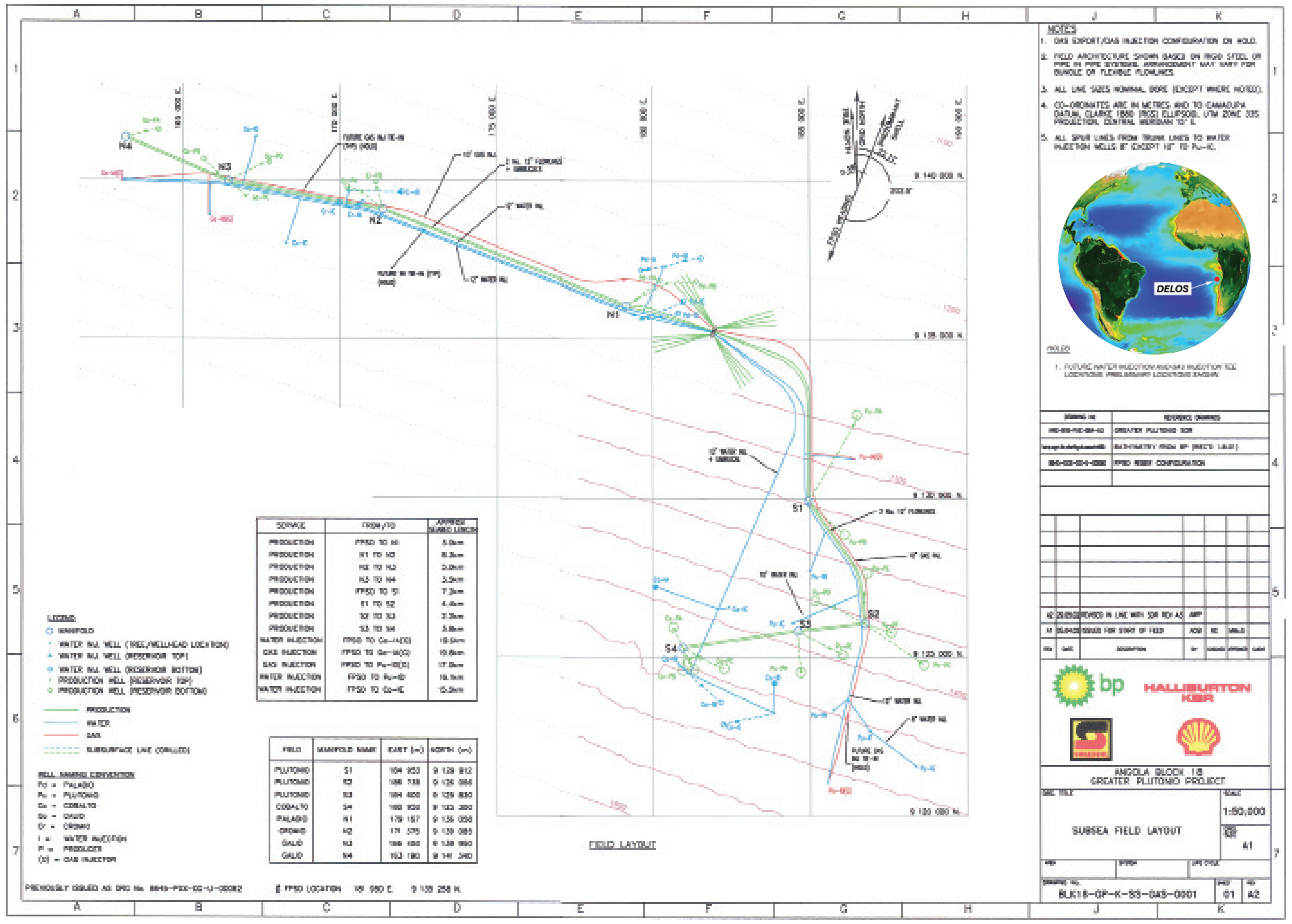
Right from the early days of ESONET CA Oceanlab has been actively involved in designing and developing deep sea observatories. Its latest foray is a joint venture with BP, MBARI, NOC, Glasgow University and Texas A&M University to develop a Deep-Ocean Environmental Long-term Observatory System DELOS.

National Oceanography Centre, Southampton
UNIVERSITY OF SOUTHAMPTON AND NATURAL ENVIRONMENT RESEARCH COUNCIL

DELOS Project

The aim of the DELOS project is to increase our understanding of the deep water areas that BP are gradually extending into, and provide long term environmental monitoring to enhance deep sea scientific research.

Two platforms are to be deployed, one within 50 metres of a sea floor well, and a second 5 miles from any sea floor infrastructure. These platforms will be situated off



West Africa, in the Atlantic Ocean at a depth of 1400m. The platforms will be deployed for 25 years and serviced every 6 months by ROV.
The long term monitoring by the DELOS platforms will allow scientist to:

Determine long term natural environmental conditions at the deepwater site

- Comparison with any changes observed at near field monitoring sites
- Increase understanding of mechanisms linking climate change to deep water ecology
- Measure and monitor deep-sea biological communities
- Understand the pace of recovery from any unforeseen impacts
- Differentiate between natural & man made changes providing a linkage between marine biodiversity & climate change

Determine long term effects of monitoring platform itself on natural processes

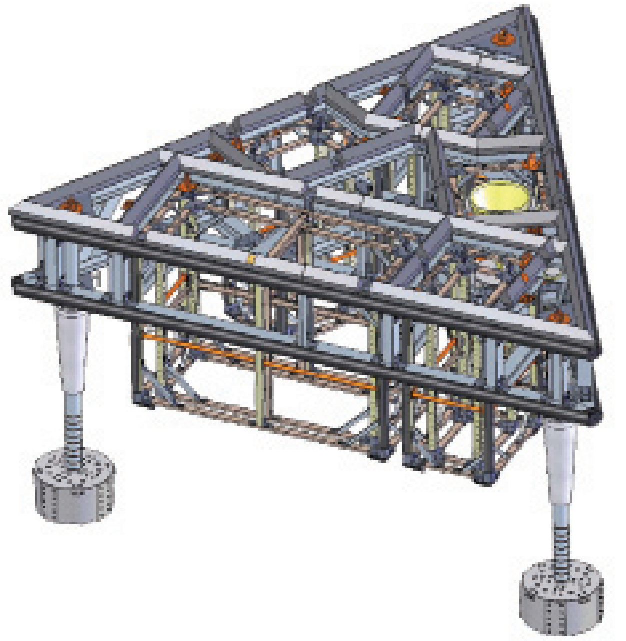
- Understanding on reef effect of large fixed structures in deep water environment
- Contributing to understanding of potential effects of sub-sea equipment in general

Contribute to individual & institutional capacity development in Angola

- Working with Angolan Scientists in international collaboration

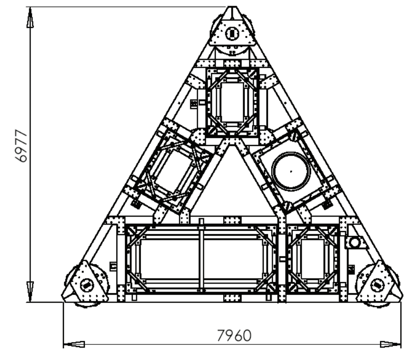
Descripton

The DELOS system comprises two environmental monitoring platforms: - one in the far field (5 miles form sea floor infrastructure); and one in the near field (within 50metres of a sea floor well). Each platform comprises two parts: - the sea floor docking station that is deployed on the sea floor at the start of the monitoring program and remains for the 25 year project duration; and a number of observatory modules that are designed to perform specific environmental monitoring functions. One of each observatory module will be available to each platform. Once deployed each observatory module will have enough battery and storage capacity for autonomous operation for at least 6 months. Towards the end of the 6 month deployment period each platform will require ROV (Remotely Operated Vehicle) intervention to recover observatory modules to the surface for service, calibration and data offload. During this service period no monitoring will be possible at the sea floor however, long periods of monitoring will be possible (months), interrupted by short service periods (days). The scientific steering committee concluded that this interruption to continuous monitoring would not significantly compromise the overall scientific objectives.

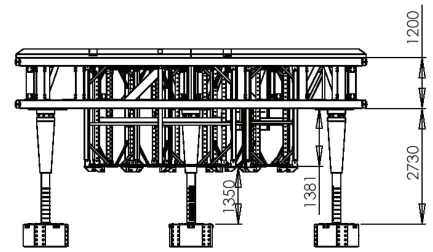


Sea Floor Docking Station

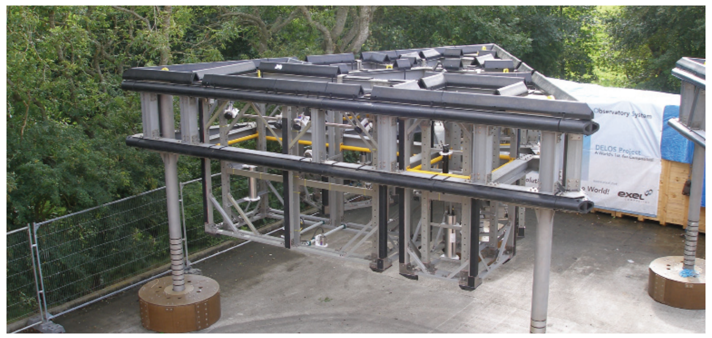
The sea floor docking station is designed to be deployed at the start of the program and left on the sea floor for the 25 year project duration. It consists of a robust triangular glass fibre construction designed to withstand long term sea floor deployment and periodic service by ROV. Glass fibre reinforced plastic is used to eliminate any corrosion effects which may affect sea floor biological processes. A major research project was conducted to determine the long term effects of deep water immersion of composite materials and the final design encompasses this research.



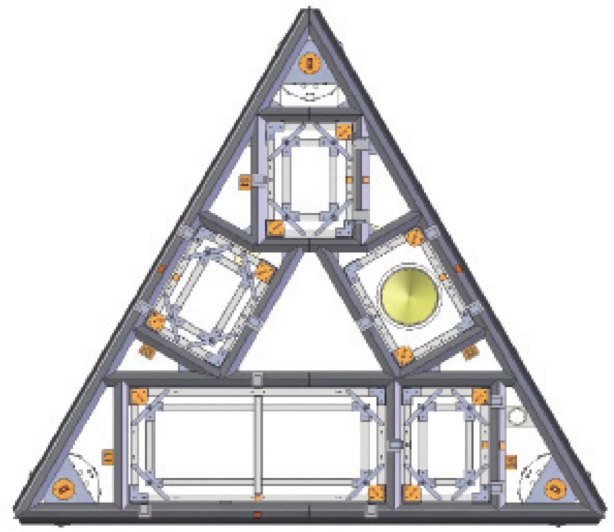
To minimise disturbance to sea floor animals from sea current eddying effects due to the sea floor structure the docking station is raised off the sea floor on legs. This design enables the observatory modules to sample both the water column above the docking station as well as sea floor processes below it.



Using the Oceanlab concept, 2HOffshore Ltd. designed the DELOS framework and Excel composites Ltd. manufactured the frame and modules. Oceanlab also designed and installed the instrumentation for each module.



DELOS platform at Oceanlab for the DELOS Open Day.



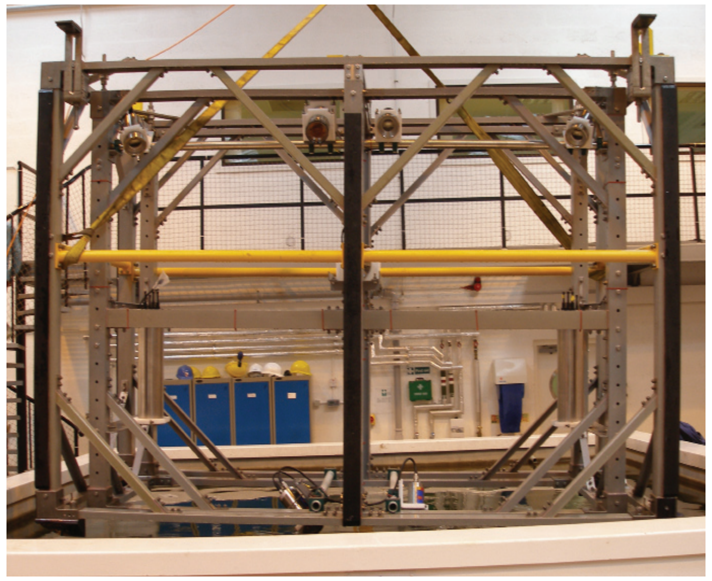
Instrument Modules

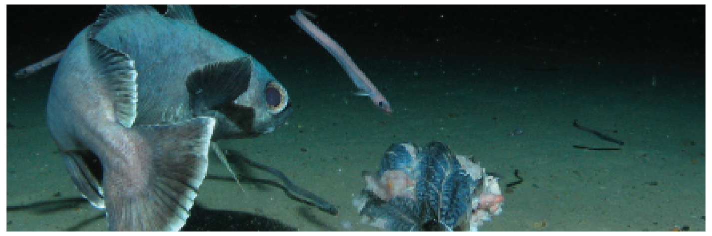
Camera Module
(Near & Far field plataforms)

The camera modules contain two camera systems, a close view and wide view camera system.

Close view camera

The close view camera takes time-lapse close up photographs of the sea floor and associated fauna. In a relatively unstudied area, such as the Angolan continental slope, it is vital that we obtain good quality high-resolution images of the indigenous fauna. The close view stills camera will give us the flexibility required to correctly identify both invertebrates and fishes. We anticipate that these high-quality images will also have considerable public outreach potential as has been highlighted by the ROV images (taken with an identical camera) used as part of the SERPENT project.

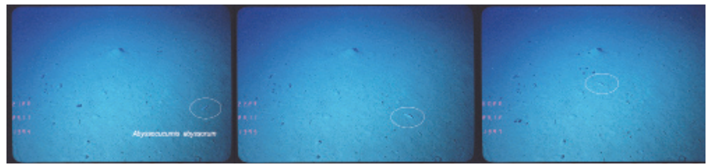




Examples of high quality close view camera photographs

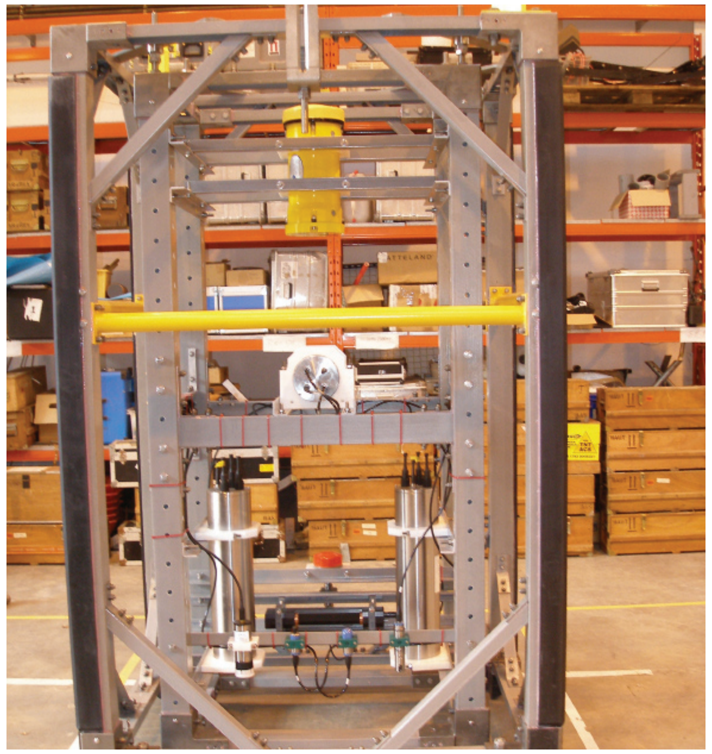
Wide view camera

The wide view camera takes time-lapse photographs of a large area of the sea floor. These observations enable a visualisation of seasonal sea floor sedimentation processes, passing animals and disturbance events over a large 20m2 area. This scale of observation is essential to categorise any patterns of long-term change in the benthic environment over the 25yr life span of the project. This imaging set up has been used to excellent effect in the deep Pacific Ocean, by Prof Ken Smith of Scripps, USA, and is proven technology. The synergy between the close view camera and the wide view camera will allow us to assess large scale and long-term patterns of diversity and community change with accurate identification of anticipated new and novel species.



An example of a time lapse wide view camera tracking a deep sea holothurians' movements across the sea floor.

Oceanographic Module
(Near & Far field plataforms)



Oceanographic module

A suite of oceanographic instruments is essential for any long term monitoring station. They provide background measurements to fully characterise the environment for all other observation modules in the docking station.

Each oceanographic module will house

- -300kHz Acoustic Current Doppler Profiler (current profiles of water column above DELOS);
- -Transmissometer (Wet labs C Star). Measures the total particle load in the water column (this includes organic matter/ sand/ sediment/ etc);
- -Fluorometer (Chlorophyll a). Measures the organic matter content of the particle load identified by the transmissometer ie the "fresh" material or "food" arriving on the sea floor;
- -Local seabed current meter (sea currents close to the sea floor)
- -Conductivity, Temperature, and Pressure sensors
- -Oxygen sensor (measure dissolved oxygen levels available to the local sea floor community);

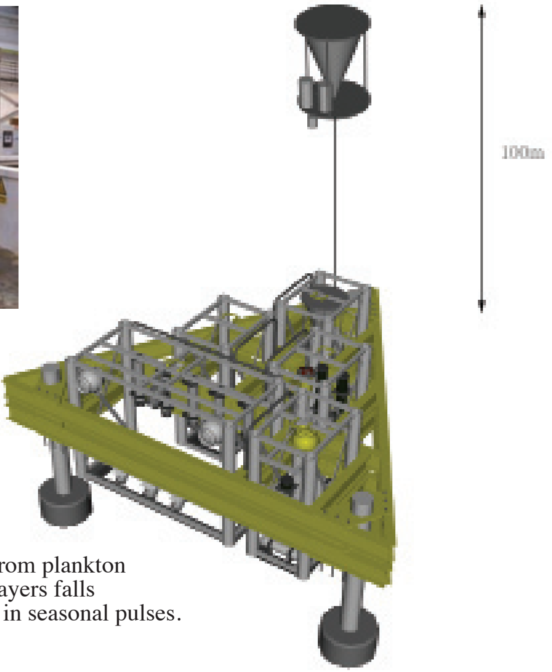
Acoustic Module
(Near & Far field plataforms)

Passive and active acoustics. A passive bioacoustic sensor will monitor the natural sounds generated by animals within its detection range, as well as the background noise level. This system will allow passing vocalising cetaceans to be identified (from characteristic sound spectra) and counted. High frequency active sonar systems enable fish movements to be observed at a lower resolution but at much greater range than photographic systems. This module contains an active sonar system to record movements of fish with suitable target strength to ranges of up to 150m from . form. In conjunction with the passive acoustic . records (amongst other things) background noise level, fish reaction to acoustic disturbance events could be monitored.

Acoustic module

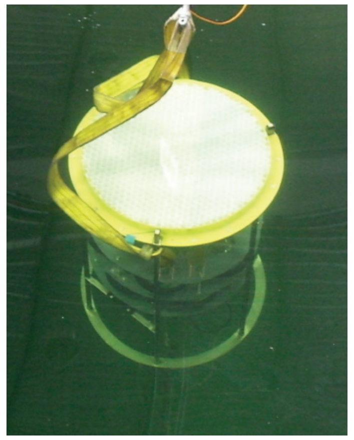
Sediment Trap Module
(Far field plataforms only)

This input of material is the major source of energy for the deep-sea community. A sediment trap collecting and periodically storing this fallout enables the composition and quantity of this energy input to be measured. To represent



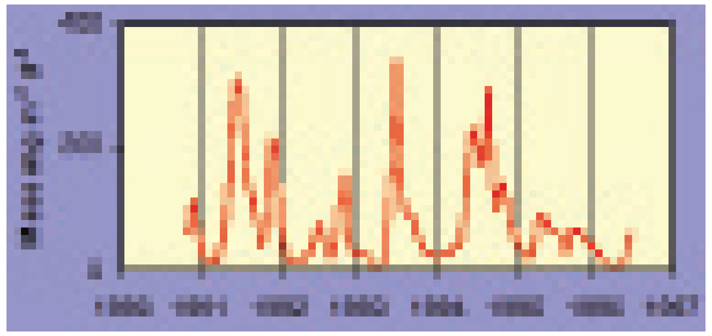
Phytodetritus from plankton in the surface layers falls to the sea floor in seasonal pulses.

an unbiased record of phytodetrial fallout the sediment trap must be a minimum of 100m above the sea floor. To achieve this, a winch unwinds a vertical tether that allows the trap to float at the required height above the observatory. Prior to recovery the winch retrieves the sediment trap back into its module on the frame.



Sediment Trap being tested using ocean lab test facilities

These data along with Transmissometer and Flourometer data will build up a comprehensive picture of food input into the deep ocean site.



Example of long term phytodetrital input to the deep sea caught in sediment traps showing a seasonal cycle.

Guest Modules

(2 guest modules in the near field plataform, 1 in the far field plataform)

Guest modules will initially be left empty and will be available for use in the future. Currently we have applications from both the science community and BP to use some of these modules for new research.

Science

The deep-sea environment into which BP operations are gradually extending is generally poorly understood with surveys regularly discovering new habitats and communities of animals previously unknown to science. There is inevitably a lack of historical data which can be used as basis for baseline knowledge and prediction. It is however apparent that all deep-sea environments support a wide range of animals that contribute significantly to global biodiversity.

By establishing long term monitoring of the deep sea physical environment and biological activity in that environment it should be possible to compensate to a large degree for previous lack of knowledge. Hitherto only two deep-sea sites in the world's oceans have been the subject of long-term studies exceeding 5 years, Station M in the NE Pacific Ocean (Smith et al. SCRIPPS Institute of Oceanography, University of California) at 4100m depth, studied since 1989 and the Porcupine Abyssal Plain (Bengal) station at 4800m in the NE Atlantic Ocean. At both stations important annual cycles have been observed with considerable variability from year to year and changes in dominant fauna over decadal time scales. In an oil production area such spontaneous changes need to be distinguished from any anthropogenic (man made) influences imposed on the deep-sea environment.

DELOS battery packs ready for shipment.

DELOS Frame ready for shipment

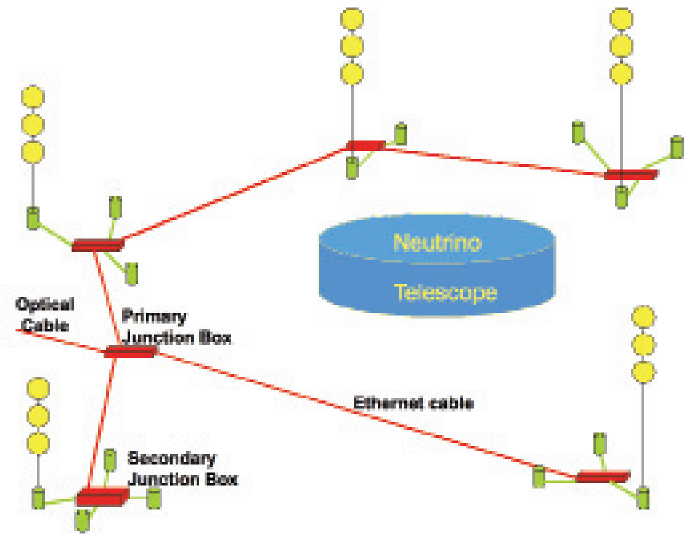
Cabled KM3NeT Observatories

Oceanlab are leading the KM3NeT Earth-Sea Science infrastructure node. The aim of the KM3NeT project is to design, construct and operate a large deep sea research infrastructure in the Mediterranean Sea hosting a cubic kilometre scale neutrino telescope and facilities for associated marine and earth sciences.

The KM3NeT deep sea infrastructure will serve as a platform for a wide spectrum of marine and geological scientific research. For these "associated science" projects the permanent connection to the shore for powering and acquiring real time continuous sensor data is of great value. Such permanent connections from the deep sea to the shore are rare. The neutrino telescope pilot projects, which already feature extensive programmes in oceanography, biology, and geology are part of the ESONET/EMSO programme and are all cabled observatories.

The Earth-Sea Science node Concept

The underwater architecture for the KM3NeT network will consist of a subsea cable connecting the observatory to the shore station and a series of nodes and branches connected



to the cable via junction boxes as shown in the conceptual diagram below.
Each junction is capable of supporting a series of instruments and modules via wet mateable connectors. The power and data links between the shore station and the primary junction boxes is via optical fibre. The links between the primary junction box and the secondary junction boxes are envisaged as either optical or copper Ethernet cable and those between the secondary junction boxes and the instruments are either by copper Ethernet cable or an asynchronous serial link such as RS422, RS485 or RS232. This choice is open and corresponds to most of the modular designs experienced in oceanography. The voltage currently envisaged for the network is up to 10kV DC to the primary junction box. Power converters are then used to supply 400V DC to the secondary junction boxes. The bandwidth required by the Earth-Sea science infrastructure will be driven by the

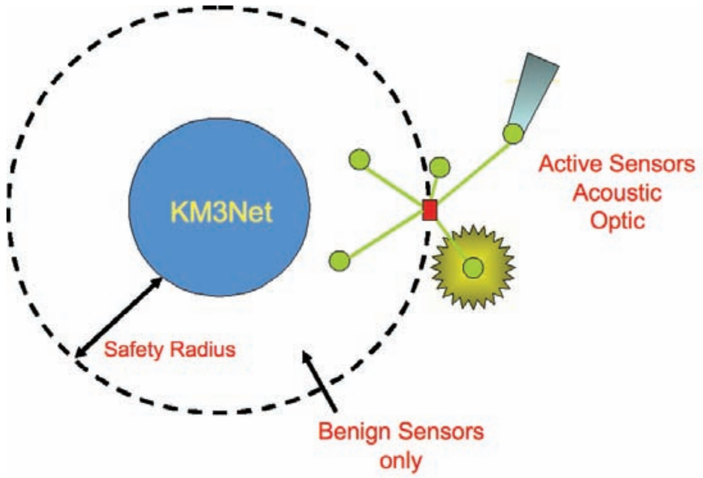


image and acoustic data. In the case of high definition video this will consist of data streamed at a rate of approximately 25 Mb/s.

The Earth-Sea science infra structure will be continually evolving and is to be designed in a flexible manner so that adding components can be achieved in a simple and cost effective manner. This infrastructure will comprise several instrument types such as seismometers, pressure sensors, fluorescence detectors, CO2 and O2 sensors, conductivity, current and temperature meters. Acoustic modules, still and video cameras are also foreseen. Additional sensor data provided by the Neutrino array for calibration and position purposes will be made available to the science community.

A safety distance between the neutrino array and the associated science nodes has to be defined and agreed between the astrophysics and the science communities. The position of an associated science node relative to the array, shown in the diagram below, will need to take into account this safety distance and the optimum position for the best scientific results.

KM3NeT Operations

A joint operations management of the marine science infrastructure and the neutrino telescope will be set up. This body will be responsible for coordinating deployment, maintenance and emergency situations. It will also coordinate data sharing between the neutrino telescope and the associated sciences projects. In addition the neutrino telescope and the Earth-Sea sciences infrastructure will each have their individual management structure to deal with "local issues".

Three categories of observatory operation are recognised:

- Operational and Civil Protection
  - o Earthquakes
  - o Tsunamis
  - o Oceanography GOOS (Global Ocean Observing System) contribution
- Ocean & Geosciences Research
- Engineering Trials.

Due to the different operational requirements in terms of availability and reliability, the Earth-Sea science user community will have a co-ordinating body which could be managed according to the standards and procedures established in ESONET NoE such as the concept of Regional Legal Entity. This body would ensure efficient integration between the KM3NeT Earth-Sea science communities, environmental agencies and organisations at the national, regional and international level including ESONET, EMSO, GOOS and Kopernikus thus maximising dissemination and use of data.

The observatory is to be service on a six or twelve monthly basis during its life time. This will enable instruments to be replaced or upgraded, new instruments to be added and new branches to be created.

The KM3NeT consortium released the conceptual design report (CDR) in April 2008 and is now preparing the technical design report (TDR).

These three websites contain further details of these projects:
www.delos-project.org
www.oceanlab.abdn.ac.uk
www.km3net.org

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