BBC NEWS

Exploring the last frontier

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Some describe them as one of the last unexplored frontiers on Earth.

They cover three-quarters of our planet's surface; play host to thousands of species; and have a critical role in controlling weather and climate. Yet scientific research has barely skimmed the surface of the world's oceans.

"At the moment, we are in the Dark Ages with respect to observing the oceans," says Steve Bohlen, president of the Joint Oceanographic Institutions (JOI), a consortium of US oceanographic research centres.

Dr Bohlen explains that most oceanographic science has been largely limited to research cruises, which survey a small area of the sea for a very limited period of time, or satellite studies that can only probe the oceans' uppermost reaches.

But, he says, this could all be about to change.

Technological advances

To look at the movements of oceanic plates, to monitor marine life or to study salinity and temperature changes at the sea bed, scientists effectively need underwater laboratories where long-term experiments can be carried out, providing continuous flows of data that can be easily accessed.

> **Everyone anticipates that we are really going to revolutionise our understanding of the oceans**
> **Steve Bohlen**

So, researchers said, why not piggyback off the recent advances in the telecommunications industry to create them?

Etienne Lafougere, general manager of submarine network activity at telecommunications firm Alcatel-Lucent, says: "Hundreds of thousands of kilometres of cable networks have been deployed in the oceans, allowing information to be sent around the world at the click of a button."

But instead of just using these information highways to connect one country to another, he says, why not simply leverage the technology to power and feed information to and from these proposed deep water labs?

The success of prototype observatories such as the Hawaii 2 Observatory (H2O), created in the late 1990s off Hawaii's coast using disused submarine telephone cables, kick-started scores of institutions' own underwater endeavours.

The idea behind them is simple, says Adrian Round, project manager of the University of Victoria's VENUS (Victoria Experimental Network Under the Sea) observatory, which is based in southern British Columbia, Canada.

A loop of submarine fibre optic and power cable is positioned on the ocean floor, he explains; located at various points along the cable are "nodes" - interfaces where bundles of scientific equipment can be attached.

Dr Round says: "You can have temperature and salinity sensors down there, cameras, videos, high resolution sonar systems, even remotely operated vehicles (ROVs) can be attached.

"And you plug the science package in underwater and you can sit at your desk anywhere in the world and actually interact in near real time with your instruments."

The VENUS project already consists of one up-and-running scientific array based 3km (2 miles) off the Saanich Peninsula at 100m-depth (330ft). The coastal observatory's instruments, which include still cameras and sensors, have been operating since 2006.

Already, the project has provided some interesting insights.

Researchers expected this area to remain pretty constant, comments Dr Round, but already the instruments have shown that the patch of water varies wildly on almost a minute-to-minute scale.

The second phase of the initiative is to install a 40km (25 mile) length of cable to survey the deeper waters of the Strait of Georgia.

Moving plates

VENUS is paving the way for some even more ambitious projects.

Last week, 800km (500 miles) of submarine cable set sail aboard a huge ship from Calais in France, where Alcatel-Lucent's cable making factory is based, towards Canada.

It is to form the basis of the North-East Pacific Time-Series Undersea Networked Experiments (NEPTUNE) Canada underwater observatory.

The great length of cable is to be installed during August and September over the northern part of the Juan de Fuca tectonic plate, a 200,000 sq km (77,000 sq miles) region off the coasts of British Columbia, Washington and Oregon.

Phase one of the 300 million-Canadian-dollar (£140m) project, due to be completed in 2008, will see scientific instruments placed in five or six areas of the plate, at up to depths of 3km (2 miles).

Like its testbed VENUS, real-time interactive work will take place to monitor the changing ocean conditions and marine life in this region of the Pacific.

The project will also, given its location on one of the Earth's tectonic plates, be able to look at the seismic behaviour of the ocean crust, aiding research into earthquakes and tsunamis.

Problem solving

Linked to NEPTUNE Canada is the planned Ocean Observing Initiative (OOI), which aims to monitor an even larger area of the Juan de Fuca plate.

Still at the conceptual design stage (it is projected to be operational within about six years), it again would involve a number of nodes sited at key spots around the plate.

JOI's Steve Bohlen says the sheer scale of the project will inevitably involve finding new technological solutions for potential problems, such as how to recharge batteries for ROVs at the bottom of the sea.

Help for these tasks will be at hand from another testbed array - the Monterey Accelerated Research System (Mars), based at the edge of the Monterey canyon.

Currently in construction, the system, which will eventually consist of a 52km-long cable (32 mile) linked to a central node, will be available for use by researchers to test out new instruments and technologies that may eventually be used in the larger observatories.

Plans are also afoot for more of these systems in other parts of the world

These include the European Sea Floor Observatory Network (Esonet), which is proposed to monitor areas in the Atlantic and Arctic Oceans as well as the Mediterranean and Black seas, and Japan's Arena (Advanced Real-time Earth monitoring Network in the Area) array which will be focusing on the seismogenic zone around Japan.

Key insights

Dr Bohlen says he expects to see more and more of these systems coming online in the next few decades.

He says: "While I don't envisage that, in the next 50, 60, 70 years, all of the oceans will be cabled up, I do think that around the coasts and the continental shelves of many countries that there will be economic, security and scientific incentives all of which will drive nations to develop systems."

The trick, he says, will be to try and find a way to connect the information.

By having longer time-series of oceanographic data from around the world, scientists hope that eventually they will begin to build up a bigger picture of some of the complicated interactions that are taking place within the oceans.

Steve Bohlen says: "Everyone anticipates that we are really going to revolutionise our understanding of the oceans.

"And that will really revolutionise our understanding of how the planet works.

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