November•December•2006

UNDERWATER

ADCI Blue Pages Directory

PLANT SURVEYS WITH NO SHUTDOWN TIME P.12

ANNUAL COMMERCIAL DIVE TEAM PICTORIAL P.51

UI2007 TECHNICAL PROGRAM PREVIEW P.74

A Cabled Seabed Observatory In the Middle East

Lou Tapscott's Lighthouse R&D Enterprises is studying current direction, eddies, and earthquakes, and the potential impact of such ocean phenomena on coastal communities.

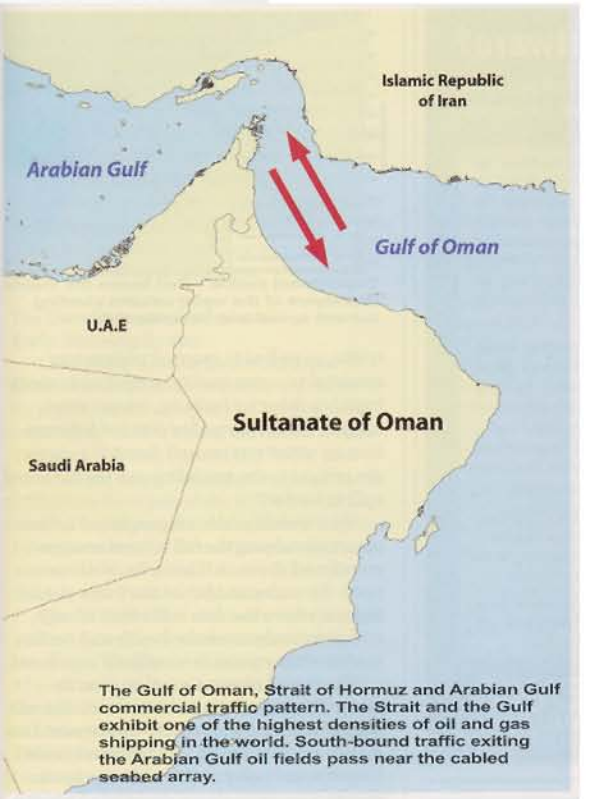
As man gains oceanographic knowledge, we continually improve our ability to predict and proactively respond to opportunities and challenges presented by ocean phenomena. Lou Tapscott firmly believes the data that Lighthouse R&D gathers and documents contributes to a better understanding of the oceanic ecosystem, including impact on wildlife, natural cyclical marine changes, and mapping of patterns to help predict likely pollution migration. Lighthouse's commitment to advance oceanographic understanding that will positively impact residential and commercial ocean communities is what fuels its determination to unlock these mysteries.

The LORI Program

The company's flagship project is the Lighthouse Oceans Research Initiative (LORI), which has its primary installation off the coast of Oman. Through his earlier work in the Gulf of Mexico with one of Deep Star's projects, Met Ocean, Tapscott became aware of the importance of loop currents. With a vision of the potential global impact of such patterns in deeper water, he continued research in this field.

The Gulf of Oman is one area that revealed a major loop current. With the interest and crucial support of Oman's Ministry of Fisheries and Agriculture, in 2005 Lighthouse completed Phases I and II of the LORI program.

As a result of its position at the northern margin of the Arabian Sea, the Gulf of Oman is a dynamic marine environment driven by the seasonal extremes of regional monsoon events. Aside from environmental variations, the Arabian Gulf is subject to real and potential pollution from the heavy traffic of large oil tankers entering and leaving the Arabian Gulf. Ballast water discharges, spills, and other effluents associated with such traffic are a continuing concern for Oman, whose pristine Batinah



The Gulf of Oman, Strait of Hormuz and Arabian Gulf commercial traffic pattern. The Strait and the Gulf exhibit one of the highest densities of oil and gas shipping in the world. South-bound traffic exiting the Arabian Gulf oil fields pass near the cabled seabed array.

coast is under development as a national resource for underutilized fisheries and an emerging recreational industry exploiting sport fishing, diving, and other tourist attractions.

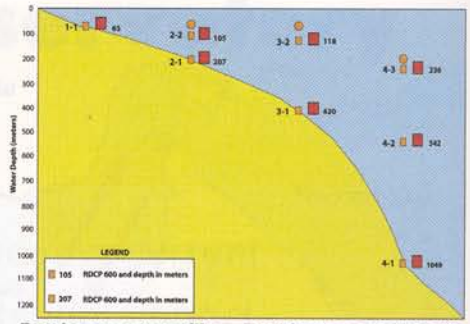
The Sultanate of Oman has a vital interest in preserving and protecting the coast. The deployment of oceanographic sensors is providing essential data necessary for monitoring existing conditions as well as predicting environmental impacts in the event of an accidental release of substances that might threaten the coastal habitat.

The global oceanographic community is mobilizing and planning seabed arrays to monitor ocean parameters through cabled instrument strings reporting to a coastal station where data is fed to researchers. Several such links are in place in Canada, the Pacific (Hawaii), Japan, the east coast of the United Sates, and elsewhere. The European community plans for extensive observatories under the European Seafloor Observatory Network (ESONET) program, where over 11 countries will share marine data.

In the past year, the Sultanate of Oman's Ministry of Agriculture and Fisheries has fielded an array of instruments to record current speed and direction, temperature, salinity, oxygen, and turbidity, leading the way to a Middle-Eastern data collection system in a vital region not yet studied in detail. The Sultanate of Oman's Marine Science and Fisheries Center (OMSFC) has emerged as the leader in oceanographic studies of the northern Arabian Sea through its four offshore sites, which record on an hourly basis.

How It Works

Data is collected onshore and forwarded to the OMSFC, forming the basis for environmental assessments to measure seasonal variations associated with monsoon activity. The array was positioned to intercept signals from any release from the Arabian Gulf shipping



Deployment profile – Red boxes are insonified layers of the water column yielding current speed and direction data.

traffic, as well as to monitor parameters essential to water quality assessments meaningful to fisheries (salinity, temperature, oxygen, etc.). It provides detailed information on water motion and density, as both are critical to the modeling and prediction of spill behavior.

Four seabed nodes are connected to base arrays containing the full suite of sensors mentioned above. A fiber optic cable connects the nodes and leaves the water at Abu Bakara, where the data collection, storage, and early analyses on the health and performance of the system is constantly monitored.

The cabled observatory thus extends about 60km northeast across the Al Batinah coastal shelf, providing real-time ocean data monitoring the health and potential threats from natural and possible anthropogenic causes. Closest to shore, designated 1-1, is a stand-alone seabed measurement system at a depth of about 213 feet (65m). Since the current speed and direction are acoustically measured in thin, 2m layers (cells, or "bins") to a height of 50m above each sensor, 1-1 is monitoring currents in nearly all the water column. Array 4-1 and its moored instruments at two levels above the seabed, along with the single moorings above arrays 2-1 and 3-1, provide a real-time snapshot of water motion in the overlying shelf waters.

The base of each array is housed in a trawl-proof cage, which protects all sensors from fishing damage while acting as an instrumented tether for the deeper buoyed arrays. They weigh about 37,000 pounds and are designed to withstand any dragging or other displacement of observatory components.

To increase the accuracy of numeric modeling, three autonomous moorings were set 60 nuaitcal miles off of Oman's Cape Ras Al Hadd. These arrays are positioned to monitor the currents coming out of the Arabian Gulf, coming up the coast from the Red Sea, and within the convergence area off the Cape.

Another stand-alone array is set off the South Eastern Margin of the Murray Ridge in the Northern Arabian Sea. Data from the autonomous moorings are retrieved annually.

Cabled seabed observatories are generally considered prototype installations and, as such, are not without problems. The Al Batinah deployment has been no exception. Electronic systems in the sea are always subject to numerous hazards, and the Batinah systems have seen sensor failures, power interruptions and mechanical problems related to complex instruments operating continuously hundreds of feet below the surface. The cabled observatory is a prototype, which through troubleshooting, analyses and repair, provides increased confidence in continued and improved data collection.

The Development of a Tsunami Early Warning System

Continuing interest by the Sultanate of Oman for ocean measurements and monitoring for public safety is also leading to its critical role in developing the Indian Ocean Tsunami Warning System (IOTWS). As a result of the tragic December 2004 tsunami, 27 nations have joined the IOTWS under a multinational program being directed by the Intergovernmental Oceanographic Commission under the United Nations Education, Science and Cultural Organization.

The IOTWS effort was launched through at least sixteen international coordination meetings. The Oman meeting was held in Muscat in June 2005 and was coordinated by Dr. Ahmed H.M. Al-Harthi, acting Director of Meteorology, Ministry of Transport and Telecommunications. The purpose of each national assessment is to help coastal states establish and operate a tsunami warning and mitigation system, assess available organizational resources, and identify capacity building needs.

Dr. Al-Harthi (a.alharthi@met.gov.om) is the designated official Omani contact for receiving instant transmissions of both Pacific Tsunami Warning Center and Japan Meteorological Agency bulletins, which provide warnings of possible tsunami threats.

The IOC/UNESCO Communications Plan regarding early warning and public awareness mentions the need for monitoring the Makran tectonic zone of eastern Iran/western Pakistan. This active zone produced a tsunami in 1945, which reached the Omani coast within 30-60 minutes. It suggests a tripartite cooperative venture in the installation of a real-time warning system around the Makran region.

By applying lessons learned in the current cabled seabed observatory experience Lighthouse R & D Enterprises is developing a seismic/tsunami system and hopes to field the first prototype system in the Gulf of Oman in December 2006.

Beginning with a youthful fascination with the coastal waters of California, Lou Tapscott's focused work and creative vision are making his dream reality. The LORI program is enhancing our understanding of ocean phenomena and protecting commercial and residential ocean communities. **UW**

November•December 2006