APPLICATION OF DEEP DIVING TECHNOLOGY TO SCIENTIFIC EXPLORATION

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Introduction

In response to industry and military needs diving technology has developed dramatically in the last 20 years. Of primary interest to scientists today is the technology allowing divers to work at deeper depths, specifically depths between 50 and 100 m. Although there are scientists working at these depths, their numbers are relatively few. In order for deep diving scientists to become more commonplace the scientific community must develop new paradigms for applying this technology. Application of the deep diving technology is relatively straightforward requiring only minor adjustments to adapt it to scientific investigations. Development and institutionalization of standards, procedures, and administrative protocols specific to academic institutions may be the greater challenge. Development of funding mechanisms to support this activity and acquiring the necessary pool of experienced personnel also pose significant challenges.

Lead by the staff of the Center for Coastal Studies of Texas A&M University-Corpus Christi scientists and students from various universities of the Gulf States utilized deep diving technology including trimix, rebreathers, and deep air decompression dives in pursuit of scientific objectives. Most of this work was based from oil/gas production platforms off Texas and Louisiana in the northwestern Gulf of Mexico. This work was productive in expanding knowledge of the artificial and natural reef system dynamics and clearly demonstrated the value of deep diving technology to the pursuit of scientific objectives.

Technology

The research projects of the Center for Coastal Studies (CCS) teams were conducted in a relatively “ideal” environment that maximized safety and productivity. The platforms provided stable decks in water depths in excess of 350 m. There was ample room for equipment and electricity to run equipment. Emergency evacuation by helicopter was available at all sites and sea-to-land communication networks were
well established. Below water, the platform structures provided opportunities to stage equipment such as extra gas bottles for emergency use. Down lines for decompression were stationary, not subject to the pitch and roll of a support vessel. And, the platform owners helped underwrite the cost of these expeditions.

The CCS teams utilized trimix and deep air decompression technology on these platform-based projects. All dives were made with scuba technology. To support emergency first aid needs a recompression chamber was installed on site.

All existing deep diving technologies can be applied to scientific explorations. Each project must be evaluated to determine which technology best suits that specific need. Available funding, location, team experience, and emergency response infrastructure must be considered.

Administrative Protocols

Most scientific divers are scientists and students associated with universities and resource managers employed by government agencies. Following OSHA exemptions for “scientific diving” these institutions and agencies rely upon the American Academy of Underwater Sciences to set standards and provide the administrative/legal foundation for the application of diving technologies to the pursuit of scientific objectives. Deep diving (>50 m) will require those responsible for institutional risk management to re-evaluate the institutional position on scientific diving. Universities will be particularly sensitive to these new risks due to the nature of the clientele they serve, primarily young students. Scientists and dive officers will face added responsibilities relative to the increased risks inherent in deep diving.

Standards

The scientific diving community and those institutions/agencies supporting scientific diving look to the American Academy of Underwater Sciences (AAUS) to establish standards for training, safety, and project implementation. “Scientific diving” is a unique form of professional diving. Purposes and objectives vary significantly from those of military, commercial, and recreational diving enterprises. Hence, standards must reflect this uniqueness and provide the diving scientist options to achieve the project objectives within the boundaries of funding, team experience, and established acceptable risk.

The AAUS is an organization run by the clientele it serves; the diving scientist, student, and supporting institution. In the process of establishing standards for deep
diving opinions and debates will cover the spectrum from being too conservative to being too lax. As a supporting professional organization with a critical mission and responsibility in the advancement of diving technology as a tool to scientific discovery, the AAUS must embrace standards that adequately serve the need for risk management without stifling scientific productivity, or worse, forcing the diving scientist into a renegade operating protocol. On the other hand, the diving scientist must recognize and accept the need for standards suitable for the activity and increased risks.

**Procedures**

All diving is technical and deep diving requires the application of increased levels of specialized technology. To utilize these technologies, procedures unique to deep diving will have to be employed. Project scientists and dive officers need to be aware of this and committed to accepting procedures that minimize risk factors.

Deep diving will require more training for the divers and expanded surface support teams. Equipment not normally employed by scientists on shallow water projects (<50 m) such as gas mixing equipment, rebreathers, diver tracking electronics, wireless communication equipment, and recompression chambers will be necessary. The technology and skills of diving will necessarily become a primary focus, more so than in the application of standard (i.e., recreationally based) scuba technology to scientific missions. Equipment maintenance between scientific missions will require expanded effort and funding. And, paperwork to track training, experience, and equipment maintenance will also increase.

**Experience**

Experience in deep diving is a critical factor. Relatively few of those involved in scientific diving are experienced at deep diving. Research and scientific diving involves a broad spectrum of practitioners, male, female, young, old, mature, and not so mature. The academic institutional setting strives to be non-restrictive, and scientists, who are often faculty members as well, are pressed to involve individuals who may not be suited to deep diving activities. Hence, standards for training and experience must be codified to provide dive officers and principal investigators a framework for excluding unsuitable candidates while staying off the slippery slope of “discrimination.”

It is not likely that every academic institution can or will maintain the necessary core of experienced deep divers and specialized equipment necessary to routinely carry out deep diving projects. And often, there is a significant down time between
deep diving projects during which the challenge will be to maintain skill proficiency and equipment condition. In the university system, students trained in deep diving technology graduate, leaving gaps in the team. The research community must develop mechanisms to share personnel and equipment. Programs such as the National Undersea Research Program must be maintained as a source of experience, equipment, and funding support.

Funding

Projects involving deep diving technology will be more costly by several orders of magnitude. Specialized equipment, more equipment, more surface-support personnel, increased emergency response infrastructure, higher levels of training, etc., will drive up the cost of projects. Funding agencies such as the National Science Foundation will have to recognize and accept the reality of greater cost for deep diving projects, as will the supporting academic institutions and resource management agencies. Legislative bodies will need to be informed and convinced of the value of programs such as the National Undersea Research Program, which can and should be a major driver in the advancement and application of deep diving technology.

On a cautionary note, university scientists and students are famous for finding ways to accomplish research objectives on a shoestring budget. However, in the application of deep diving technology, this ingenuity could be a liability if safety is compromised to stay within budget. It is the responsibility of the deep diving scientist to educate the funders and press the need for adequate funding to carry out deep diving missions that stay within established acceptable risk boundaries. Dive officers and diving control boards will need to be vigilant and disciplined in controlling deep diving projects.

Conclusion

The application of deep diving technology to scientific missions will greatly advance our understanding of aquatic ecosystems. This technology can and should be applied to scientific missions. However, it must be done within boundaries of acceptable risk. Dive officers, scientists, institutional administrators, funding agencies, and the American Academy of Underwater Sciences must all recognize the unique challenges involved in deep diving and accept the responsibility for applying deep diving technology in a manner that minimizes risk. Standards and procedures must be developed and codified that recognize the uniqueness of scientific diving and provide the practitioners of deep diving an administrative/legal platform from which to operate. Funding must be adequate to apply advanced deep diving technology in a manner that ensures that the projects occur within the boundaries of acceptable risk.
Programs such as the National Undersea Research Program should be supported and enhanced as a leader in the development and implementation of advanced diving technologies.