אוניברסיטת חיפה
University of Haifa
جامعة حيفا

HMS
מרכז חיפה למחקרי מדיניות ואסטרטגיה ימית
Haifa Research Center for Maritime Policy & Strategy

MARITIME STRATEGIC EVALUATION FOR ISRAEL 2017/18

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The Mediterranean Sea Research Center of Israel (MERC)

Zvi Ben-Avraham

The Mediterranean is only 1% of the world's oceans, but its waters bordered by 19 nations. Millions of people live and work along it shores and depend on its waters for their livelihood, affecting its natural environment.

The discoveries of huge reserves of natural gas in the Mediterranean Sea off the coast of Israel, estimated at 2% of the world's global natural gas reserves, pull the Mediterranean Sea into the international spotlight and onto Israel's national agenda. These developments present Israel with unprecedented scientific and technological, economic, security, environmental challenges and opportunities which the State of Israel beginning to address.

In response to these developments, in 2012, the University of Haifa was chosen by the State of Israel to lead the national marine consortium, "Mediterranean Sea Research Center of Israel" (MERCI) – an organizational umbrella for the entire scientific community dealing with research on the eastern Mediterranean - seven universities, one college and two governmental research institutes:

University of Haifa; Technion – Israel Institute of Technology; The Hebrew University of Jerusalem; Ben-Gurion University of the Negev; Bar-Ilan University; Tel-Aviv University; Weizmann Institute of Science; Ruppin Academic Center; Israel Oceanographic and Limnological Research; Geological Survey of Israel.

MERCI brings together scientists from all relevant and necessary disciplines to meet the important scientific and technical challenges in the coastal and offshore Eastern Mediterranean. In parallel, it continues its mission to develop advanced infrastructure to study the Eastern Mediterranean comprehensively. MERCI encourage interdisciplinary, inter-institutional projects that will foster cooperation between researchers from a wide range of scientific fields.

The Mediterranean Sea Research Center of Israel focuses on:

- Developing and purchasing modern, scientific infrastructure needed to study the coastal and offshore Eastern Mediterranean
- Supporting marine scientists and researchers to be the academic guards of Israel's decision makers, and serve the government, industry and NGO's
- Aiming sustainable development of Israel’s national resources in the Eastern Mediterranean

Israel's energy and environmental policy-making must be driven by the highest caliber of interdisciplinary scientific research. MERCI's activities set Israel on the path to academic

excellence and sustainable energy independence that will ultimately strengthen Israel at home and abroad.

The situation of marine research and infrastructure in Israel **before MERCI was established was poor**. There was little equipment dedicated to modern, high-quality shallow and deep marine research, and national monitoring programs were few and under-budgeted. Large-scale research was limited to the 50-year old outdated research vessel the R/V Shikmona.

MERCI institutions invested many of the initial funding in purchasing the necessary infrastructure required to conduct modern, interdisciplinary shallow water and deep-sea resources. Today, 5 years later, MERCI has strong toolset to study areas that were previously off limits due to water depths. The entire academic community in Israel can benefit from this marine platform.

The use of this equipment enables us to study important issues such as:

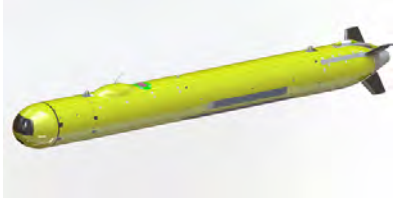
- Gas/fluid seeps on the seafloor and their consequences
- Submarine landslides and slumping and their potential hazard
- Life in the deep sea
- Deep sea ship wrecks

Examples of MERCI Main Marine Platform:

Remotely-Operated-Vehicle (ROV) – Haifa University

A work class Remotely-Operated-Vehicle (ROV), capable of operating to 3,000m depth, equipped with 11 powerful electric thrusters for outstanding maneuverability, a Schilling Orion 7P manipulator, cameras, survey sonars and a dedicated scientific skid allowing the installation and testing of additional sensors and the collection and storage of samples.

Autonomous Underwater Vehicle (AUV)- Haifa University



A medium size (0.5m in diameter, 6m in length) Autonomous Underwater Vehicle (AUV), rated to 3000m depth, equipped with synthetic-aperture-sonar (SAS), camera stereo-pair, sub-bottom profiler, obstacle avoidance system

and a dedicated section allowing the testing of own developed subsea mechanism and sensors, hardware and integrated software

Sea Gliders – The Hebrew University of Jerusalem, Weizmann Institute of Science and Bar-Ilan University

The Sea Explorer, manufactured by Alseamar, is an underwater glider driven solely by buoyancy changes, with no external moving parts. This autonomous scientific platform is rated to 700m depth and equipped with an array of physical, chemical and biological sensors. The glider is capable to stay at sea for long durations (up to 8 weeks) and provide a very large spatio-temporal coverage, collecting water column data profiles, while traveling in a saw-tooth trajectory through the water. Gliders in general are a very cost-effective solution for data collection as they greatly reduce the use of large research vessels, are monitored from shore via satellite link and are easily deployed and recovered by use of small boats.

ICP MS – Weizmann Institute of Science

Laser Ablation – Inductively Coupled Plasma – Mass Spectrometer (LA-ICP-MS). The system is composed from an Agilent 7700 ICP-MS coupled to a Laser Ablation NWR 213 from ESI.

The Agilent 7700 ICP-MS is configured for routine analysis of high matrix samples, and includes HMI (Hight Matrix Introduction), pre-set plasma conditions and He mode ORS as standard. Shield Torch System (STS) provides effective plasma grounding, reducing and narrowing the ion energy spread. The Octopole Reaction System (ORS) works effectively using He mode, for simplified operation and consistent results, even in complex sample matrices. A unique 3rd generation collision/reaction cell is utilized in all 7700 Series instruments to remove spectral interferences that might otherwise bias results.

The Laser Ablation NWR 213 is a 213nm solid state laser ablation. It has a > 30 J cm-2 fluence (energy density) at the sample surface, with widest spot size range of 4-250 microns and unmatched High Definition Viewing with 3 LED based light sources and cross polarization.

FACS – Ben-Gurion University of the Negev

Florescence Activated Cell Sorter – FACSAria III (BD) is a high performance multi-dimensional analysis and cell-sorting instrument. It can analyze suspended particles (0.5µm-70µm in diameter) at up to 30 kHz. With two light scattering channels (FSC &

SSC) and 13 florescent channels, FACSAria III can detect and isolate up to four cell populations simultaneously (e.g. stem cells from peripheral blood) that can be cultured and used in further experiment. FACSAria III allow single cell sorting with automated cell deposition unit.

Isotope Analyzer – The Hebrew University of Jerusalem

A Nu Perspective isotope ratio mass spectrometer is used for measurements of carbonate clumped isotopes. This is a new geochemical technique, based on the abundance of chemical bonds between two heavy isotopes, 13C-18O, in CaCO3. This abundance is temperature dependent and provides a geochemical thermometer used in shells of marine organisms to determine sea surface temperature in the geologic past. It is also used in freshwater organisms and in cave deposits (stalagmites) in order to decipher past climatic conditions on land and the interplay between seawater and rainfall. For example, we use this technique in a variety of Pleistocene carbonate archives in Israel to study glacial-interglacial temperatures and rainfall patterns and the links between these and the Mediterranean Sea as the main source of moisture.

BAT-GALIM vessel

R/V Bat Galim – Owned by the Ministry of Energy and operated by Oceanographic and Limnological Research (IOLR)

R/V Bat Galim is a general-purpose research vessel serving the needs of governmental agencies and academia. It has the capabilities to map, sample and analyze the water column, seafloor and sub-bottom at depths of 10-3,000 m.

R/V Bat Galim is also equipped to combat oil spills, operate work-class ROVs, other autonomous equipment, and for search and rescue missions.

The Bat-Galim serves as a national research infrastructure for all academic institutions, research institutes and government ministries, regardless of membership in MERCI. It is a non-profit operational at the lowest possible cost for these entities.

Mediterranean Explorer vessel

R/V Mediterranean Eplorer – Owned and operated by the NGO Eco ocean

The Mediterranean Explorer serves as a national research infrastructure for all academic institutions, research institutes and government ministries, regardless of membership in MERCI. It is a non-profit operational at the lowest possible cost for these entities and subsidized via the NGO.

Strategic R&D Plans for the upcoming 5 years

The Mediterranean Sea is facing a major crisis. Global warming is effecting this area quicker and more drastically than most other places in the world, with an expected rise of ~ 3ºC over the next 30 years. It is vital to understand how this unique bio-geo-chemical system works and how it reacts to past, current and future changes. This is why MERCI is so committed to supporting high-quality research across disciplines and research institutes.

In addition to the rising sea tempertures, its terrestrial counterpart will witness increasing droughts, fires and a chronic shortage of water. These compounding issues will lead to a decrease in ability to maintain land-based agriculture, due to the expected rise in evapotranspiration. Even marine heritage sites suffer from natural weathering, unlawful excavation, and the construction of underwater infrastructures.

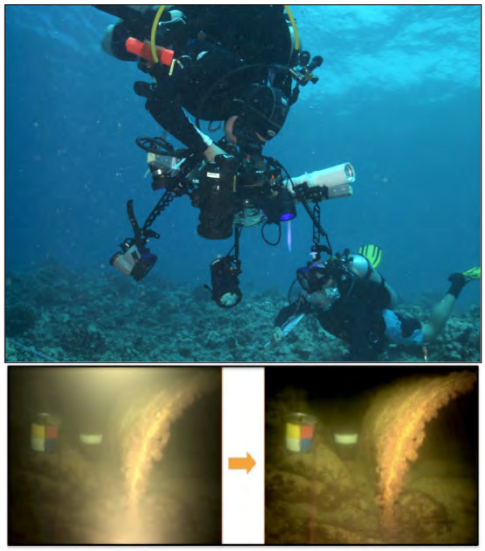
On top of these, the massive gas reservoirs discovered in the eastern Mediterranean (and oil discovery may soon follow), there is a direct threat with any malfunction – massive seeping of these reserves within the water column and sea surface contamination that will lead to a regional disaster. One result can be the formation of deadly tsunami waves, which can engulf the coastal cities of Tel Aviv, Gaza or Haifa.

As Israel looks to the future, it faces with a number of pertinent issues related to scientific research, increased rates of climate change and geopolitical unrest. Israel needs to plan a long-term marine strategy to implement policy that will harness its natural resources without causing regional turmoil and without harming the delicate ecosystem that has developed in this unique area. The need for extensive research in order to lay a solid foundation for such a plan is evident. MERCI does not carry out research itself, but supports research conducted at the various member universities and research institutes.

The next phase of the Center's activities will focus on developing capabilities that will enable Israel and the region to capitalize on the vast opportunities that lay ahead, while minimizing inherent risks. This is to ensure sustainable development of Israel's national resources in the Eastern Mediterranean for posterity. MERCI already brought together scientists from all relevant and necessary disciplines to focus on the important scientific and technical challenges in the coastal and offshore Eastern Mediterranean. In parallel, it has invested in advanced infrastructure to study the Eastern Mediterranean comprehensively.

In keeping with our vision for the Eastern Mediterranean Sea:

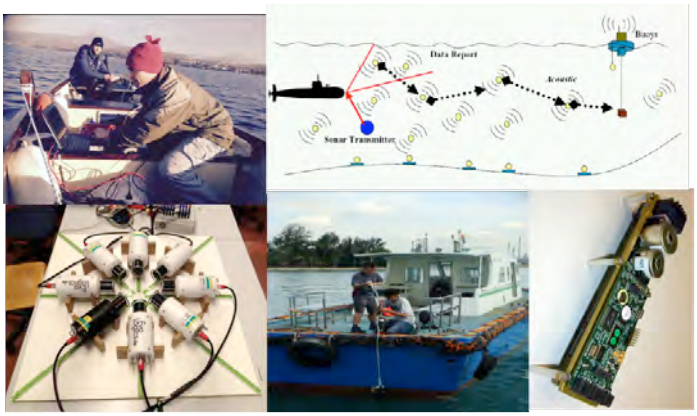
- MERCI will continue to purchase and develop the modern infrastructure needed to study the coastal and offshore Eastern Mediterranean both in the water column and in the sediments beneath. All instruments purchased through the consortium, as well as facilities (laboratories), will be readily available to all participating universities and research institutes without limitations (except for running costs and consumables). Such a step will significantly increase the national knowledge base in the exclusive economic zone (EEZ) of Israel and throughout the Mediterranean, while ensuring state-of-the-art scientific infrastructure for research.
- MERCI will encourage its members to participate in governmental boards and in meetings where policy is decided. Members will provide the government of Israel with the necessary tools to exploit in the most sustainable way best suited to Israel's national interests, the Eastern Mediterranean.
- MERCI will foster interdisciplinary and interinstitutional projects to study and understand the unique challenges that the Eastern Mediterranean Sea poses to Israel.
- MERCI will by providing the necessary infrastructure and databases, encourage international cooperation across relevant disciplines making Israel an important location of international excellence in marine science. We sincerely believe in using science as a tool for overcoming political and cultural differences and have set this as one of our main goals. We all face the same challenges and MERCI has the capability to bring neighboring countries together for the purpose of securing a better future for this resource we all share.
- MERCI will initiative to join international organizations on the subject of Marine Observatory as part of the efforts to conduct long-term monitoring in the framework of MERCI (Gliders, Sediment Traps). The Scientific Committee is still looking favorably at the possibility to join one of the international organizations, uniting the research bodies with similar systems throughout.
- MERCI will also invest in developing the field of marine strategy. This will include projecting the geopolitical situation under different scenarios; investigating security issues that may change due to the new energy discoveries in recent years; providing a detailed economic study on the different paths that Israel and other regional economies may be heading towards; and formulating our statutory position regarding international law, especially following disputes about the EEZ boundaries.



The Subsea Engineering lab, headed by Prof. Morel Groper. Focuses on new concept submersibles, propulsion and maneuvering for underwater vehicles including the development of trajectory simulations and unique underwater directional thrusters, novel oil compensated actuators for deep-sea operation, pressure vessels and sealing methods. Some of the current research topics include: motion of planning crafts in seaway, dynamic modeling of hovering AUVs, deep sea propulsion components and pressure vessels. In the lab we perform also research in tribology where the lubricant is sea water.

The Marine Imaging lab, headed by Dr. Tali Treibitz. Focuses on cutting edge research in underwater computer vision, scene, color and 3D reconstruction, automatic analysis of scenes, and autonomous decision making based on visual input. In addition we design and build novel underwater imaging systems, such as underwater microscopes.

The Applied Marine Exploration lab, headed by Dr. Yizhaq Makovsky. Focuses on innovative use of observational geophysics to address geological and environmental questions. Main research interests include the study of traditional and alternative marine energy sources, and the geotechnical and environmental aspects of exploiting them. In particular, gas hydrates, their potential exploitation and response to global changes; Morphology and recent evolution of the seafloor as an indicator of: recent paleo-environmental and tectonic processes; Active processes of the geosphere: Paleoseismology and mechanism of faulting; the role of free fluids in the Earth's crust; Innovative techniques for monitoring environmental changes (e.g. coral reef bleaching, marine biomass, pollutants accumulation, soil water interaction, etc.).



The Underwater Acoustics and Navigation lab (ANL), headed by Dr. Roee Diamant, , is active in the fields of underwater acoustic communication networks, underwater signal detection, object classification, underwater localization, and underwater navigation. Our research interests include channel modeling, design of algorithms and protocols, analysis, and development of simulation tools. We focus on applied research and develop tools for problems like underwater mine detection, navigation without GPS, communication between divers and autonomous vehicles, classification and characterisation of marine mammals and fish, tracking the motion of marine animals, and long range acoustic communication. The facilities in the lab include equipment for sea experiments, a large acoustic chamber, and a direct access to perform measurements from the lab in a testing pool and in the Shikmona reef.