

**UNDER THE AUSPICES OF H.E. THE PRESIDENT OF THE HELLENIC REPUBLIC  
MR. PROKOPIOS PAVLOPOULOS**

**International Conference in Management of Accessible Underwater  
Cultural and Natural Heritage Sites:**

**“DIVE IN BLUE GROWTH”**

**16-18 October 2019  
Athens, Acropolis Museum, Auditorium**

**CONFERENCE PROCEEDINGS**

**BLUEMED**

Plan, test and coordinate Underwater  
Museums, Diving Parks and Knowledge  
Awareness Centres in order to support  
sustainable and responsible tourism  
development and promote Blue growth  
in coastal areas and islands of the  
Mediterranean



# Introduction

The International Conference in Management of Accessible Underwater Cultural and Natural Heritage Sites, “*Dive in Blue Growth*”, was organized by the University of Patras in collaboration with Region of Thessaly, Ephorate of Underwater Antiquities, ATLANTIS Consulting and the active participation of BLUEMED partners, under the auspices of H.E. the President of the Hellenic Republic Mr. Prokopios Pavlopoulos, in Acropolis Museum, in Athens, from 16 to 18 October 2019.

Coastal areas and islands of the Mediterranean are tourism-based economies with key underwater assets that are vulnerable to extreme climatic conditions. They face common challenges: a) lack of coordinated policies, methods and tools to support sustainable economic development, b) ineffective protection of underwater heritage and inability to use it for sustainable tourism development, c) insufficient measures to tackle impacts of extreme climatic conditions.

BLUEMED aims to protect and preserve in a unified manner the underwater natural and cultural heritage of the Mediterranean, to help coastal and island economies prosper through a sustainable blue model for tourism development, and to protect our marine ecosystem. BLUEMED is part of Interreg MED 2014-20 Programme, co-financed by the European Regional Development Fund.

The overall success of the Conference is based on the warm welcome that conference subjects received and the high level of participation, as more than 300 people from 11 countries, from Europe, Asia and the America participated in the conference.

The three productive days of the Conference, in which 55 speakers from all over the world participated, was a great opportunity for underwater archaeologists, public organizations, local governments, universities, marine researchers, NGOs, tourist organizations, diving park/dry dive managers, and underwater industry players to exchange views on problems and solutions for underwater natural and cultural heritage.

Roberto Petriaggi, Istituto Superiore per la Conservazione ed il Restauro (ISCR) consultant for Restoring Underwater Project, Dimitris A. Pados, Charles E. Schmidt Eminent Chair Professor of Engineering and Computer Science in the Florida Atlantic University and Christos Economou, Head of the Unit Sea basin strategies in DG MARE, specialist Maritime Regional Cooperation and Maritime Security participated as Keynote Speakers in the International Conference.

During the conference different perspectives were discussed in the 3 very interesting conference topics:

- Management and protection of accessible Underwater Cultural Heritage sites and diving parks

- Initiatives for sustainable Blue tourism through accessible UCH sites and diving parks
- Technologies for offering dry dive experiences to non-drivers.

Conference participants had the opportunity to live a dry dive experience in BLUEMED pilot sites with the Virtual Reality glasses and equipment that University of Calabria provided.

In the following, you can find the submitted full papers that were presented during the Conference.

For more information about “Dive in Blue Growth” Conference visit the official website of BLUEMED ([bluemed.interreg-med.eu](http://bluemed.interreg-med.eu)).

## Acknowledgement

International Conference and particularly the authors for their contributions. We are indebted to all who assisted in the organizing effort.

We express our sincere gratitude to all who have actively contributed towards the success of this

## Conference Chair

**Dr. Kalamara Pari**

Director of the Ephorate of  
Underwater Antiquities  
Hellenic Ministry of Culture and Sports

**Dr. Davidde Barbara**

Director of the Underwater Archaeology Operation Unit (NIAS - Nucleo per gli Interventi di Archaeologia Subacquea) at the Istituto Superiore per la Conservazione ed il Restauro - Superior Institute for Conservation and Restoration (ISCR)  
Italian Ministry of Cultural Heritage and Activities (MiBAC)

# Committees

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Dr. Barbara Davidde

Dr. Yorgos Stephanedes

† Sebastiano Tusa

Dr. Fabio Bruno

Dr. Irena Radic Rossi

## Organizing Committee

Aggela Veneti

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Consuelo Garcia

Yianna Samuel – Rhoads

Nikola Miskovic

## Welcoming Committee

Panagiota Saranti

Anastasia Mitsopoulou

Michela Ricca

Zoi Pataki

*In memory of Sebastiano Tusa  
who tragically passed away in  
the Ethiopian Airlines plane  
crash (Sunday March 10th,  
2019).*

**UNDER THE AUSPICES OF H.E. THE PRESIDENT OF THE HELLENIC REPUBLIC  
MR. PROKOPIOS PAVLOPOULOS**

**INTERNATIONAL CONFERENCE IN MANAGEMENT OF  
ACCESSIBLE UNDERWATER CULTURAL AND NATURAL HERITAGE SITES:**

## **“DIVE IN BLUE GROWTH”**

ATHENS, GREECE  
16-18 October 2019  
ACROPOLIS MUSEUM, AUDITORIUM

### **CONFERENCE AGENDA**

#### **DAY 1- 16 October 2019**

09.00 -09.30 REGISTRATION OF PARTICIPANTS

09:30 -10.00 OPENING AND WELCOME REMARKS  
**Yorgos J. Stephanedes**, *Professor, Civil Engineering, BLUEMED Scientific Coordinator at University of Patras*  
**Kostas Agorastos**, *Regional Governor of Thessaly*

**Lina G. Mendoni**, *Minister of Culture and Sports*

**Prof. John Chrysoulakis**, *Secretary General for Greeks Abroad, Ministry of Foreign Affairs*

**Angela Gerekou**, *President of Board of the Greek National Tourism Organization (GNTO)*

**Luigi Ficacci**, *Director of the Istituto Superiore per la Conservazione ed il Restauro, Ministry of Cultural Heritage and Activities (MiBAC)*

10.00 -10.30 KEYNOTE SPEECH

**The “Restoring Underwater Project”: how everything started**

**Dr. Roberto Petriaggi**, Underwater Archaeologist, Consultant of the Istituto Superiore per la Conservazione ed il Restauro for the Restoring Underwater Project

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10.30 -12.00      **Management and protection of accessible Underwater Cultural Heritage (UCH) sites and UCH diving parks**  
*Session Chair: Yorgos J. Stephanedes*

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*Reflections on the prospects and the institutional framework of the organization of the Accessible Underwater Archaeological Site: starting with BLUEMED*

Pari Kalamara

*Touristic potential of the Supetar, Cavtat, underwater archaeological zone*

Irena Radić Rossi, Katarina Batur

*Sustainable management and protection of accessible Underwater Cultural Heritage sites; global practices and bottom-up initiatives*

Angelos Manglis, Anastasia Fourkiotou, Dimitra Papadopoulou

*Protecting marine biodiversity at accessible Underwater Cultural Heritage (UCH) sites and UCH diving parks*

Yianna Samuel, Yiannos Mylonas, Stavros Stylianou, Gregory Konnaris, Pavlos Diplaros, Georgios Fyttis

12.00 -12.30      *Coffee break*

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12.30 -14.00      **Technologies for offering dry dive experiences to non-divers**  
*Session Chair: Fabio Bruno*

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*Diving into a sea of history. Communicating the Underwater Experience in a Museum: An Analysis of ARQVA's Interactive Media*

Antonio Cosseddu

*Raising the awareness about underwater archaeological heritage through Edutainment and Virtual/Augmented Reality*

Fabio Bruno, Marco Cozza , Maurizio Mangeruga , Dimitrios Skarlatos , Panagiotis Agrafiotis , Barbara Davide Petriaggi , Roberto Petriaggi , Selma Rizvic , Fotis Liarokapis

*Results of the "SOMMERGIAMOCI" project in the MPA Gaiola underwater park*

Maurizio Simeone, Paola Masucci, Caterina De Vivo

*An innovative platform for virtual underwater experiences targeting the cultural and tourism industries*

Paraskevi Nomikou, Konstantinos Karantzalos, Andreas El Saer, George Pehlivanides, Panagiotis Tsoiris, Christos Stentoumis, Anna Dura, Giotis Ioannidis, Michalis Sarantinos, Varvara Antoniou, Othonas Vlassopoulos, George Katopodis, Katerina Plessa, Ilias Kalisperakis, Konstantina Bejelou, Konstantinos Monastiridis

*Deep-Sea archaeology in the Exclusive Economic Zone (EEZ) of Cyprus*

Achilleas Iasonos

14.00 -15.00      *Light lunch and networking*

15.00 -15.30 KEYNOTE SPEECH

**Financing Opportunities for Blue Growth**

**Christos Economou**, Unit Sea basin strategies, DG MARE, Maritime Regional Cooperation and Maritime Security

15.30 -17.00 **Initiatives for sustainable Blue tourism through accessible UCH sites and diving parks**  
*Session Chair: Barbara Davidde Petriaggi*

*Technological protection of an underwater archeological site; a newly discovered Roman shipwreck from the 1st century BC, on the island of Pag*

**Vedran Dorušić**, Matko Čvrljak

*Theraic Sea: A bottom-up initiative for marine conservation and sustainable living*

**Maria Salomidi**, Sylvaine Giakoumi, Vangelis Paravas, Pierre-Yves Cousteau

*Towards the Creation of Accessible Underwater Archaeological and Historical Sites in Fournoi and Leros (Eastern Aegean): an Interreg VA, Hellas - Cyprus 2014 -2020 program under Development*

**George Koutsouflakis**

*Project: blue HOMER*

**Marko Mišić**, Toni Mandušić

17.00 -18.30 **Management and protection of accessible UCH sites and diving parks – Case studies**  
*Session Chair: Angelos Manglis*

*The studies on the underwater cultural heritage of Istanbul from the Anatolian side to the Princes' islands*

**Ahmet Bilir**, Mustafa Şahin

*Accessing Underwater Cultural Heritage on dry feet: some Sicilian case studies*

**Francesca Oliveri**

*Preservation, management and protection of Tangible Underwater Cultural Heritage of Anfeh (North Lebanon)*

**Nadine Panayot Haroun**

*Community cultural infrastructure: sustainability of the underwater cultural heritage of Bocachica, Cartagena*

**Liliana Patricia Rozo Pinzón**

*The in situ preservation as a priority option. Experiments in the upper Adriatic Sea*

**Massimo Capulli**

18.30 -20.00 **Networking hour**

10.00 -18.00 PARALLEL ACTIVITY

**Dive in Virtual Reality!**

Live a Virtual Diving experience in BLUEMED pilot sites **#VR #drydive**  
Supported by 3D Research s.r.l.

**DAY 2- 17 October 2019**

09.00 -09.30 REGISTRATION OF PARTICIPANTS

09.30 -11.30 **Management and protection of accessible Underwater Cultural Heritage (UCH) sites and UCH diving parks**  
*Session Chair: Pari Kalamara*

*How the Greek pilot sites were selected and the creation of the Knowledge Assessment Centers (KACs) in Greece*

Angeliki G. Simosi

*EGNAZIA: Enhancement and use of submerged Structures along the coast guided diving and snorkeling tours*

Gianpaolo Colucci

*Change behavior and raise awareness about the Adriatic's underwater treasures as common goods: the UnderwaterMuse Project*

Rita Auriemma, Carlo Beltrame, Ivanka Kamenjarin, Danilo Leone, Ivan Šuta, Maria Turchiano

*MUSAS: an innovative project for the enhancement of the Underwater Cultural Heritage*

Barbara Davide Petriaggi, Michele Stefanile, Marco D'Agostino, Sandra Ricci, Carlotta Sacco Perasso

*Linking WWI and II Underwater Cultural Heritage to Sustainable Development in the Mediterranean: An Integrated Participatory Strategic Planning Approach*

Vasilike Argyropoulos, Anastasia Stratigea

*Tourism experience in the Underwater Archaeological heritage site: managing emotional state to increase archaeological diving tourism in the Sunken City of Baiae*

Cristina Canoro, Francesco Izzo, Barbara Masiello

11.30 -12.00 KEYNOTE SPEECH

**Autonomous underwater localization, communication, and networking**

**Dr. Dimitris A. Pados**, Charles E. Schmidt Eminent Chair Professor of Engineering and Computer Science, Florida Atlantic University

12.00 -12.30 *Coffee break*



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12.30 -14.30      **Initiatives for sustainable Blue tourism through accessible UCH sites and diving parks**  
*Session Chair: Angelos Manglis*

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*Diving and Underwater Cultural Heritage: a reasonable or a forced marriage? The Greek case*  
Dimitris Kourkoumelis, Alexandros Tourtas

*Protection and development of the Lake Bolsena underwater heritage*  
Antonia Sciancalepore, Edigio Severi, Maria Letizia Arancio, Barbara Barbaro

*Cartographic Documentation and Proposed Criteria towards the Protection and Preservation of Wrecks from the Great War in the Greek Seas*  
Elpida Katopodi, Kimon Papadimitriou

*The National Marine Park of Alonnisos Northern Sporades: an area of rich natural and cultural heritage facing human and climatic pressures*  
Dimitris Poursanidis, Vasiliki Vasilopoulou

*A fresh (water) case study: the time travel under water project in Lake Attersee*  
Cyril Dworsky

*A framework for underwater cultural heritage and environmental services evaluation*  
Lydia Stergiopoulou

*S/S Burdigala, former Schnelldampfer Kaiser Friedrich (1897-1916)*  
Dimitris Galon

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14.30 -15.30      *Light lunch and networking*

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15.30 -18.30      **Management and protection of accessible Underwater Cultural Heritage (UCH) sites and UCH diving parks**  
*Session Chair: Elpida Hadjidaki, Yianna Samuel*

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*Performance management in Underwater Cultural Heritage (UCH) site, UCH diving parks and Knowledge Awareness Centers (KACs)*  
Dimitra Chondrogianni, Yorgos J. Stephanedes, Panagiota-Georgia Saranti, Irini Kafousia

*SUB: THE WRECKS in THE GREEK SEAS, 1830-1951. The Underwater Heritage of Navy's Shareholding Fund And Mariners' Retirement Fund*  
Panagiotis Tripontikas

*Management and protection of a little known underwater archaeological site: the case of the "Roman Villa of the Dolia" in Ancient Epidaurus; past experience and future prospects*  
Barbara Davidde Petriaggi, Panagiota Galiatsatou, Angelos Tsompanidis

*L'Anfora ASD, the sustainable tourism and use of submerged archaeological sites in Apulia*  
Gianpaolo Colucci, Paola Palumbo

***Japanese Shipwreck and Diving Tourism in Sangihe Islands Indonesia***

Sultan Kurnia Alam Bagagarsyah

***The Faro Convention and the sustainable valorization of the underwater heritage. Case studies and projects in the Adriatic and Ionian Sea***

Rita Auriemma

***Perspectives and obstacles for accessible underwater archaeological sites. The case of Crete***

Theotokis Theodoulou

***Public Access to Underwater Archaeological Sites. Enjoying and Protecting our Maritime Heritage***

Carles Aguilar

***"Hippocampus" the Microscopic Mythical Dragon of the Sea***

Vasilis Mentogiannis

10.00 -18.00 PARALLEL ACTIVITY

**Dive in Virtual Reality!**

Live a Virtual Diving experience in BLUEMED pilot sites **#VR #drydive**

Supported by 3D Research s.r.l.

**DAY 3- 18 October 2019**

09.00 -09.30 REGISTRATION OF PARTICIPANTS

09.30 -11.30 **Technologies for offering dry dive experiences to non-divers**  
**Session Chair: Fabio Bruno**

***A low cost equipment and SFM software photogrammetric survey of two shipwrecks in the sea area of Methoni, Southwestern Greece***

George Michailidis

***Operating contemporary recreational submersibles in Kea's Underwater Historic Park***

Ioannis Tzavelakos

***Reconstructing a submerged villa maritima: the case of the villa dei Pisoni in Baia***

Barbara Davidde Petriaggi, Michele Stefanile, Roberto Petriaggi, Fabio Bruno, Raffaele Peluso, Marco Cozza

***Opto-acoustic 3D Reconstruction for Virtual Diving on the Peristera Classical Shipwreck***

Fabio Bruno, Antonio Lagudi, [Matteo Collina](#), Salvatore Medaglia, Pari Kalamara, Dimitris Kourkoumelis, Nikola Miskovic, Dula Nad, Nadir Kapetanovic, Mato Markovic

***Remotely operated group of vehicles for underwater scientific exploration and intervention***

Lorenz E. Baumer, Yanis Bitsakis, Mathias Buttet, Eftstratios Charchalakis, [Alessia Mistretta](#), Alexandros Sotiriou

***Monitoring and protection of accessible underwater cultural heritage***

Siarita Kouka, Paraskevi Nomikou, Konstantinos Karantzalos, Aikaterini Tagonidou

11.30 -13.30 **Initiatives for sustainable Blue tourism through accessible UCH sites and diving parks**  
**Session Chair: Yianna Samuel**

***In situ conservation of cannons in marine environment: cathodic protection, cleaning treatment and coverage with geotextiles***

Flavia Puoti, Barbara DaviddePetriaggi, Marco Ciabattoni, Claudio Di Franco

***Underwater Archaeological Sites as a touristic and educational resource. The Isla Grosa Project***

Carlota Pérez-Reverte Mañas, Felipe Cerezo-Andreo

***Western Black Sea underwater cultural tourist routes***

Preslav Peev

***New institutions for diving tourism: Diving Parks, Archaeological Diving Parks, Modern Shipwrecks & Implementation opportunities and problems in Greece***

Thanassis Stathis, Dimitris Markatos, Kostas Koutsis

***Creation of a virtual museum and a diving park east of the island of Lemnos on the site of the wreck of the Svyatoslav ship***

Sergey Fazlullin, Ivan Gorlov, Yury Tkachenko, Sergey Khokhlov, Michael Bardashov, Rolan Sadekov

***Integrated management plan for the preservation and promotion of cultural and natural environment at Pavlopetri (Elafonissos, Greece)***

Despina Koutsoumba, Stamatis Zogaris, Ioannis Kapakos, Maria Salomidi, Stergiopoulou Lydia

13.30 -14.00 **CONCLUSIONS**

*Moderator: Dimitra Chondrogianni*

**Fabio Bruno, Barbara Davidde Petriaggi, Pari Kalamara, Angelos Manglis, Yianna Samuel, Yorgos J. Stephanedes**

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## The Studies on the Underwater Cultural Heritage of Istanbul from the Anatolian Side to the Prince Islands: The NEMSUS Project

Ahmet Bilir<sup>1</sup>, Mustafa Şahin<sup>2</sup>

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<sup>2</sup> Prof. Dr. Mustafa Şahin. Department of Archaeology, Faculty of Science and Letters, Uludağ University 16059 Görükle - Bursa. mustafasahin@uludag.edu.tr

**Abstract:** The aim of this study is to determine the underwater cultural heritage of Istanbul between the Anatolian Side and the Prince Islands. For this purpose, underwater surveys are conducted regularly in the region since 2016. Within the scope of the North-eastern Marmara Sea Underwater Survey (NEMSUS) project, a marble carrying ship discovered at the sunken island of Vordonisi in 2016. The wreck was found at a depth of 4 – 6 meters and spread over an area 35 meters. Among the wreckage, 18 roughly quarried marble blocks were found. As a result of mineralogical-petrographic analyses showed that the marbles belong to the Island of Proconnesos. The location of the shipwreck indicates that it was traveling from the marble quarries on the Island of Proconnesos in the Sea of Marmara to the Island of Vordonisi.

Another UCH site was discovered during the seabed dredging at the Kalamış Bay on the Anatolian side in 1989. A number of Yortan vessels dating to the Early Bronze Age were found. In addition, during the dredging in 1989, a number of Yortan vessels dating to the Early Bronze Age were found at Kalamış Bay on the Anatolian side. It is emphasized that the works recovered from this site point to the presence of a sunken settlement here.

It is mentioned by Aristotle that the copper mines were ruins in Heybeliada, which overlooks Kalamış Bay. The ancient name of the island is Chalkitis = Copper is explained by mineral deposits. Çamlımanı, located in the south of the island, must be a copper bed beneath the two fathoms of the sea, which is used to make the sculpture in the Temple of Apollo at Sicyon, which is referred to by Aristotle.

**Keywords:** Marmara Sea, Vordonisi, Istanbul, Prince Islands, Chalcedon

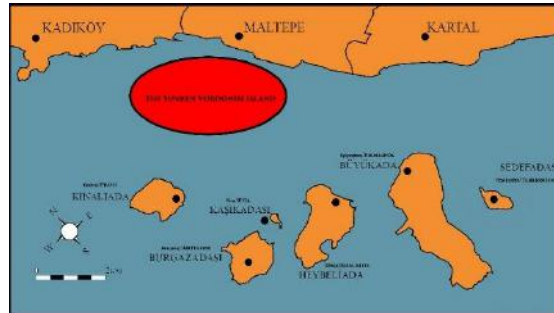
### 1. INTRODUCTION

The NEMSUS (the North-eastern Marmara Sea Underwater Survey) project aim to conduct a systematically and comprehensive scientific research with a multidisciplinary approach along the shoreline of Anatolian side of Istanbul and The Prince Islands (Fig. 1).



**Fig. 1:** The NEMSUS Project Area

Prince Islands consist of the Büyükada Island (Πρίγκηπος/Prinkipos), the Heybeliada Island (Χάλκη/Khalkitis), the Burgaz Island (Αντιγόνη/Antigoni), the Κίναλιada Island (Πρότη/Proti), the Sedef Island (Τερέβινθος/Terebinthos, modern Greek: Αντιρόβυθος/Antirovithos), the Yassıada Island (Πλάτη/Plati), the Kaşık Island (Πίτα/Pita), the Sivriada Island (Οξειά/Ohia) and the Tavşan Island (Νέανδρος/Neandros). Additionally, there is a submerged island called the Vordonisi Island, which should be added to this list<sup>29</sup>. With this survey, we attempt to reveal the underwater cultural heritage of the region. The primary focus of the survey was the Vordonisi Island<sup>30</sup> (Fig. 2) an area claimed to contain building ruins from the Byzantine Period, and thus known as Monastery Rocks.



**Fig. 2:** The Vordonisi Island

Nevertheless, an earlier underwater survey was conducted in Kalamış Bay and the earliest underwater data were obtained from this region. A review of previous archaeological underwater surveys that have been conducted in and around Istanbul showed that a number of Yortan vessels dating from the Early Bronze Age were found in Kalamış Bay in 1989 during a cleaning work on the seafloor. It was reported that the Istanbul Archaeological Museums found stone wall foundations during the rescue dives they performed there. However, their work was terminated because of very poor visual conditions. Studying these remains, Dönmez indicated a potential submerged settlement in Kalamış Bay. Özdoğan also emphasized that the artefacts recovered from this site suggest presence of a settlement underwater. A review of the evolution of the Marmara Sea, which was once a lake, it appears that Marmara Sea met the salt water from the Aegean Sea by crossing the Dardanelles around 7000 BC. The connection of the Sea of Marmara with the Black Sea was probably around 5500 BC<sup>31</sup>. Based on the elevation of the Neolithic settlement of Yenikapı, the sea level was less than minus 6 meters 9-8 thousand years before today. Accordingly, the Sea of Marmara at the beginning phase of the Fikirtepe Culture, which is called the Archaic Phase, should have been at a level 15 to 20 meters lower than the present-day elevation<sup>32</sup>. For this reason, the Prince Islands should have been linked to the mainland during the Neolithic Period<sup>33</sup>. However, Yarımburgaz 4-0 material was reported in Yenikapı today under the Marmara Sea level<sup>34</sup>. The settlements between today's Anatolian coastal

<sup>29</sup> Bilir et al. (2017), 132-150.

<sup>30</sup> Millas (1992), 205-208.

<sup>31</sup> Algan et al. (2011), 30; for relevant arguments see (Ryan et al. (1997); Aksu et al. (1999); Çağatay et al. (2000); Görür et al. (2001); Hiscott et al. (2002)).

<sup>32</sup> Although the exact dating of the finds that belong to the Archaic Phase of the Fikirtepe Culture was not established, similar materials recovered from the Yenikapı excavations are dated to 6400-5800 BC based on C14 data (Özdoğan (2013), 173, fig. 12).

<sup>33</sup> Algan et al. 2011, 44; Özdoğan 2013,175.

<sup>34</sup> For detailed information on the Yarımburgaz 4 layer and materials dating to the Chalcolithic Age, see (Özdoğan et al. (1986), 12; Özdoğan (1990), 382, pl. 246-248, figs. 4a-b, 5b-c, 6a-b.).



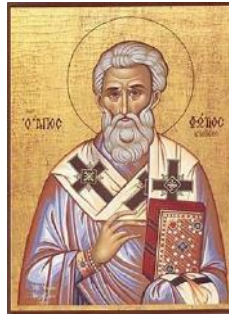
borders and Prince Islands should have been flooded during this period<sup>35</sup>. Vordonisi should also have become an island during this period.

## **2. THE NEMSUS PROJECT 2016 – 2017 CAMPAIGNS**

Our archaeological underwater survey within the scope of the NEMSUS project began with the permission of the Ministry of Culture and Tourism under No. 159887 dated 02.09.2016 on behalf of Düzce University between September 20<sup>th</sup> and October 5<sup>th</sup> 2016 - June 12<sup>th</sup> – 23<sup>rd</sup> 2017 in the area known as the Manastır Kayalıkları (Monastery Rocks), lying 1.5 km southwest of the Maltepe coastline and 4 km northeast of Kınalıada in Istanbul.

### **2.1. The Vordonisi Island**

Most probably due to sea level rise and tectonic movements, Vordonisi should have sunk into the waters of Marmara Sea over time. However, it is not known exactly when the island vanished. Between 858 - 867 AD and 877 – 886 AD, Photios the Patriarch of Constantinople (Fig. 3), was sent to exile to the Armonians or Armenians Monastery in Vordonos<sup>36</sup>.



**Fig. 3:** Saint Photios the Great, Patriarch of Constantinople

There is a strong possibility that the rocky region known among the sailors as Büyük (Big) Vordonos and Küçük (Small) Vordonos was in fact the Vordonisi Island, which was once above the sea level, but sank into the sea due to massive earthquakes and floods over time. An analysis of the earthquakes that occurred in the region and the tsunamis triggered by these earthquakes shows that there was a tsunami in the Eastern Marmara due to an earthquake in 989 AD<sup>37</sup>.

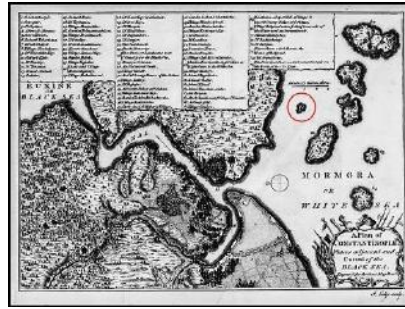
Considering that the ancient records of the island are no later than the 10th century, it is probable that Vordonisi inundated during this period. However, an explicit mention of Vordonisi in a map of 1770 (Fig. 4) prepared by J. L. Cowley raises doubts about this probability.

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<sup>35</sup> Özdoğan (2015), 15, fig. 6.

<sup>36</sup> White (1981), 36.

<sup>37</sup> Soysal (1985); Altınok et al. (2001), 530.



**Fig. 4:** J. L. Cowley's Map showing Vordonisi Island.

While the earthquake and tsunami that occurred on May 22, 1766 led to damage in the Mudanya Bay and the Bosphorus, all this happened before the map of 1770 was drawn. After this date, the first major earthquake that caused tsunami had occurred on July 10, 1894<sup>38</sup>. However, this tsunami did not cause much changes on the Anatolian coastline<sup>39</sup>. It is also better not to rule out that Vordonisi may have been specifically indicated in the above mentioned map to warn sailors against dangerous rocks. In the meantime, these rocks are also referred to by the sailors as the Monastery Rocks. It is clear that the Adalar (Islands) district of Istanbul, also called the Prince Islands, served as a religious and political exile centre during the Byzantine Period. For this reason, this sunken land may be the island where the Patriarch Photios was sent to exile and once the Armonians Monastery was located. In order to prove this from an archaeological point of view, we need to identify the architectural remains of the monastery on the island. Therefore, we wanted to clarify the claims about the presence of Patriarch Photios' monastery and that the island on which it was built had been devastated by an earthquake. We spend efforts to obtain clues about the history of the island. We also aim to register quickly it if remains of such a building are found on the island. Our survey dives focused on four different points of the study area where cliffs rising from the sea are located because we believe that remains should be located in shallows. In addition, when viewed from a satellite photograph, it was observed that most of the settlements in the Prince Islands looked northward, that is, the Anatolian side of Istanbul, and it was estimated that the possible building remains could be on the north facing side of the sunken island.

In particular, our focus was around a large rock on the north-east side of the beacon facing the islands<sup>40</sup>. During these dives, we observed that the sea bottom of the island was covered with shells. The rocks beneath (Fig. 5a) and sticking out of the sea (Fig. 5b) are almost unnatural formations.

<sup>38</sup> Especially in Heybeliada, it was recorded that sea water broke at the shore violently after ebbing approximately 15m, causing the boats in the bay to sink in the south of the island (Altinok et al. (2001), 531).

<sup>39</sup> Altinok et al. (2001), 531.

<sup>40</sup> During the dives, we observed that the depth changes between 0-10 m, and the visibility was clear and the water was around 23- 24°C. In particular, we would like to mention that the best time for clarity of visibility is the end of September and the beginning of October, the month of our work.



**Fig. 5a - 5b:** Unnatural rocks beneath the sea and sticking out of the sea.

Since the depth was not too much and the visibility conditions were very suitable, we also examined the area using mask and snorkel from the surface in addition to scuba diving. The scan was done systematically by two distant divers swimming in the direction of the route defined, in the wake water of the boat running at the lowest speed at a constant rotation. As a result of the surveys performed on the sunken island, we found a number of amphora handles and body fragments, roof tiles, unprocessed marble blocks, architectural blocks, as well as an anchor. Among the sherds recovered during these surveys, a total of four amphora handles and sherds of various amphorae are noteworthy (**Fig. 6**). Although we cannot get an idea about the period of handles, they clearly point to a commercial



activity in the region.

**Fig. 6:** Amphora sherds

#### 2.1.1. Roof Tiles

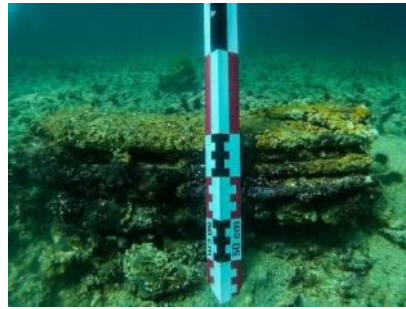
Among the cultural assets identified, roof tiles have a very important place. In addition to four intact pieces of roof tiles which seem support the presence of a settlement before sinking, we found some



fragments (**Fig. 7**).

**Fig. 7:** Roof Tiles

At the beginning, we thought that they belonged to an architectural structure on the sunken island. Eight more roof tiles were found as stacked and welded to each other (**Fig. 8**).



**Fig. 8:** Stacked roof tiles

All of the tiles found intact are 0.50 m x 0.25 m in size. It is possible to trace these tiles by their size and shape. The size of the tiles that were found in-situ in the dome of one of the rooms of the madrasah in front of the Ilyas Bey mosque, built in 1404 in Miletos by Menteşeoğulları are close to our samples. With a length of 0.50 m, they measure 0.30 m wide on one side, and 0.26 m wide on another. Another example to these roof tiles with a similar dimension was found in Enez. This structure was used as a small Byzantine chapel, but after the conquest of Enez, it was converted into a türbe (shrine) for Has Yunus Bey. The structure is dated before 1456 when Enez was conquered. The tiles in the building are 0.51 m long. They measure 0.30 m wide on one side, and 0.26 m wide on



another. It is believed that similar measurements were used throughout the 15th century<sup>41</sup>.

**Fig. 9:** Marble blocks plan

It is possible to suggest that our samples belong to the 15th century, as in the above examples, although they are of the same width on both sides. In the meantime, we believe that these tiles belonged to a sunken ship loaded with tile that stroke the rocks rather than to a 15th century structure on the island, based on the assemblage of tiles found piled up on top of each other<sup>42</sup>.

<sup>41</sup> Özyiğit (1990), 171, 172.

<sup>42</sup> Based on the stacked tiles seen in Fig. 8, we are of the opinion that these artefacts belong to a shipwreck. However, we have observed that tiles from this shipwreck were scattered around the island. Apart from that, we must take into account

### 2.1.2. Marble Blocks

Perhaps the most important group of artefacts identified during the survey are the raw cyclopean marble blocks, consisting of 18 pieces (Fig. 9).

They are encrusted with layers of seashells, sea urchins and shipworms. They were not arranged in any particular order, and some were evenly cut (Fig. 10).



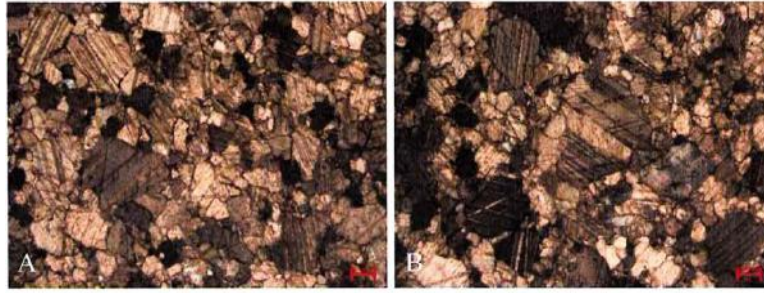
**Fig. 10:** Cleaning and measurement of blocks

Since they were found together and irrelevantly, they give off the impression that they spilled off a ship. It's known that, especially in the busy construction businesses of Istanbul, Proconnesos marble was usually preferred. Sailors trailed the southern shores of Marmara Sea after crossing the Çanakkale Strait in search of protection from the strength of the south-westerly lodos winds. The Vordonisi Rocks to the northeast of Marmara is especially open to lodos and extremely dangerous for sailors. These marbles must be from a cargo that was loaded onto a ship as being cut from marble beds, that hit the sunken island's reefs and sank. Therefore, we can assume that a ship loaded with marble that set sail from Proconnesos sunk after crashing into the Vordonisi Rocks. Additionally, it is known from correspondence between Pliny the Younger, the Governor of Bithynia and Emperor Trajan that the marbles carried over the Lake Sapanca were taken to seaside<sup>43</sup>. Pliny the Younger suggested to dig a tunnel between Lake Sophon / Sapanca and Astacos / Izmit Bay in order to facilitate this transportation network. Even though it's not really clear if this project was ever completed, it's certain that the marbles obtained from the marble beds to the east of Marmara Sea reached Istanbul through the Vordonisi route. Although we were unable to obtain any information about dating from these marble blocks, analysis of fragments allowed us to learn from which marble bed they came from. For this reason, in order to determine the marble bed and take the route of the shipwreck, the samples taken from both the wreck and the Proconnesos / Marmara Island Saraylar Marble Quarries were analysed from the mineralogical-petrographical point of view in the Istanbul Central Laboratory. As a result of the analyses, it was proved that the marble blocks came from the Proconnesos Island (**Fig. 11**).

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that the shipwreck may have been destroyed since diving near the island is not prohibited, and the shipwreck is within the hunting area for fishermen and harpooners.

<sup>43</sup> Plin.Ep, X. 41.



**Fig. 11:** Thin section image under polarized microscope shows that both samples have the same characteristics.

### **3. NEMSUS PROJECT 2018 CAMPAIGN**

The Underwater Survey of the North-eastern Marmara has been taking place since 2016 on the Anatolian coast of Istanbul and the waters surrounding the Prince Islands. The surveys performed in 2016 and 2017 on the Vordonisi Island continued in the islands of Büyükada (Big Island), Sedef (Mother of pearl) and Heybeliada (Saddlebag) in 2018. A 15-day long survey was carried out between September 3 and 17, 2018. During this period, surveys were performed in the Çamlımanı Bay at Heybeliada Island, at Sedef Island and the Aya Nikola and Nakibey beaches that lie on the eastern shore of the Büyükada Island.

#### **3.1. Sedef Island**

The waters surrounding the Sedef Island is off limits to recreational divers due to the presence of sunken national heritage according to the Article 35 of the Law No. 2863 on Conservation of Cultural and Natural properties, except for the scientific dives. Diving was prohibited in the region based on the above mentioned law following removal of a few amphorae from the bottom of the sea by a group of recreational divers who noticed the presence of such cultural heritages in 1981. We first cruised around the island in order to identify any potential architectural remains near the shore. As a result, remains of a historical building was observed on the northwest shore of the island, which is currently occupied by a modern boat yard facility. Since there were many boats at the time that anchored in this part of the island, we performed dives to see whether it was also used as a harbour during Antiquity. We found a white porcelain milk bowl decorated with blue plants at a depth of approximately 18 meters (**Fig. 12**). In addition to this, an 18<sup>th</sup> – 19<sup>th</sup> century metal anchor was found at a depth of approximately 21 meters during another dive to the south of the island. A potsherd was found during



the same dive at a depth of approximately 17 meters.

**Fig. 12:** A porcelain milk bowl decorated with blue plants.

#### **3.2. Çamlımanı Bay, Heybeliada Island**

The Çamlımanı Bay to the south of the Heybeliada Island was our initial site for surveying to identify the remains of an ancient breakwater structure. Since the depth was too shallow, skin diving technique

was used for exploration. Scuba diving was required in the following days for explorations inside the harbour due to increased depths. A bell-like metal object was observed at a depth of 1.5 meters. With an opening of 0,50 m, its function was unknown. Another remain that was considered to be a building block was also observed. Among other finds are some potsherds and a column-like object. The most important find of the exploration dives in the Çamlımanı Bay was a green copper ore bed.

### **3.3. Underwater Copper Ore Bed**

We know that in ancient times the Heybeliada Island was named “Khalkitis”, which means copper. Thus, it is not very surprising that the copper ore oxidized under the sea turns green. The green copper lode was found at a depth of 4 m (**Fig. 13**).



**Fig. 13:** The underwater copper lode

The four samples that we took from this spot (**Fig. 14**) were delivered to the Directorate of Istanbul Archaeology Museums to be transferred for further analyses to the Scientific and Technologic Researches Applied Sciences Centre at the Düzce University (DÜ- BİT). Analysis results to be published upon completion.



**Fig. 14:** The samples taken for analysis

Our bibliographic search revealed that it was an important copper mine also mentioned by the ancient philosopher and scientist Aristotle (de mir. Auscult 834. 58.), and it was known as the “diver’s copper = khalkon kolymbeten”<sup>44</sup> that was used to be mined during Antiquity by divers from a depth approximately of two fathoms<sup>45</sup>. More importantly, it is reported that the statue of god in the Temple of Apollo in Sicyon was made of this copper.

## **4. CONCLUSION**

The most important UCH findings obtained during the underwater surveys conducted within the scope of the NEMSUS project are the Proconnesian Marble Blocks we discovered on Vordonisi Island and the underwater copper mine in Heybeliada mentioned by Aristotle. The monastery where the Patriarch Photios of Constantinople was exiled, is still not fully identified. We believe that the architectural

<sup>44</sup> Arslan 2010, 21.

<sup>45</sup> 2 fathoms = 3.6576 m. The information on the depth of the ore from Antiquity coincides with our finding at the approximately the same depth.

remains we found on Vordonisi Island belong to this monastery. In order to prove this, an underwater excavation is required on the island.

In addition, the copper production process will be revealed by analysing the samples taken from the underwater copper mine in Heybeliada. Also Lysippos was the famous sculptor born in Sicyon who lived in the same period with Aristotle. Thus, the statue of Apollo, which Aristotle mentions, should have been cast by Lysippos of Sicyon. For this reason, the copper extracted from underwater has a special importance. It is possible to designate Çamlımanı Bay, where the mine was extracted, as the place where industrial diving first emerged.

## 5. REFERENCES

- Aksu A. E., R. N. Hiscott and D. Yaşar (1999). "Oscillating Quaternary Water Levels of the Marmara Sea and Vigorous Outflow into the Aegean Sea from the Marmara Sea Black Sea Drainage Corridor", *Mar. Geol.*, Vol. 153, pp. 275-302.
- Algan O., M. N. Yalçın, M. Özdoğan, Y. Yılmaz, E. Sarı, E. Kırıcı-Elmas, İ. Yılmaz, Ö. Bulkan, D. Ongan, C. Gazioglu, A. Nazik, M. A. Polat and E. Meriç, (2011). "Holocene coastal change in the ancient harbor of Yenikapı–İstanbul and its impact on cultural history", *Quaternary Research*, Vol. 76, No. 1, pp. 30-45.
- Altınok Y., S. Ersoy, A. C. Yalçiner, B. Alpar and U. Kuran, (2001). "Historical Tsunamis in the Sea of Marmara", *Proc. Int. Tsunami Symposium*, Seattle, Washington, 2001, pp. 527-534.
- Aristot. de mir. Auscult. (= Aristoteles, De Mirabilibus Auscultationibus) On Marvellous Things Heard. With an English translation by W. S. Hett, vol. XIV. Cambridge, Mass.-London 2000.
- Arslan M. (2010). İstanbul'un Antikçağ Tarihi: Klasik ve Hellenistik Dönemler, İstanbul.
- Bilir A., S. Gündüz and C. Ciner, (2017). "2016 Yılı Vordonisi Sualtı Araştırmaları", *Tina Denizcilik Arkeolojisi Dergisi*, Vol. 8, pp. 132-150.
- Çağatay M. N., N. Görür, O. Algan, C. Eastoe, A. Tchapylyga, D. Ongan, T. Kuhn and İ. Kuşçu (2000). "Late Glacial-Holocene Paleogeography of the Sea of Marmara: Timing of Connections with the Mediterranean and the Black Seas", *Mar. Geol.*, Vol. 167, pp. 191-206.
- Dönmez Ş. (2006). "The Prehistory of the Istanbul Region: A Survey", *ANES*, Vol. 43, pp. 239-264.
- Görür N., M. N. Çağatay, Ö. Emre, B. Alpar, M. Sakınç, Y. İslamoğlu, O. Algan, T. Erkal, M. Keçer, R. Akkök and G. Karlık (2001). "Is the Abrupt Drowning of the Black Sea Shelf at 7150 yr BP a myth?", *Mar. Geol.*, Vol. 176, pp. 65-73.
- Hiscott R. N. and A. E. Aksu (2002). "Late Quaternary History of the Marmara Sea and Black Sea from High-Resolution Seismic and Gravity-Core Studies", *Mar. Geol.*, Vol. 190, pp. 261-182.
- Millas A. (1992). *Proti-Antigoni*, Athens.
- Özdoğan M. and A. Koyunlu, (1986). "Yarımburgaz Mağarası 1986 Yılı Çalışmalarının İlk Sonuçları ve Bazı Gözlemler", *Arkeoloji ve Sanat*, Vol. 32/33, pp. 4-17.
- Özdoğan M. (1990). "Yarımburgaz Mağarası", *Proc. X. Türk Tarih Kurumu Kongresi, Kongreye Sunulan Bildiriler I*, TTK Yayınları, Ankara, Türkiye, 1990, pp. 373-388.
- Özdoğan M. (2003). "The Black Sea, the Sea of Marmara and Bronze Age Archaeology: An Archaeological Predicament", *Troia and the Troad. Natural Science in Archaeology*, (eds. G. A. Wagner, E. Pernicka, H. P. Uerpmann) Springer, Berlin, Heidelberg, pp.105-120.
- Özdoğan M. (2013). "Neolithic Sites in the Marmara Region Fikirtepe, Pendik, Yarımburgaz, Toptepe, Hoca Çeşme and Aşağı Pınar", *The Neolithic in Turkey*, Vol. 5. (eds. Özdoğan M., N. Başgelen and P. Kuniholm), İstanbul, pp. 167-269.



Özdoğan M. (2015). "The Riverine and Lacustrine Settings Along the Sea of Marmara as the Habitat of Neolithic Settlements", *Istanbul and Water, Ancient Near Eastern Studies*, 47, (eds. Magdalino P. and N. Ergin), Peeters, Leuven, Paris, Bristol, Ct., pp. 9-30.

Özyiğit Ö. (1990). "Alaturka Kiremidin Oluşumu", *Arkeoloji ve Sanat*, Vol. 5, pp. 149-179.

Plin.Ep. Plinius, *Epistulae*, Genç Plinius'un Anadolu Mektupları, 10. Kitap (Trans. Dürüşken Ç. and E. Özbayoğlu), Istanbul, 2005.

Ryan W. B. F., W. C. Pitmann III, C. O. Major, K. Shimkus, V. Moskalenko, G. A. Jones, P. Dimitrov, N. Görür, M. Sakınç and H. Yüce, (1997). "An Abrupt Drowning of the Black Sea Shelf", *Mar. Geol.*, Vol. 138, pp. 119-126.

Soysal H. (1985). "Tsunami ve Türkiye Kıyılarını Etkileyen Tsunamiler", *Deniz Bilimleri ve Coğrafya Enstitüsü Bülteni*, Vol. 2, pp. 59-67.

White D. S. (1981). *Patriarch Photios of Constantinople: His Life, Scholarly Contributions, and Correspondence Together with a Translation of Fifty-two of His Letters*, Holy Cross Orthodox Press.