

# CRL School 2023

## Corinth Rift Observatory



**Patras-Nafpaktos, Greece**

**22-26 September 2023**

# Welcome!!!

Dear teachers and students, welcome to the 2023 edition of the CRL-School!

As you know, the general objective of the School is to unite Master and PhD students from various Greek and foreign universities collaborating in the Corinth Rift Observatory (<http://crlab.eu>), together with high school European teachers to introduce them to different geophysical and geological methods and observations and first-hand scientific knowledge.

At the School, methods such as seismology, GPS, SAR interferometry, the methods underlying the ESA-SENTINEL mission, the Geohazards Exploitation Platform (GEP) and paleomagnetism, will be examined from a theoretical point of view as well as from the point of view of their applications and results in the specific areas of the Corinth Rift. This rift is one of the most seismically active regions of Europe, where movements are so rapid that it has been defined as “a natural geodynamical laboratory”. The knowledge acquired there is applicable to other seismically active regions worldwide and, thus, has a general signification.

As every year, this school will comprise a mixture of topical presentations, excursions in the field and hand-on activities. It will take place partly in Nafpaktos, partly in Patras. We foresee that the participants will gain understanding of all these methods and their results and be engaged in discussions about the interpretation of the results and how they can be used in teaching and learning in general Earth Sciences, Chemistry, Physics, Biology and Geology.

In Nafpaktos, the presentations will be done in the Municipality Building, which has been generously proposed to us by the Mayor and the Council of the city of Nafpaktos. In Patras we will be hosts of several departments of the University.

Highlights will be, among others, the educational activities for High School, the dissemination to the general public, the presentation of the seismobox, the hand-on ESA software, the field training sessions and the presentation of cores from the sea bottom. There will be also a presentation of the structural monitoring and geometric control of the Rio-Antirrio bridge.

The Organising/Scientific Committee has been one of the actors in preparing this School, but other persons and/or Institutions have contributed to it. We would like to continue to offer students and teachers the opportunity to the CRL School in future years. Of course, this depends upon us being able to show our sponsors that the School has been useful to students and teachers in their studies and in their daily teaching, or as inspiration for teaching geoscience in new ways in their schools.

### **Therefore, after the School we will ask you:**

- To complete the evaluation forms (for students and for teachers) as soon as possible and email it back to us,
- To make a presentation of your experiences at the CRL School to a group of your colleagues after your return from Nafpaktos, and
- Teachers, we invite you to send us reports and photographs about how you have used the CRL School information in your classrooms. We also encourage you to write reports on the School in publications specifically intended for geosciences, science and geography teachers.

### **Important Note!!!**

The interaction among the lecturers and the students of the School is considered crucial. It is being performed throughout the full duration of the School and will be depended not only from the type of the presentation/hand on but also from the students' availability, their preparedness and their proactiveness with the corresponding lecturer/chairperson and the Organising/Scientific Committee. We encourage the students and it is foreseen as their duty to initiate communication.

For now, please enjoy your CRL School 2023 in Nafpaktos-Patras! And please tell your colleagues at school, fellow students and friends about it and encourage them to come to future editions of the School!

The CRL School Organising/Scientific Committee

## **Acknowledgments**

- The European Geosciences Union (EGU) for financial support.
- The Centre National de la Recherche Scientifique (CNRS)
- The municipality of Nafpaktos for logistical support for the lectures given in Nafpaktos,
- Annita Panteleli for her significant help to the organizing committee of CRL School 2023. Her advice contributed to the better organization of the School.
- A special thanks is given to Uni Systems for taking the time and energy to invest in our vision and in our event by sponsoring CRL School 2023.
- And we thank all the speakers who have contributed to the School and their institutions.

# CRL School 2023 Organising/Scientific Committee

## **CHAIR**

### **Panagiotis Elias**

Associate Researcher,  
National Observatory of Athens, Institute for  
Astronomy, Astrophysics, Space Applications and  
Remote Sensing,  
Athens, Greece  
*pelias@noa.gr*

## **MEMBER**

### **George Kaviris**

Associate Professor,  
National and Kapodistrian University of Athens  
Department of Geology and Geoenvironment,  
Section of Geophysics and Geothermics,  
Athens, Greece  
*gkaviris@geol.uoa.gr*

## **MEMBER**

### **Fotios Danaskos**

Secondary Education teacher of Geology,  
8th Junior High School in Chalandri,  
EGU GEFO for Greece.  
Athens, Greece  
*fdanas@yahoo.gr*

## **MEMBER**

### **Angelos Zymvragakis**

Msc Geologist,  
National and Kapodistrian University of Athens  
Department of Geology and Geoenvironment,  
Section of Geophysics and Geothermics,  
Athens, Greece  
*azymvragakis@geol.uoa.gr*

## **MEMBER**

### **Kiki Makri**

PhD Geologist,  
Postdoctoral Researcher/National  
Observatory of Athens  
Teacher at Secondary Education/A'Athens  
Athens, Greece  
*kikimakri@noa.gr*

## **MEMBER**

### **Christofer Kaltsas**

BSc Student,  
National and Kapodistrian University of  
Athens, Department of Geology and  
Geoenvironment,  
Athens, Greece  
*christoferkaltsas@gmail.com*

## **MEMBER**

### **Olympia Tripolitsiotou**

MSc Geologist,  
Geology Teacher at Evangeliki Scholi  
Smyrnis Model Junior High School  
Athens, Greece  
*olytrip20@gmail.com*

## **MEMBER**

### **Nikos Kalamaras**

BSc Geologist,  
National and Kapodistrian University of  
Athens, Department of Geology and  
Geoenvironment,  
Athens, Greece  
*nickalamaras2486@gmail.com*

Panagiotis Elias



George Kaviris



Fotios Danaskos



Angelos Zymvragakis



Kiki Makri



Christofer Kaltsas



Olympia Tripolitsiotou



Nikos Kalamaras

## Corinth Rift Laboratory School–2023



(Patras-Nafpaktos September 22-26, 2023)

## *Programme*

### **Friday September 22, 2023**

#### **Department of Physics, University of Patras**

- 13:00 – 13:30**      **Welcome to the CRL School 2023**
- 13:30 – 14:00**      **Why CRL?**  
Pierre Briole, École normale supérieure / CNRS, Paris, France
- 14:00 – 14:30**      **Understanding the physics of earthquakes from the smallest to the largest and the growth of faults in the western gulf of Corinth**  
Athanasios Ganas, National Observatory of Athens, Greece
- 14:30 – 15:00**      **The geodetic monitoring of the Corinth Rift Observatory with GPS and SAR interferometry**  
Pierre Briole, École normale supérieure / CNRS, Paris, France  
Panagiotis Elias, National Observatory of Athens, Greece
- 15:00 – 15:30 Break**
- 15:30 – 16:00**      **Seismic Parameters and Microseismicity in the Gulf of Corinth**  
Eleftheria Papadimitriou, Aristotle University of Thessaloniki, Greece  
Vasileios Karakostas, Aristotle University of Thessaloniki, Greece
- 16:00 – 16:30**      **Large Earthquakes and Focal Mechanisms in the Gulf of Corinth**  
George Kaviris, National and Kapodistrian University of Athens, Greece
- 16:30 – 17:00**      **Opposing development practices within the Delphic landscape**  
Christos Merantzas, University of Patras, Greece
- 17:00 – 17:30**      **Off-shore faults imaging and monitoring in the Corinth Rift**  
Maria Geraga, University of Patras, Greece
- 17:30 Departure to Nafpaktos (Akti Hotel)**

## Saturday September 23, 2023

### 08:30 Departure from Akti Hotel

08:45 – 09:20 Welcome messages

09:20 – 09:40 **Tectonics, structural setting and tectono-sedimentary processes in the Corinth Rift**

Haralambos Kranis, National and Kapodistrian University of Athens, Greece

09:40 – 10:00 **Historical elements for sciences and observatories**

Fiori-Anastasia Metallinou, National Observatory of Athens, Greece

### 10:00 – 11:00 Break

11:10 – 13:00 **Hands on GNSS measuring**

Panagiotis Elias, National Observatory of Athens, Greece

George Polykretis, TREE Company, Athens, Greece

### 13:00 – 15:00 Lunch Break

15:00 – 16:00 **Hand on simple seismic software package provided in the CRL portal**

George Kaviris, National and Kapodistrian University of Athens, Greece

Ioannis Spingos, National and Kapodistrian University of Athens, Greece

16:00 – 17:30 **Presentations by the students**

3mn per student + questions

### 17:30 – 21:30 Free time

21:30 – 23:00 **Sky gazing (in an area close the hotel Akti that will be announced shortly before)**

Fiori-Anastasia Metallinou, National Observatory of Athens, Greece

## Sunday September 24, 2023

### 08:30 Departure from Akti Hotel

**08:30 – 13:30**      **Field trip at Psaromita (GNSS and seismic station), geologic stops along the journey**  
Athanasios Ganas, National Observatory of Athens, Greece  
Haralambos Kranis, National and Kapodistrian University of Athens, Greece

### Arrival at Akti hotel

### 13:30 – 15:00 Lunch Break

### Afternoon: Nafpaktos

**15:00 – 15:40**      **A concise overview of the lithostratigraphy architecture and its implications to the Quaternary evolution of the Gulf of Corinth (Greece)**  
Koutsovitis Petros, University of Patras

**15:40 – 16:10**      **Data mining at school: some examples to address geosciences cases studies at school with online data**  
Jean-Luc Berenguer, University Côte d’Azur / EGU, France

### 16:10 – 16:40 Break

**16:40 – 17:10**      **The earthquake suitcase**  
Vasiliki Kouskouna, National and Kapodistrian University of Athens, Greece

**17:10 – 17:40**      **Innovative ideas and activities for Earth Science Environmental and Physical Geography teaching and learning.**  
Fotis Danaskos, GR EGU GEFO

**17:40 – 18:30**      **Creating school seismology Labs (SEISMO - Labs) for the development of students’ competences**  
Dragos Tataru & Eduard Nastase, National Institute for Earth Physics, Applied Geophysics, prevention and education, Bucharest, Romania.



## Monday September 25, 2023

### School Teachers

**10:00** Departure from Akti Hotel to 3rd Junior High School in Nafpaktos

- 10:30 – 11:30** **Teaching Earthquakes in classroom using stem tools**  
Fotis Danaskos, 8th Junior High School in Chalandri, Greece
- 11:30 – 12:10** **Teaching Earthquakes in classroom using open data, case study: active fault bases**  
Kiki Makri, 2nd Modern Junior High Schools of Athens/National Observatory of Athens
- 12:10 – 12:40** **CRL School's educational team**  
Experimental activities, Pedagogical activities, Online activities

### University Students

- 09:00 – 09:20** **Introduction to GNSS**  
Panagiotis Elias, National Observatory of Athens, Greece
- 09:20 – 09:40** **Introduction to satellite SAR interferometry**  
Panagiotis Elias, National Observatory of Athens, Greece
- 09:40 – 10:00** **Quantification of N. Peloponnese shoreline displacement using very high spatial resolution remote sensing data**  
Emmanouel Vassilakis, National and Kapodistrian University of Athens, Greece
- 10:00 – 10:20** **Ground Deformation Studies in Seismic Active Areas combining Local GPS/GNSS and permanent GNSS networks. The Case of Central Ionian Islands and Patras Gulf**  
Vasilios Sakkas, National and Kapodistrian University of Athens, Greece
- 10:20 – 10:50 Break**
- 10:50 – 11:10** **Open Seismic Data Retrieval through EIDA Nodes and Automated Moment Tensor Analysis**  
Christos Evangelidis, National Observatory of Athens, Greece
- 11:10 – 11:30** **Physical mechanisms behind seismic site response - Some examples from Aegean**  
Olga Ktenidou, National Observatory of Athens, Greece
- 11:30 – 11:50** **Seismic hazard in Greece with a focus in the Western Gulf of Corinth**  
Angelos Zymvragakis, National and Kapodistrian University of Athens, Greece
- 11:50 – 12:30 Break**
- 12:30 – 13:30** **Follow-up Hands on GNSS measuring**  
Panagiotis Elias, National Observatory of Athens, Greece

## Tuesday September 26, 2023

### 08:30 Departure from Akti Hotel

Laboratory of Seismology, University of Patras

09:30 – 09:50 Use of CRL Data for Detailed Seismological Studies  
Thimios Sokos, University of Patras, Greece

09:50 – 10:10 **Relative Sea level changes in the Corinth Gulf during the late Holocene**  
Niki Evelpidou, National and Kapodistrian University of Athens, Greece  
Anna Karkani, National and Kapodistrian University of Athens, Greece

10:10 – 10:30 **Structural morphology and geometric control of the Rio-Antirrio bridge**  
Akis Panagis, GEFYRA S.A., Greece

10:30 – 10:50 **Natural Catastrophes in the Helike Delta: From Prehistory to Late Antiquity**  
Dora Katsonopoulou, The Helike Project & The Helike Society, Greece

### 10:50 – 11:20 *Move from Seismology Laboratory to Department of Geology*

11:20 – 11:40 **Recent sedimentary processes in the Gulf of Corinth. Seismic and aseismic turbidites**

Spyros Sergiou, University of Patras, Greece

11:40 – 12:30 **(parallel groups of ~10) Laboratory class for coring study**

Spyros Sergiou, University of Patras, Greece

**(parallel groups of ~10) Laboratory class: Study of archaeomaterials in "[KERAMos Lab](#)"**

Ioannis Iliopoulos, University of Patras, Greece

Vaia Xantopoulou, University of Patras, Greece

### 12:30 – 13:00 Lunch at the cafeteria near the department of Physics

### 13:00 – 14:00 *Drive to the Helike Fault*

14:00 – 14:30 **Educational field activities for Helike fault**

CRL School's educational team: Kiki Makri, Fotis Danaskos & Olympia Tripolitsiotiou

14:30 – 16:30 **Field trip to the Helike fault**

Emmanouel Vassilakis, National and Kapodistrian University of Athens, Greece

## End of the CRL School 2023 - School Bus to the city of Aigion and to Nafpaktos

[See the timetable for buses from Aigio to Athens](#)

# Participants

# Students

a/a	First Name	Last Name	E-mail Address	Affiliation
1	Bogdan	Cerbu	cerbub@gmail.com	University of Bucharest, Faculty of Physics, Bucharest, Romania
2	Anna	Dosiou	adosiou@gmail.com	Harokopio University of Athens, Dept. of Geography, Athens, Greece
3	Pinar	Duran	pinar.duran@iuc.edu.	Istanbul University-Cerrahpasa, Dept. of Geophysics, Istanbul, Turkey
4	Angeliki	Grigoriou	antzigrigoriou1@gma	Harokopio University of Athens, Dept. of Geography, Athens, Greece
5	Iskren	Ivanov	iskren.s.ivanov@gma	Bulgarian academy of Sciences, Space Research and Technology Institute, Sofia, Bulgaria
6	Ljubcho	Jovanov	ljubco.jovanov@hotmail	Cyril and Methodius University, Faculty of natural sciences and mathematics, Skopje, North Macedonia
7	Nikos	Kalamaras	nickalamaras2486@g	National and Kapodistrian University of Athens, Dept. of Geology and Geoenvironment, Athens Greece
8	Ioannis	Kalogiannidis	j.kalo@noa.gr	Harokopio University of Athens, Dept. of Geography, Athens, Greece
9	Christofor	Kaltsas	christoferkaltsas@gm	National and Kapodistrian University of Athens, Dept. of Geology and Geoenvironment, Athens Greece
10	Christofor	Kosmidis	gp222107@hua.gr	Harokopio University of Athens, Dept. of Geography, Athens, Greece
11	Dulce	Lima	dulce.lima@fc.up.pt	University of Porto, Faculty of Science, Porto, Portugal
12	Katerina	Panora	kate.panora@gmail.c	Aristotle University of Thessaloniki, School of Geology, Thessaloniki Greece
13	Alexandr	Papadopoulos	345alabes@gmail.co	National and Kapodistrian University of Athens, Dept. of Geology and Geoenvironment, Athens Greece
14	Dimitrios	Spatharis	dimitriospatharis@gm	National and Kapodistrian University of Athens, Dept. of Geology and Geoenvironment, Athens Greece
15	Claudio	Strumia	claudio.strumia@unin	University of Naples Federico II, Dept. of Physics "Ettore Pancini", Napoli, Italy
16	Isabel	Teixeira	isabel.teixeira@fc.up.	University of Porto, Faculty of Science, Porto, Portugal
17	Nikos	Vavlas	navavlas@geo.auth.g	Aristotle University of Thessaloniki, School of Geology, Thessaloniki Greece
18	Angelos	Zymvragakis	azymvragakis@geol.u	National and Kapodistrian University of Athens, Dept. of Geology and Geoenvironment, Athens Greece

# Teachers

a/a	First Name	Last Name	E-mail Address	Affiliation
1	Anastasia	Barmparousi	4gym.barbarousi@gmail.com	4th Gymnasio of Palaio Faliro Greece
2	Sofia	Chronopoulou	sofchronopoulou@gmail.com	66 High school Athens Greece
3	Kostas	Louvaris	klouvari@gmail.com	1st Highschool of Lamia Greece
4	Anastasia	Gkaragkouni	agkaragkouni@yahoo.com	Gymnasio Antirriou Greece
5	George	Diamantopoulos	g_diam@hotmail.com	Etoliko High School Greece
6	Telemachus	Baltsavias	tbaltsavias@gmail.com	Keramies Junior High School Greece
8	Emmanuelle	Jammart	emmanuelle.jammart@gmail.com	France
9	Pane	Perunovski	pane.perunovski@ahss.edu.mk	North Macedonia
10	Nataliia	Halaliuk	nata.galalyuk@gmail.com	Ukraine
11	Marc	Padrosa Rios	marc.padrosa.rios@gmail.com	Spain
12	Maria	Assunção	maria.assuncao1321@gmail.com	Portugal

# Curricula Vitae





## **Pierre Briole**

Research Director  
Ecole Normale Supérieure,  
Paris Sciences et Lettres Research University,  
Département des Géosciences

briole@ens.fr

### **Education**

1990 Ecole Normale Supérieure de Cachan in applied physics. Agrégation 1983. PhD, University Paris VI, Paris

### **Career**

2007-today Research Director CNRS  
Ecole Normale Supérieure/Paris Sciences et Lettres Research University - Département des  
Géosciences - Laboratoire de Géologie

2008-2009 09/2008-2009: Directeur des études,  
2010-2013 2010-2013: Head of the Department

2004-2007 Research Director CNRS  
Institut de Physique du Globe de Paris

2005-2006 Director of the laboratory of Geodesy

1990-2004 Chargé de Recherche CNRS  
Institut de Physique du Globe de Paris - Département de Sismologie

1989-1990 Researcher  
Institut Géographique National – Laboratoire d’Opto-Electronique et de Micro-  
informatique

### **Research interests**

Study of the deformation of volcanoes (Etna, Campi Flegrei, Vulcano (Italy), Piton de la Fournaise (France), Nisyros (Greece), Sakurajima (Japan) and seismic zones (Asal Rift (Djibouti), Gulf of Corinth (Greece), Northern Chile, Umbria (Italy), Algeria, Bulgaria) using various methods, including GPS, radar interferometry, high resolution imaging and local methods (tiltmeter, micro-gravity, ...).

Modelling of ground deformations and interpretation combining tectonic, geodetic, and seismological data.

Development of new technologies (Projects of satellites, ground based radars, robots).

### **Publications and services**

73 articles in journals with peer review, 2951 citations

194 communications in international meetings

3 articles in outreach journals, participation to 4 educational &/or educative movies, several interviews in French radios, several lectures in schools

Coordinator of the “Insegnaci Etna” project <http://ietna.eu>



## Athanassios Ganas

Research Director  
Institute of Geodynamics, National Observatory of Athens

aganas@noa.gr

### Education

Bachelor of Science, Geology, University of Athens; Master of Science Carleton University, Canada; PhD University of Reading, UK

### Career

2012-2023      Research Director NOA  
2000-2011      Researcher NOA

### Research interests

Active Tectonics-Seismology and Remote Sensing / Geophysical Earth Observation including Fault Interaction, Tectonic Geomorphology and GNSS networks.

### Publications and services

Melgar, D., Taymaz, T., Ganas, A., et al. 2023. Sub- and super-shear ruptures during the 2023 Mw 7.8 and Mw 7.6 earthquake doublet in SE Türkiye. *Seismica*, 2(3), <https://doi.org/10.26443/seismica.v2i3.387>  
Mesimeri, M., Ganas, A., Pankow, K.L., 2022. Multisegment ruptures and Vp/Vs variations during the 2020-2021 seismic crisis in western Corinth Gulf, Greece, *Geophysical Journal International*, Volume 230, Issue 1, Pages 334–348, ggac081, <https://doi.org/10.1093/gji/ggac081>

In October 2021 he was elected President of the Geological Society of Greece. He is the Editor-in-Chief of BGS <https://ejournals.epublishing.ekt.gr/index.php/geosociety>. Since May 2009 he serves as Member of the Greek National Committee for Seismic Hazard Assessment and the National Committee for Seismotectonics. During 2010-2017 he served as regular member at the Board of Directors of the EPPO (Earthquake Planning and Protection Organisation, Greece). Since 2021 he is an elected member of the EPOS TCS-GNSS consortium Board.

### Awards and honors

In 2016 he received the best Geodesy paper of the Academy of Athens (with Kostas Chousianitis). In 2007 he won the Fulbright prize “Project Title: *Earthquake recurrence and seismic hazard forecast along the Cascadian and Hellenic subduction zones*”. In 2010 he was awarded the distinction «AGU Editors’ Citations for Excellence in Refereeing». In 2017 he was announced as “Outstanding Reviewer” for Tectonophysics.



## **Panagiotis Elias**

Associate Researcher

National Observatory of Athens  
Institute for Astronomy, Astrophysics, Space  
Applications and Remote Sensing (IAASARS)

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### **Education**

2013 PhD in the framework of co-tutelle agreement between the École Normale Supérieure (Département des Géosciences, France) and the University of Patras (Department of Physics, Greece), with title “Ground deformation observed in the western Corinth rift (Greece) by means of SAR interferometry”.

2007 MSc in Signal Processing for Telecommunications and Multimedia of the department of Informatics and Telecommunications of the University of Athens, Greece.

2003 Degree of Electronics Engineering of the Technological Educational Institute of Piraeus.

### **Career**

2021-today Associate Researcher of IAASARS/NOA.

2005-2021 Scientific staff of IAASARS/NOA.

1998-2005 Research assistant of Institute for Space Applications and Remote Sensing (later IAASARS) of NOA.

### **Research interests**

I have participated in more than 40 research projects in the field of satellite geodesy and image/signal processing exploiting the synergy of active and passive earth observations satellites as well as GNSS and other in-situ measurements such as inclinometers, levelling and seismological data. My research interest is focused in the detection and measurement of ground deformation and infrastructure instability due to geophysical processes of manmade activities. Moreover I am contributing to the development of methodologies and to the modelling of the deformation sources considering the particular underlying geodynamic and geophysical background. I am author of 43 peer refereed publications in international journals, and more than 70 presentations in international conferences.

### **Selected publications and services**

G Kaviris, P Elias, V Kapetanidis, A Serpetsidaki... (2021) The Western Gulf of Corinth (Greece) 2020–2021 seismic crisis and cascading events: First results from the Corinth Rift Laboratory network. *The Seismic Record*, 1 (2), 85-95

P. Elias, I Spingos, G Kaviris, A Karavias, T Gatsios, V Sakkas and I. Parcharidis (2021). Combined Geodetic and Seismological Study of the December 2020 Mw= 4.6 Thiva (Central Greece) Shallow Earthquake. *Applied Sciences* 11 (13), 5947

Briole P., Ganas A., Elias P., Dimitrov D. (2021). The GPS velocity field of the Aegean. New observations, contribution of the earthquakes, crustal blocks model, *Geophysical Journal International*, 2021, ggab089, <https://doi.org/10.1093/gji/ggab089>

Roukounakis N., Elias P., Briole P., Katsanos D., Kioutsoukis I., Argiriou A., Retalis A. (2021). Tropospheric Correction of Sentinel-1 Synthetic Aperture Radar Interferograms Using a High-Resolution Weather Model Validated by GNSS Measurements. *Remote Sensing* 13 (12), 2258

Briole P., Ganas A., Elias P., Dimitrov D. (2021). The GPS velocity field of the Aegean. New observations, contribution of the earthquakes, crustal blocks model, *Geophysical Journal International*, 2021, ggab089, <https://doi.org/10.1093/gji/ggab089>

Co-responsible for the operation of 16 GNSS stations of the CRL observatory

### **Awards and honors**

Member of the ESA Living Planet Symposium Scientific Committee for the years 2010 and 2013.



## **Eleftheria Papadimitriou**

Professor of Seismology  
Aristotle University of Thessaloniki  
School of Geology  
Geophysics Department

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### **Education**

1981 B. Sc. In Geology – University of Thessaloniki, Greece  
1984 Ph. D. Thesis in Seismology – University of Thessaloniki, Greece

### **Career**

1985-1990 Research Assistant of the Geophysics Department of the Aristotle University of Thessaloniki  
1985-1990 Lecturer  
1990-1994 Assistant Professor  
1994-2001 Associate Professor

### **Research interests**

Long-term earthquake prediction on the basis of seismicity and probabilistic models  
Studies of seismic sequences  
Seismotectonics  
Fault plane solutions and stress patterns  
Source parameters by synthetic seismograms  
Time dependent seismicity by the application of the Time Predictable Model.  
Fractal analysis of the global seismicity and the seismicity of Greece  
Stress evolution by the use of Coulomb Failure Function changes  
Statistical Seismology  
Seismic hazard assessment

### **Publications and services**

Karakostas, V., Mirek, K., Mesimeri, M., Papadimitriou, E. & Mirek, J. The aftershock sequence of the 2008 Achaia, Greece, earthquake: joint analysis of seismicity relocation and persistent scatterers interferometry. *Pure & Applied Geophysics*, 174, 151–176, DOI 10.1007/s00024-016-1368-y, 2017.  
Mangira, O., Console, R., Papadimitriou, E. & Vasiliadis, G. A restricted Linked Stress Release Model (LSRM) for the Corinth gulf (Greece). *Tectonophysics*, 723, 162–171, 2018.  
Bountzis, P., Papadimitriou, E. & Tsaklidis, G. Estimating the earthquake occurrence rates in Corinth Gulf (Greece) through Markovian arrival process modeling. *Journal of Applied Statistics*, 46(6), 995–1020, doi:10.1080/02664763.2018.1531977, 2019.



## **Vassilis Karakostas**

Professor of Seismology  
Aristotle University of Thessaloniki  
School of Geology  
Geophysics Department

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### **Education**

1981 B. Sc. In Geology – University of Thessaloniki, Greece  
1988 Ph. D. Thesis in Seismology – University of Thessaloniki, Greece

### **Career**

1988–1991 Cooperating Researcher of the Geophysics Department of the Aristotle University of Thessaloniki  
1991–1999 Seismologist of the Central Seismological Station of Thessaloniki of the same Department  
1999–2003 Lecturer of Seismology  
2003–2009 Assistant Professor of Seismology  
2009–2014 Associate Professor of Seismology

### **Research interests**

Long-term earthquake prediction on the basis of seismicity and probabilistic models.  
Studies of seismic sequences  
Seismotectonics  
Fault plane solutions and stress patterns  
Tsunamis and tsunami hazard  
Fractal analysis of the global seismicity and the seismicity of Greece  
Stress evolution by the use of Coulomb Failure Function changes  
Statistical Seismology  
Seismic Hazard Assessment  
Induced Seismicity

### **Publications and services**

Karakostas, V., Mirek, K., Mesimeri, M., Papadimitriou, E. & Mirek, J. The aftershock sequence of the 2008 Achaia, Greece, earthquake: joint analysis of seismicity relocation and persistent scatterers interferometry. *Pure & Applied Geophysics*, 174, 151–176, DOI 10.1007/s00024-016-1368-y, 2017.  
Mesimeri, M., Karakostas, V., Papadimitriou, E., Tsaklidis, G. & Jacobs, K., (2018). Relocation of recent seismicity and seismotectonic properties in the Gulf of Corinth (Greece), *Geophys. J. Int.*, 212, 1123-1142. doi: 10.1093/gji/ggx450.  
Mesimeri, M. & Karakostas, V. Repeating earthquakes in western Corinth Gulf (Greece): implications for aseismic slip near locked faults. *Geophys. J. Int.*, 215, 659-676. doi: 10.1093/gji/ggx301, 2018.



## George Kaviris

Associate Professor  
National and Kapodistrian University of Athens  
Faculty of Geology and Geoenvironment  
Department of Geophysics and Geothermics

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### Education

- 1994: Graduated from the Faculty of Physics, National and Kapodistrian University of Athens (NKUA)  
2003: PhD of Seismology, Department of Geophysics and Geothermics, Faculty of Geology and Geoenvironment, NKUA. Thesis subject: "Study of Seismic Source Properties of the Eastern Gulf of Corinth".

### Career

- 2021 – today: Associate Professor of "Seismology–Seismic Anisotropy", Sect. Geophysics and Geothermics, Department of Geology and Geoenvironment, NKUA.  
2016 – 2021: Assistant Professor of "Seismology – Seismic Anisotropy", Sect. Geophysics and Geothermics, Department of Geology and Geoenvironment, NKUA.  
2013 – 2016: Lecturer of "Seismology", Sect. Geophysics and Geothermics, Department of Geology and Geoenvironment, NKUA.  
2006 – 2013: Research Associate, Laboratory of Seismology, Sect. Geophysics and Geothermics, Department of Geology and Geoenvironment, NKUA.  
2004 – 2007: Post-Doc Researcher, Research Project "Pythagoras" entitled: «Identification of Anisotropic Media in Greece using body and surface waves».

### Research interests

My primary research interest is Seismic Anisotropy and Shear-wave Splitting of the upper crust and mantle. In addition, Seismotectonics, Seismic Hazard and Risk, Receiver Functions, Ambient Noise, Slip Distribution, Seismic Swarms and Earthquake Early Warning.

### Publications and services

Supervisor of 20 MSc and 24 BSc students. I am currently supervising 2 PhD Theses.

I have 191 publications in international scientific journals and congress proceedings. Among my publications for the Gulf of Corinth:

- G. KAVIRIS, A. Zymvragakis, P. Bonatis, V. Kapetanidis, N. Voulgaris, 2022. Probabilistic and Scenario – based Seismic Hazard Assessment on the Western Gulf of Corinth (Central Greece). *Appl. Sci.*, 12 (21), 11152. doi: 10.3390/app122111152.
- G. KAVIRIS, P. Elias, V. Kapetanidis, A. Serpetsidaki, A. Karakonstantis, V. Plicka, L. De Barros, E. Sokos, I. Kassaras, V. Sakkas, I. Spingos, S. Lambotte, C. Duverger, O. Lengliné, Ch. Evangelidis, I. Fountoulakis, O.-J. Ktenidou, F. Gallovič, S. Bufféral, E. Klein, El M. Aissaoui, O. Scotti, H. Lyon-Caen, A. Rigo, P. Papadimitriou, N. Voulgaris, J. Zahradnik, A. Deschamps, P. Briole, P. Bernard, 2021. *The Seismic Record*, 1, doi.org/10.1785/0320210021.
- G. KAVIRIS, I. Spingos, V. Kapetanidis, P. Papadimitriou, N. Voulgaris and K. Makropoulos, 2017. Upper crust seismic anisotropy study and temporal variations of shear-wave splitting parameters in the Western Gulf of Corinth (Greece) during 2013. *Phys. Earth Plan. Int.*, 269, 148-164, doi.org/10.1016/j.pepi.2017.06.006.
- G. KAVIRIS, Ch. Millas, I. Spingos, V. Kapetanidis, I. Fountoulakis, P. Papadimitriou, N. Voulgaris and K. Makropoulos, 2018. Observations of shear-wave splitting parameters in the Western Gulf of Corinth focusing on the 2014 Mw=5.0 earthquake. *Phys. Earth Plan. Int.*, 282, 60-76. doi.org/10.1016/j.pepi.2018.07.005.

### Awards and honors

January 2017: Highly cited Research Award for "Karst collapse susceptibility mapping considering peak ground acceleration in a rapidly growing urban area" (co-author). This publication was awarded as being among the five (5) most cited works of the "Engineering Geology" for the period January 2014 - June 2016.





## **Christos Merantzis**

Associate Professor  
Department of History & Archaeology  
University of Patras

[hmerantz@upatras.gr](mailto:hmerantz@upatras.gr)

### **Education**

Archaeology, Universities of Ioannina (Greece), Louvain-la-Neuve (Belgium) and Paris I Panthéon-Sorbonne (France)

### **Career**

2006-today Associate Professor, University of Patras  
2008-2023 Teaching fellow, Hellenic Open University  
1998-2006 Laboratory of Archaeology, University of Ioannina  
1997-1998 Foundation of the Hellenic World (Athens)  
1991 Archaeological Service of Greece

### **Research interests**

Cultural history and theory

### **Publications and services**

Published extensively in the field of cultural history (seven books, three co-authored monographs) and in the aesthetic appreciation of human-constructed environments (one book) and numerous articles in a variety of journals covering subjects from cultural history of the body to cultural management and environmental aesthetics. Project manager for the Greek part of the European Programme *In-NovaMusEUm: Museums come back to the local community through arts and food*, co-funded by the Creative Europe Programme of the European Union (2016-2018) and scientific responsible for the Research Project entitled *The Virtual Museum* funded by the 'John S. Latsis Public Benefit Foundation' (2015).

### **Awards and honors**

Awarded the Metsovion Interdisciplinary Research Prize of the National Technical University of Athens for the best academic research (2013).



## **Maria Geraga**

Professor,

Laboratory of Marine Geology and Physical Oceanography, Department of Geology,  
University of Patras, 26504 Rio Achaia

mgeraga@upatras.gr

### **Education**

- 2000: Phd in Oceanography, Department of Geology, University of Patras, Greece.  
Title of thesis: 'Evaluation of palaeoceanographic and palaeoclimatic changes during Holocene in SW Aegean Sea (Greece) and the formation of the sapropels'
- 1993: B. Sc. in Geology, University of Patras, Greece

### **Career**

- 2020-today Professor, Dept. of Geology, University of Patras, Greece
- 2016-2020 Assistant Professor (permanent), Dept. of Geology, University of Patras, Greece
- 2012-2015 Assistant Professor (adjustment), Dept. of Geology, University of Patras, Greece.
- 2006-2012 Lecturer in "Archaeological Oceanography", Dept. of Geology, University of Patras, Greece
- 2000-2006 Under Appointed Ass. Professor in Polytechnics, in Chemical Oceanography. Higher Educational Technological Institute of Messolonghi, Greece.
- 1993-2006 Research Associate in the Laboratory of Marine Geology and Physical Oceanography, Dept. of Geology, University of Patras.

### **Research Interests**

Palaeoclimatology-Palaeoceanography, Marine sedimentology, Marine Geoarchaeology, Marine hazards, Marine natural and cultural heritage sites and Marine Pollution

### **Publications And Services**

She has more than 85 articles in journals of Science Citation Index, peer reviewed scientific journals and chapters in scientific books and 65 publications (full length papers) and more than 55 publications (abstracts) in International Conferences in the field of Marine Science. Scientist in charge for several national and EU projects. Reviewer in journals of Science Citation Index and peer reviewed journals. Evaluator in national and international Science Foundations. Supervisor of undergraduate and postgraduate dissertations and Phd dissertations. Member of the Science Party of IODP Expedition 381 Corinth Rift.



## **Haralambos Kranis**

Assistant Professor  
National and Kapodistrian University of Athens  
Department of Geology and Geoenvironment

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### **Education**

Degree in Geology National and Kapodistrian University of Athens, Post-graduate Diploma, in Seismology, (International Institute for Seismology and Earthquake Engineering), Ph.D. in Geological Sciences, National and Kapodistrian University of Athens

### **Career**

My scientific career mainly involves working for the Department of Geology and Geoenvironment, at the Sector of Dynamic, Tectonic and Applied Geology, while I have also served as Tectonics and Structural Geology expert for the General Secretariat for Civil Protection, collaborated with the Earthquake Research and Planning Organization (EPPO), and the Hellenic Centre for Marine Research (HCMR); and as a consultant for major infrastructure projects, such as gas and oil pipelines, and management of natural hazards.

### **Research Interests**

My main research interests include, but are not limited to, Tectonics and Structural Geology (especially brittle deformation), Neotectonics, Active Tectonics and Earthquake Geology, Tectonic Geomorphology and Palaeoseismology. In the last decade, I am involved in research on the tectonic control on sedimentation and basin formation in actively evolving continental rifts and their inactive analogues. Extending my scope in field geology and geological mapping, I have adopted methods and techniques that involve spatial analysis of geological structures through Structure from Motion (SfM), 3D outcrop modelling of outcrops, digital field mapping and modelling of tectonically-controlled landscapes.

### **Publications and Services**

I have published over 40 articles in peer-reviewed scientific journals, several field guides and special reports, as well as geological and neotectonic maps at various scales.

### **Awards and Honors**

Scholarship from the Government of Japan (Japan International Cooperation Agency)  
Goldschmidt Lecturer, Geological Survey of Norway



## **Fiori - Anastasia Metallinou**

Public Outreach Officer  
National Observatory of Athens  
Institute for Astronomy, Astrophysics, Space  
Applications and Remote Sensing (IAASARS)

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### **Education**

- 2009 Ph.D. in Space Physics, Aristotle University of Thessaloniki, National Observatory of Athens. Title of Thesis: “Development and Recovery of Magnetic Storms in Geospace”.
- 2001 M.Sc. Degree in Atmospheric and Environmental Physics, Aristotle University of Thessaloniki, Greece.
- 1998 Diploma in Physics, Physics Department, Aristotle University of Thessaloniki, Greece.
- 2008 Diploma in Classical Singing from the Athens Conservatory “Musical Horizons”.
- 2004-2006 Studies in the Faculty of Melodramatic State Conservatory, Thessaloniki, Greece.

### **Career**

- 2014-today Lead Public Outreach Officer at the Thissio Visitor Center of the National Observatory of Athens (located at the historic site in the center of Athens).
- 2010-2013 Research Associate at the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory of Athens.

### **Research interests**

Simulation of ion acceleration in the Earth's magnetosphere during magnetic storms and magnetospheric substorms.  
Sonification of scientific data describing magnetospheric disturbances.  
The use of the “sounds of space” in education, dissemination of Astronomy and the arts.

### **Publications and services**

- F.-A Metallinou, “Pythagoras Redivivus: The Music of the Spheres and it’ s Reification in Modern Astronomy” 10<sup>th</sup> Congress of the International Society for the Interdisciplinary Study of Symmetry, Adelaide, Australia, 1-6 December 2016.
- E. Rovithis, F.-A Metallinou, A. Floros, “Hearing a magnetic storm: an Educational Interactive Audio Environment”, 8<sup>th</sup> Pan Hellenic Conference of Acoustics 2016, 3-4 October 2016, Athens.
- 2019: Scientific research, scenario and presentation of the documentary “*The Experiment of Eratosthenes*”, production: Cosmote TV.
- 2018: Scientific research, scenario and voice over of the documentary “*Time of Greece*”, production: Cosmote TV.

### **Awards and honors**

She has received the Research Grant “HRAKLEITOS” with priority in Basic Research of the Ministry of Education of Greece (2002 - 2005) and the award of the “Barbanis Price of Astronomy” from the Aristotle University of Thessaloniki (1995).

She has been a TEDx speaker in 2014, 2018 and 2022. She contributes to the dissemination of Astronomy and Space Physics concepts with public lectures and articles in the media, newspapers, public journals, TV shows, documentaries and activities combining science and art. She has been an invited speaker by educational organizations, private and public schools, laboratory science centers of the Hellenic Department of Education, associations of amateur astronomers, cultural foundations, art and science festivals all over Greece.



## **Ioannis Spingos**

PhD Candidate in Seismology  
National and Kapodistrian University of Athens  
Department of Geology and Geoenvironment  
Section of Geophysics and Geothermics

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### **Education**

I completed the undergraduate programme of the Department of Geology & Geoenvironment at the National and Kapodistrian University of Athens to obtain my BSc and then continued in the postgraduate courses at the same department, to obtain my MSc in Seismology. Today, I am a PhD candidate in Seismology.

### **Career**

August 2018-today

Researcher in various nationally and EU- funded research projects at the National and Kapodistrian University of Athens, the Geodynamic Institute of the National Observatory of Athens, and the Hellenic Mediterranean University.

### **Research interests**

My research focuses on shear-wave splitting in the upper crust and its properties as earthquake precursors. I have also worked on seismic hazard and earthquake early warning topics. I extensively code in Python, maintaining my own GitHub repositories.

### **Publications and services**

My published work includes 16 articles in international peer-reviewed journals and 29 publications in conferences, with over 100 citations, which focus on shear-wave splitting, seismotectonics and earthquake early warning. Selected publications:

- Kaviris, G., Spingos, I., Kapetanidis, V., Papadimitriou, P., Voulgaris, N., Makropoulos, K., 2017. Upper crust seismic anisotropy study and temporal variations of shear-wave splitting parameters in the Western Gulf of Corinth (Greece) during 2013. *Phys. Earth Planet. Inter.* 269, 148–164. doi: 10.1016/j.pepi.2017.06.006
- Kaviris, G., Millas, C., Spingos, I., Kapetanidis, V., Fountoulakis, I., Papadimitriou, P., Voulgaris, N., Makropoulos, K., 2018. Observations of shear-wave splitting parameters in the Western Gulf of Corinth focusing on the 2014 Mw = 5.0 earthquake. *Phys. Earth Planet. Inter.* 282, 60–76. doi: 10.1016/j.pepi.2018.07.005
- Spingos, I., Kaviris, G., Millas, C., Papadimitriou, P., Voulgaris, N., 2020. Pytheas: An open-source software solution for local shear-wave splitting studies. *Comput. Geosci.* 134, 104346. doi: 10.1016/j.cageo.2019.104346



## **Petros Koutsovitis**

Assistant Professor, [pkoutsovitis@upatras.gr](mailto:pkoutsovitis@upatras.gr)

University of Patras, Department of Geology

### **Education**

Dr. Petros Koutsovitis specializes on the fields of Geology, Petrology, Mineralogy, Geochemistry and CCS applications, having conducted post-doctoral research in Greece and Austria (NKUA, UNIVIE and HSGME). During 2016-2019 he collaborated with CERTH, actively participating in Horizon2020 and RFCS funded project's. As of 2019, he is Assist. Prof. (University of Patras, Department of Geology). Dr Petros Koutsovitis has been awarded by the Academy of Athens for his research.

### **Research Interests**

- Magmatic Rocks
- Petrogenesis of Ophiolites
- Metasomatic processes
- Sustainable use of raw materials

### **Publications**

- Koutsovitis, P., Magganas, A., Ntaflos, T., Koukouzas, N., Rassios, A.E., Soukis, K., 2020. Petrogenetic constraints on the origin and formation of the Hellenic Triassic rift-related lavas. *Lithos* 368-369, 105604.
- Tzevelekou, T.; Lampropoulou, P.; Giannakopoulou, P.P.; Rogkala, A.; Koutsovitis, P.; Koukouzas, N.; Petrounias, P. Valorization of Slags Produced by Smelting of Metallurgical Dusts and Lateritic Ore Fines in Manufacturing of Slag Cements. *Appl. Sci.* 2020, 10, 4670.
- Arvanitis, A.; Koutsovitis, P.; Koukouzas, N.; Tyrologou, P.; Karapanos, D.; Karkalis, C.; Pomonis, P. Potential Sites for Underground Energy and CO<sub>2</sub> Storage in Greece: A Geological and Petrological Approach. *Energies* 2020, 13, 2707.
- Badouna, I.; Koutsovitis, P.; Karkalis, C.; Laskaridis, K.; Koukouzas, N.; Tyrologou, P.; Patronis, M.; Papatrechas, C.; Petrounias, P. Petrological and Geochemical Properties of Greek Carbonate Stones, Associated with Their Physico-Mechanical and Aesthetic Characteristics. *Minerals* 2020, 10, 507.
- Petrounias, P. Giannakopoulou, P., Rogkala, A., Kalpogiannaki, M., Koutsovitis, P., Damoulianou, M.E., Koukouzas, N., 2020. Petrographic Characteristics of Sandstones as a Basis to Evaluate Their Suitability in Construction and Energy Storage Applications. A Case Study from Klepa Nafpaktias (Central Western Greece). *Energies*, 13(5), 1119.
- Petrounias, P.; Rogkala, A.; Giannakopoulou, P.P.; Lampropoulou, P.; Koutsovitis, P.; Koukouzas, N.; Laskaris, N.; Pomonis, P.; Hatzipanagiotou, K. Removal of Cu (II) from Industrial Wastewater Using Mechanically Activated Serpentine. *Energies* 2020, 13, 2228.
- Koukouzas, N., Koutsovitis, P., Tyrologou, P., Karkalis, C., Arvanitis, A., 2019. Potential for Mineral Carbonation of CO<sub>2</sub> in Pleistocene Basaltic Rocks in Volos Region (Central Greece). *Minerals*, 9 (10), 627.
- Koutsovitis, P., Magganas, A., Ntaflos, T., Koukouzas N. 2018. Rodingitization and carbonation, associated with serpentinization of Triassic ultramafic cumulates and lavas in Othris, Greece. *Lithos* 320-321, 35-48.
- Liard, F., Pomonis, P. Koutsovitis, P., Gait, J., Stamatakis, M. 2017. Ophiolites associated with pottery production in Bronze Age Crete. *Archaeometry*.





## Jean-Luc Berenguer

Science Teacher  
Geoazur Laboratory (University Côte d'Azur)  
Education & Outreach team  
UMR Geoazur,  
University Côte d'Azur, France

jean-luc.berenguer@univ-cotedazur.fr

### Career

2022 – today: EGU (European Geoscience Union) Committee of Education Chair  
2017: IESO (Geoscience Olympiads) 2017 FRANCE - Organization Committee President  
2017 – today: EduMed Observatory project leader - University Côte d'Azur  
2014 – today: InSight Education project (NASA-CNES-IPGP) leader in France  
2006 – 2017: French educational seismological network leader  
2019 – today: Biology and Geoscience Teacher in Valbonne International Highschool, France

### Publications and services

Berenguer, J.-L., Hands-on Booklet, SISMO Collector, DDTM 06, 2020.  
Berenguer, J.-L., Balestra, J., Jouffray, F., Mourau, F., Courboulex, F., and Virieux, J.: 25 years of seismology at school in France, *Geosci. Commun. Discuss.*, <https://doi.org/10.5194/gc-2020-32>, in review, 2020.  
Balestra J., Berenguer J.-L., F. Bigot-Cormier, F. Courboulex, L. Rolland, D. Ambrois, M. Van Driel, and P. Lognonné (2020) The InSight Blind Test: An Opportunity to Bring a Research Dataset into Teaching Programs, *SRL* - doi: 10.1785/0220190137. Volume 91, Number 2A, March 2020  
Berenguer J.-L., F. Bigot-Cormier, G. Coupechoux, F. Boutaud (2020) Juega con Namazu en el mundo de las Ciencias de la Tierra / Playing with Namazu in geosciences topic (2020) *Enseñanza de las Ciencias de la Tierra*, 2020 (28.1) – p.99-106  
Bigot-Cormier F., Berenguer J.-L., How Students Can Experience Science and become Researchers: Tracking MERMAID Floats in the Oceans, *Seis. Res. Letters* ., 88 , 10.1785/0220160121 , 2017  
Berenguer J.-L. et al., Tuned into the Earth from the school EduSismo: French educational seismological network, *Bull. Soc. Géol. de France*, 184, 183, 10.2113/gssgfbull.184.1-2.183, 2013.  
Berenguer J.-L., Virieux J., How to teach natural hazards in school: Raising awareness on earthquake hazard, Office for Official Publications of the European Communities, 2008



## Vasiliki Kouskouna

Professor  
National and Kapodistrian University of Athens  
Department of Geology and Geoenvironment  
Section of Geophysics and Geothermics

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### Education

Degree in Physics, PhD in Seismology, National and Kapodistrian University of Athens

### Career

2021-today Professor, NKUA  
2007-2021 Associate Professor, NKUA  
1999-2007 Assistant Professor, NKUA  
2017 Fulbright Visiting Scholar, Saint Cloud State University (SCSU), MN, USA  
2009-2012 Director of Laboratory of Seismology, DGG, NKUA  
2008-todate Volunteer lecturer, «Popular Open University», Athens, Greece

### Research interests

Seismicity, Seismic Hazard, Seismic Risk, Natural Hazards, Macroseismology, Historical Earthquakes, Disaster Response, Engineering Seismology, Educational Seismology

### Publications and services

V. Kouskouna, N. Petropoulos, T. Tsounakos (2005). "Living with earthquakes – protecting myself". Patakis Editions, 38pp. (in Greek)

A. Kourou, M. Panoutsopoulou, O. Vaggelatou, I. Bergiannaki, N. Petropoulos, I. Parcharidis, V. Kouskouna, 2005. "Earthquakes and society – Education, Protection, Recovery". Patakis Editions, 40pp. (in Greek)

Kouskouna V, Diagourtas D, Galanos N, Makropoulos K (2006). Earthquake scenarios for educational shake table. ECEES: 1st Eur. Conf. on Earthq. Eng. and Seismology 3-8/9, Geneva, ID-2022, p.472.

Kouskouna V, Sakkas G (2013). The University of Athens Hellenic Macroseismic Database (HMDB.UoA): historical earthquakes. *J Seismol*, 17(4), 1253-1280, <https://doi.org/10.1007/s10950-013-9390-3>.

Kouskouna V, Kaperdas V, Sakellariou N (2020). Comparing calibration coefficients constrained from early to recent macroseismic and instrumental earthquake data in Greece and applied to eighteenth century earthquakes. *J Seismol*,

Kassaras I, Kapetanidis V, Ganas A, Tzanis A, Kosma C, Karakonstantis A, Valkaniotis S, Chailas S, Kouskouna V, Papadimitriou P (2020). The New Seismotectonic Atlas of Greece (v1.0) and Its Implementation. *Geosciences*, 10(11):447, <https://doi.org/10.3390/geosciences10110447>.

Kouskouna V, Sakkas G, Cecic I, Tsimpidaros VI, Sakkas S, Kaviris G, Tertulliani A (2020). Earthquake induced crises: game tree approached risk communication and lessons learnt. *Annals of Geophysics*, 64/3,

Kouskouna V (2020). The earthquake suitcase. 360°Actions, Corporate Social Responsibility Panorama, Hellenic Petroleum Group, p.8.

Kouskouna V, Ganas A, Kleanthi, M Kassaras I, Sakellariou, N Sakkas G, Valkaniotis S, Manousou E, Bozionelos G, Tsironi V, Karamitros I, Tavoularis N, Papaioannou Ch, Bossu R (2021). Evaluation of macroseismic intensity, strong ground motion pattern and fault model of the 19 July 2019 Mw5.1 earthquake west of Athens. *J Seismol*, <https://doi.org/10.1007/s10950-021-09990-3>.

Kouskouna V, Ridge H, Young D, Olafson E, Gazouli M (2021). Building Partnerships for Building Resiliency in Traumatized Youth. we4DRR (women exchange for Disaster Risk Reduction) virtual Gen. Ass. 16/6. Poster

Kouskouna V, Dakis M, Ridge H, Young D, Gazouli M, Olafson E (2021). Teaching Social-Emotional learning through an earthquake lesson. 37th ESC2021 virtual, 19-24/9.

Kouskouna et al. (2022). Projects INFRASEPTEL, KNETSEISRL ACTCIPROL: towards a state-of-the-art centre for the study of earthquakes in Lixouri (W. Kefalonia, Greece). 3rd European Conference On Earthquake Engineering & Seismology, Bucharest, Romania, 2022

### Awards and honors

Fulbright Scholar Award (2017)



## **Fotios Danaskos**

Geologist, School Teacher  
8<sup>th</sup> Junior High School in Chalandri, HELLAS

fdanas@yahoo.gr

### **Education**

2008: National and Kapodistrian University of Athens Hellas, School of Education/University College London Institute of Education, M.A. Education and Human Rights direction Special Education, MSc.

2004: National and Kapodistrian University of Athens Hellas, Department of Communication & Media Studies, Annual Teacher Training Seminar, "Professional Identity and Communication Counseling".

1994: Technological Educational Institute of Athens Hellas, Faculty of Health and Caring Professions, Physiotherapy Department, BSc.

1986: National and Kapodistrian University of Athens Hellas, Department of Geology, Athens, BSc.

### **Career**

1997-2007	Freelance Physiotherapist
1994-2013	Physiotherapist School Teacher
2013-today	Geologist School Teacher

### **Research interests**

Researcher «Recording the symptoms of pain in the joints of the spine and upper and lower limbs of students in Vocational Secondary School, 2005.

Member of the research group "Pattern of Child Status in Primary and Vocational Secondary School, 2005

### **Publications and services**

E.G.U. Geoscience Education Field Officer for Greece

Member of the Scientific Committee of C.R.L. School, Corinth Rift Observatory

G. Secretary of the Committee of GEOsciences Didactis of Geological Society of Greece

Participation in CRL 2018 – 2021 and Insegnaci Etna School 2019, Assistant presenter in CRL 2019 on the SEISMOBOX

Member of the B' Training Team in the New Curricula for Geology/Geography in High School 2022-2023

Erasmus+ , eTwinning School Coordinator

Organization of programs on Environmental Education and Geosciences through partnerships with schools of Europe.

Member of the Writing Team for the course "Introduction to Physiotherapy", of the of the Assistant Physiotherapists 2nd class of the TVES of Health and Welfare Sector, Pedagogical Institute 2001.

Member of the Jury Team for the Workshop on "Supervised Practice in Welfare Services" Round 1, Class 2 TVES, of Health and Welfare Sector, Pedagogical Institute 2001.

Member of the Curriculum Development Team of the Assistant Physiotherapists of the TVES. 2000.



## **Dragos Tataru**

Applied Geophysics, Prevention, and Education Laboratory  
National Institute for Earth Physics, Romania

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### **Education**

- 2010 Ph.D. in Physics – Faculty of Physics, University of Bucharest
- 2005 Master's degree in Engineering Geology – Faculty of Geology and Geophysics, University of Bucharest
- 2004 Bachelor's degree in Geophysics, Faculty of Geology and Geophysics, University of Bucharest

### **Career**

- 2022 Coordinator of Applied Geophysics, Prevention, and Education Laboratory, National Institute for Earth Physics, Romania
- 2010 Researcher at National Institute for Earth Physics, Romania
- 2006 Research Assistant at National Institute for Earth Physics, Romania

### **Research interests**

He graduated in Geophysics and has a strong background in seismology. He has more than 18 years of work experience in seismology research on seismicity analysis, seismic velocity structure investigation using innovative techniques, and science education and outreach.

Interest: Near Surface Geophysics, Seismological database management; Geophysical data processing and analysis; Seismicity analysis; seismic velocity structure investigation using innovative techniques and array analyses; Informing, Education, and Outreach activities.

### **Publications and services**

With more than 18 years of experience, he has coordinated no less than five national projects and 9 other international ones as a partner coordinator. He published more than 15 articles as the main author or co-author and presented the results obtained at more than 50 national and international conferences. He was involved in the organization of both scientific and educational events (summer schools, training, and conferences for teachers).  
<https://www.researchgate.net/profile/Dragos-Tataru>

### **Awards and honors**

Best presentation award and best oral speaker (BGSC2021, Geoscience2020, CBGA2018) and EGU Geoscience Field Officer for Romania



## **Eduard Nastase**

Researcher

National Institute for Earth Physics - Romania

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### **Education**

- 2022 Ph.D. - Doctoral School of Geology, Faculty of Geology and Geophysics, University Bucharest (Romania)
- 2018 Fulbright Student Award 2017-2018 (Ph.D. work stage), University of Nevada, Reno (United States)
- 2013 Master's degree in Physics and computer science, Faculty of Physics, University Bucharest (Romania)
- 2011 Bachelor's degree in Physics and computer science, Faculty of Physics, University of Bucharest, (Romania)

### **Career**

- 2016-today Researcher, National Institute for Earth Physics, Romania
- 2011-2016 Scientific Research Assistant, National Institute for Earth Physics

### **Research interests**

My experience and certifications are in the GNSS field & Remote Sensing and cover equipment installation, maintenance, acquisition, and data processing. My expertise ranges from data analysis to modeling and interpretation of crustal motions, block modeling with the goal of understanding the seismic hazard and various aspects of geodetic reference frame absolute plate motion determination. I'm actively involved in the implementation and management of several national and international projects and during the last five years focus on educational and digital fabrication.

### **Publications and services**

<https://www.researchgate.net/profile/Eduard-Nastase>

### **Awards and honors**

Fulbright Student Award 2017-2018.

Best Presentation Awards in various conferences during the years.

InSAR, LiDAR, GNSS-seismology for monitoring and modeling the Earth's surface deformations and seismic risk - Summer School in Poland September 2022 scholarship.



## **Kiki Makri**

Teacher of Geosciences - Postdoctoral Researcher - Institute of Environmental Research and Sustainable Development of National Observatory of Athens

kikimakri@noa.gr

### **Education**

2015: PhD, Department of Geology, Aristotle University of Thessaloniki. Prof. Spyridon Pavlides. Study of historical development of geological education in Greece, (Greece). ND36236

2007: M.Sc., Teaching of Chemistry and New Educational Technologies, Department of Chemistry, Aristotle University of Thessaloniki

2005: B.Sc., Department of Geology, Aristotle University of Thessaloniki (Greece).

### **Career**

2020 - today: Teacher of Geosciences at Secondary Education Ministry of Education and Religious Affairs.

2020 - today: Postdoctoral Researcher: Institute of Environmental Research and Sustainable Development of National Observatory of Athens.

2021 - 2021: Curriculum Designer of course Geology and Geography for Junior High School. Institute of Education Policy/Ministry of Education and Religious Affairs.

2021: Curriculum Designer of Skill Labs "Climate change - Natural disasters - Civil protection" for High School. Institute of Education Policy/Ministry of Education and Religious Affairs.

2019 - 2020: Educator at the school program "Sustainable Planet", Stavros Niarchos Foundation Cultural Center, Athens.

2017 – 2020: Assistant Coordinator MSc in Space Sciences Technologies and Applications at National Observatory of Athens.

2016 – 2018: Contract Lecturer: Teaching for the course "Teaching of Geology". Department of Geology, Aristotle University of Thessaloniki, Greece.

### **Research interests**

History of Geosciences, History of Education, Epistemology, Teaching Methodology, Curriculum Design, Curriculum Studies.

### **Publication and services**

Kyriaki Makri, The Content of Meteorology in Greek Geosciences' Textbooks. World Journal of Educational Research ISSN 2375-9771 (Print) ISSN 2333-5998 (Online) Vol. 9, No. 5, 2022, <http://dx.doi.org/10.22158/wjer.v9n5p43>

Makri, K. and Danaskos, F., The history of Geosciences, as teaching scenario, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-9044, <https://doi.org/10.5194/egusphere-egu23-9044>, 2023.

Danaskos, F., Makri, K., Kaviris, G., and Elias, P. The CRL School in the European Education community and the modern classroom, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-4424, <https://doi.org/10.5194/egusphere-egu23-4424>, 2023.

### **Awards and Honors**

Operational Programme «Human Resources Development, Education and Lifelong Learning» in the context of the project “Reinforcement of Postdoctoral Researchers - 2nd Cycle” (MIS-5033021), implemented by the State Scholarships Foundation (IKY). Co-financed by Greece and the European Union (European Social Fund- ESF). Research title: "Approaches of Meteorology and Climate Change in school textbooks of sciences: the case of at Junior High School and High School in Greece".

EC2E2N Award for excellence present: 2012 Makri K., Antoniadis A., Koliarmou E. National Greek Team. The Magic of Chemistry - European Competition of educational chemical experiments. Annual Plenary meeting Milan





## **Emmanuel Vassilakis**

Associate Professor in Remote Sensing & Tectonic Geomorphology  
Director of Remote Sensing Laboratory  
National and Kapodistrian University of Athens  
Department of Geophysics and Geothermics

[evasilak@geol.uoa.gr](mailto:evasilak@geol.uoa.gr)

### **Education**

My education at NKUA includes BSc in Geology, MSc in Applied Geology and PhD in Remote Sensing & GIS Techniques. I'm still collaborating with Earth, Atmospheric & Planetary Sciences Dpt at MIT (USA) after appointed for a Post-Doctoral Associate Position during 2006.

### **Career**

2021	Associate Professor National and Kapodistrian University of Athens
2016	Assistant Professor National and Kapodistrian University of Athens
2012	Lecturer National and Kapodistrian University of Athens
2003	Researcher National and Kapodistrian University of Athens
2000	Sergeant (Hellenic Air Force, National Centre of Space Applications)

### **Research interests**

My scientific interests include optical Remote Sensing data processing, Airborne and Terrestrial LiDAR data interpretation, UAS data acquisition and processing, active tectonics, coastline displacement and high precision geodetic techniques, mainly used for surface deformation measurements.

### **Publications and services**

My research work (more than 150 papers) has been published in international scientific journals or conference proceedings and have been cited more than 700 times. In the most recent publications, my colleagues and I describe techniques for combining UAS and LiDAR data for measuring several geomorphological landforms and processes.

### **Awards and honors**

I have been offered scholarships from GSF for my PhD studies (1996), from MIT for a Post-Doctoral Associate position (2006), as well as for a Visiting Scientist (2018).



## Vassilis Sakkas

Laboratory Teaching Personnel  
National and Kapodistrian University of Athens  
Department of Geology and Geoenvironment  
Section of Geophysics and Geothermics

vsakkas@geol.uoa.gr

### Education

- 1999 Ph.D. in Geophysics - University of Leicester, UK.  
Research project: “Combined Transient Electromagnetic and Magnetotelluric study across southern Kenya Rift Valley”
- 1994 BSc in Physics - National and Kapodistrian University of Athens

### Career

- 2000-2015 Research Associate in Space Application Research Unit in Geosciences, Department of Geophysics & Geothermics,
- 2015-today Laboratory Teaching Personnel, Department of Geophysics and Geothermics, NKUA

### Research interests

Exploration geophysicist with twenty five years experience in field operations and R&D with emphasis on processing and interpretation of multiple geophysical (Electromagnetic, magnetic, gravity, seismic) data to investigate earth's interior.

Great experience in collecting, processing and interpretation of geodetic data (GNSS) and joint interpretation and modelling of GNSS and interferometric data for ground deformation monitoring due to tectonic, seismic, volcanic or manmade (water/oil extraction) reasons. Person in charge of the permanent GNSS stations of NKUA. Expert in processing of GNSS data using Bernese v5.2 software.

### Publications and services

- Tzanis, A., Chailas, S., Sakkas, V., Lagios, E., 2020. “Tectonic deformation in the Santorini volcanic complex (Greece) as inferred by joint analysis of gravity, magnetotelluric and DGPS observations” *Geophys. J. Int.* 220, 461–489. doi: 10.1093/gji/ggz461
- Sakkas, V., Lagios, E. 2017 "Ground deformation effects from the ~M6 earthquakes (2014–2015) on Cephalonia–Ithaca Islands (Western Greece) deduced by GPS observations” *Acta Geophysica*,65,1,207-222, Springer International Publishing, DOI: 10.1007/s11600-017-0017-x).
- Sakkas, V., Lagios, E., 2015 "Fault modelling of the early-2014 ~M6 Earthquakes in Cephalonia Island (W. Greece) based on GPS measurements” *Tectonophysics*,644,184-196, Elsevier. DOI 10.1016/j.tecto.2015.01.010.

### Awards and honors

2017 “Academy of Athens” Reward “Dimitrios Lampadarios” for research publication on geodesy for the paper: «*Fault modelling of the early-2014 ~M6 Earthquakes in Cephalonia Island (W. Greece) based on GPS measurements*» [Tectonophysics, Vol. 644-645 (2015) pp. 184-196].



## **Christos P. Evangelidis**

Senior Researcher  
Institute of Geodynamics  
National Observatory of Athens

cevan@noa.gr

### **Education**

He obtained a Bachelor's degree in Geology from the University of Patras between 1994 and 1999. Additionally, he holds a Ph.D. in Geophysics/Seismology, earned from the National Oceanography Center at the University of Southampton from 2001 to 2004. Prior to that, he completed a Master's degree in Advanced Geophysics at the University of Durham from 1999 to 2000.

### **Career**

2020–today	Senior Researcher, National Observatory of Athens, Athens (Greece)
2016–2019	Associate Researcher, National Observatory of Athens, Athens (Greece)
2011–2015	Assistant Researcher, National Observatory of Athens, Athens (Greece)
2007–2011	Research Assistant, National Observatory of Athens, Athens (Greece)
2004–2004	Postdoctoral Researcher, National Oceanography Center, Southampton (United Kingdom)

### **Research interests**

His main research interests include studying the crust and upper mantle seismic anisotropy using earthquake recordings from seismic station deployments. He is focused on large and moderate earthquake source studies by back-projecting waveforms at local and regional stations. He is involved on ambient seismic noise studies aiming to image temporal changes in volcanoes, active faults and man-made structures. He is the manager of NOA broadband seismic network (HL network) and the European Intergrated Data Archive (EIDA) National Node at NOA. He has served and coordinates as PI in many European and National research projects, infrastructural national development funds on seismology, EU Civil Protection programmes and exercises and major Seismic Monitoring Assessment commercial projects in the energy sector in Greece. He has an extensive fieldwork experience in broadband and strong motion seismic station installations and has participated in seismic exploration research cruises.

### **Publications and services**

He has 29 publications in international peer reviewed journals. His publications include the current state-of-the-art reference articles on earthquake backprojection. He has reviewed many third party manuscripts, served as a guest editor in well respected SCI journals and convened special sessions in international conferences and meetings. He is supervising PhD candidates in Geophysics and Applied Mathematics and acts as a mentor on undergraduate and postgraduate students in Physics and Geology.

### **Awards and honors**

He serves as the elected Chair of the EIDA Management Board (EMB) of ORFEUS and Member of the Executive Committee (ExeCom) of the ORFEUS. He is the appointed delegate for Greece on EPOS-European Research Infrastructure Consortium (ERIC). He is the Representative of NOA as Foreign Affiliate to IRIS (Incorporated Research Institutions for Seismology) and in Comprehensive Test Ban Treaty Organization (CTBTO) of United Nations. He is an assistant Mountaineering and Rock Climbing Instructor of the Hellenic Federation of Mountaineering & Climbing (since 2013)



## **Olga-Joan Ktenidou**

Associate researcher

Institute and department: National Observatory of Athens (NOA), Institute of Geodynamics, Athens, Greece

olga.ktenidou@noa.gr

### **Education**

- 2023 Aristotle University Thessaloniki, BA in English Language & Literature
- 2018 University of Greenwich, Postgraduate Certificate in Higher Education
- 2010 Aristotle University Thessaloniki, Greece, PhD in Civil Engineering  
National Autonomous University of Mexico, Visiting researcher (2008)
- 2004 Imperial College London, MSc in Soil Mechanics and Engineering Seismology
- 2003 Aristotle University Thessaloniki, Greece, Diploma in Civil Engineering

### **Career**

- 2018–today NOA, Associate researcher
- 2016–2018 University of Greenwich, Department of Engineering Science, Senior Lecturer
- 2015–2016 GFZ German Research Centre for Geosciences, Senior researcher
- 2011–2014 Université Grenoble-Alpes - ISTerre (France), Postdoctoral researcher  
PEER - University of California at Berkeley, Visiting scholar (2013)
- 2010–2011 Institute for Radiological Protection and Nuclear Safety (France), Postdoc.

### **Research interests**

Expertise in engineering seismology and strong ground motion: site characterisation and reference station definition, site effects and soil amplification (experimental and numerical study), seismic hazard and ground motion prediction, uncertainty and variability. Interested in geotechnical/earthquake engineering, earthquake reconnaissance, structural response under low gravity and other stuff.

### **Publications and services**

Publication summary: 31 articles in int'l journals, 29 in peer-reviewed conferences, 28 invited talks, 52 intl conf. abstracts, 11 technical reports, 3 book sections.

Pub metrics (GoogleScholar): 1200 citations • h-index=18 • i10-index=34

2020 - today: Head of NOA seismic monitoring and analysis group

2022 - today: Assistant secretary of ESC (European Seismological Commission)

2019 - today: Executive Committee of EFEHR (European Facilities for Earthquake Hazard & Risk)

2018-2022: UAG of ORFEUS (Observatories & Research Facilities for European Seismology)

2022 - today: Associate Editor for SRL (Seismological Research Letters)

Convener or co-organiser for 15 international conference special sessions

Consulting services for ground motion characterisation for critical facilities & energy sector

### **Awards and milestones**

2020: Top-2 finalist for the British Council's 'Study UK' Professional Development awards in Greece (top 2 out of over 1000 UK graduates since 2004)

2020: Featured alumna, Imperial College London, School of Engineering  
(<https://www.imperial.ac.uk/alumni/alumni-stories/olga-joan-ktenidou/>)

Fellow of the UK Higher Education Academy since 2018



## Angelos Zymvragakis

MSc Geologist  
National and Kapodistrian University of Athens  
Faculty of Geology and Geoenvironment  
Department of Geophysics and Geothermics

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### Education

2021 BSc degree in Geology and Geoenvironment, National and Kapodistrian University of Athens (NKUA).  
2023 MSc degree in Applied Geology and Geophysics, Earth Science and Environment, National and Kapodistrian University of Athens (NKUA).  
2023-today PhD candidate in seismic hazard, National and Kapodistrian University of Athens (NKUA).

### Career

2021-2022 Participated in research project titled "Evaluation of Seismic, Conflagration & Flood In Attica Region", in the Deliverable titled "Seismicity, seismic hazard and strong motion distribution maps of Attica region (Argosaronikos' islands, Kithira and Antikithira)".

### Research interests

My primary research interest is Probabilistic Seismic Hazard Assessment (PSHA) and Physics-based seismic hazard assessment.

### Publications and services

Pavlou, K., Kaviris, G., Kouskouna, V., Sakkas, G., Zymvragakis, A., Sakkas, V., Drakatos, G., 2021. Minor seismic hazard changes in the broader area of Pournari artificial lake after the first filling (W. Greece). Results in Geophysical Sciences 100025. <https://doi.org/10.1016/j.ringps.2021.100025>  
Kaviris, G., Zymvragakis, A., Bonatis, P., Sakkas, G., Kouskouna, V., Voulgaris, N., 2022. Probabilistic Seismic Hazard Assessment for the Broader Messinia (SW Greece) Region. Pure and Applied Geophysics. <https://doi.org/10.1007/s00024-022-02950-z>  
Kaviris, G., Zymvragakis, A., Bonatis, P., Kapetanidis, V., Voulgaris, N., 2022. Probabilistic and Scenario-Based Seismic Hazard Assessment on the Western Gulf of Corinth (Central Greece). Applied Sciences 12. <https://doi.org/10.3390/app122111152>  
Kaviris, G., Zymvragakis, A., Bonatis, P., Kapetanidis, V., Spingos, I., Mavroulis, S., Kotsi, E., Lekkas, E., Voulgaris, N., 2023. A Logic-Tree Approach for Probabilistic Seismic Hazard Assessment in the Administrative Region of Attica (Greece). Applied Sciences 13. <https://doi.org/10.3390/app13137553B>

I have taken part in multiple fieldworks with the objective of installing or maintaining seismological stations.

### Awards and honors

2021: First degree grade in the undergraduate program of the Department of Geology and Geoenvironment of the National and Kapodistrian University of Athens.

2022: Award for the third best oral presentation by a young scientist at the 3rd European Conference on Earthquake Engineering and Seismology (3ECEES) held in Bucharest, Romania from September 4-9, 2022. The publication was entitled "A Preliminary Probabilistic Seismic Hazard Assessment for Boeotia, Central Greece".

2022: Scholarship under the programme "Awards of Excellence to Higher Education Graduates" for the academic year 2020-2021.

2022: Reciprocal scholarship with the obligation to provide auxiliary teaching work in the respective first cycle curricula. The title of the scholarship is "Support of the educational activities of the National and Kapodistrian University of Athens (NKUA) during the academic year 2021-2022 with the integration of supplementary teaching in addition to the main lectures".



## **Efthimios Sokos**

Professor of Seismology and Engineering Seismology  
University of Patras, Geology Department

esokos@upatras.gr

### **Education**

BSc in Geology (1992, Univ. of Patras), PhD in Seismology (1998, Univ. of Patras).

### **Career**

2002-2005      Researcher at the Geodynamical Institute of the National Observatory of Athens  
2005-today      Faculty member, Geology Department, Univ. of Patras

### **Research interests**

Seismic source studies, seismotectonics and seismic hazard

### **Publications and services**

Prof. E. Sokos has more than 80 publications in international peer reviewed journals, and more than 2000 citations for his work (h-index:25). He is responsible for the seismic network operation at the University of Patras, for the last fifteen years. He is co-author of ISOLA moment tensor inversion software, which is used in many research institutes.





## **Niki Evelpidou**

Professor

National and Kapodistrian University of Athens

Department of Geology and Geoenvironment

evelpidou@geol.uoa.gr

### **Education**

Dr. Niki Evelpidou holds a BSc degree in Geology from the National and Kapodistrian University of Athens, an MSc in “Geography and Environment” from the National and Kapodistrian University of Athens, a PhD on Geomorphology and GIS from the Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens, and a second PhD on Geoarchaeology from the University of Franche Comte.

### **Career**

2019-today	Professor, Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens
2014-2018	Associate Professor
2009-2014	Assistant Professor
2003-2009	Lecturer

### **Research interests**

geomorphology  
sea level changes  
palaeogeography  
geoarchaeology  
spatial technologies  
study and modeling of natural hazards

### **Publications and services**

Her research numbers more than 300 publications in scientific conferences and journals and 28 books and educational textbooks.

She is actively involved in academic, research and educational activities, as she has organized more than 30 educational seminars and training schools while she has participated in the organization of 37 national conferences and workshops, of national and international interest.

Evelpidou N., Karkani A., Kampolis I., 2021. Relative sea level changes and morphotectonic implications triggered by the Samos earthquake of 30th October 2020. *Journal of Marine Science and Engineering*, 9(1), 40. <https://doi.org/10.3390/jmse9010040>

Evelpidou, N., Zerefos, C., Synolakis, C., Repapis, C., Karkani, A., Polidorou, M., Saitis, G., 2020. Coastal Boulders on the SE Coasts of Cyprus as Evidence of Palaeo-Tsunami Events. *Journal of Marine Science and Engineering* 8, 812. doi:10.3390/jmse8100812

### **Awards and honors**

Dr. Evelpidou has received a number of awards and recognitions. Amongst the most significant are two awards from the Academy of Athens: in 2013 for work promoting the geological knowledge of the Greek region for the paper entitled "Evidence of a recent rapid subsidence in the S-E Cyclades (Greece): an effect of the 1956 Amorgos earthquake?" and in 2019 for her monography “Sea level changes”.



## **Anna Karkani**

Postdoctoral researcher  
National and Kapodistrian University of Athens  
Department of Geology and Geoenvironment

ekarkani@geol.uoa.gr

### **Education**

- 2009 BSc in Geology and Geoenvironment, National and Kapodistrian University of Athens
- 2012 MSc in Oceanography and Management of Marine Environment
- 2017 PhD “Study of the geomorphological and environmental evolution of the coastal zone of Central Cyclades”

### **Career**

- 2020-today Postdoctoral researcher
- 2012-2016 Research associate, Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens

### **Research interests**

Geomorphology, palaeogeography, sea level changes, geoarchaeology, natural hazards

### **Publications and services**

- Karkani A., Evelpidou N., 2021. Multiple submerged tidal notches: A witness of sequences of coseismic subsidence in the Aegean Sea, Greece. *Journal of Marine Science and Engineering* 9(4), 426, <https://doi.org/10.3390/jmse9040426>.
- Evelpidou, N. Karkani, A., Kampolis, I. 2021. Relative sea level changes and morphotectonic implications triggered by the Samos earthquake of 30th October 2020. *Journal of Marine Science and Engineering*, 9(1), 40. <https://doi.org/10.3390/jmse9010040>.
- Evelpidou N., Zerefos C., Synolakis C., Repapis C., Karkani A., Polidorou M., Saitis I., 2020. Coastal boulders on the SE coasts of Cyprus as evidence of palaeo-tsunami events. *Journal of Marine Science and Engineering* 8(10), 812. <https://www.mdpi.com/2077-1312/8/10/812>
- Karkani, A., Evelpidou, N., Morhange, C., Giaime, M., Marriner, N., Spada, G., Late Holocene sea level evolution of Paros Island (Cyclades, Greece), *Quaternary International* 500, 139-146. <https://doi.org/10.1016/j.quaint.2019.02.027>

### **Awards and honors**

- 2020-2021 Scholarship for postdoctoral research by State Scholarships Foundation
- 2012-2016 Scholarship from National & Kapodistrian University of Athens for PhD studies
- 2014 DAAD scholarship for training on OSL–Optically Stimulated Luminescence on beachrocks





## **Akis Panagis**

Civil Engineer MSc University of Patras

Monitoring engineer GEFYRA SA

akis.panagis@gefyra.gr

### **Education**

2004: Diploma in Civil Engineering Department University of Patras

2006: Master in Seismic design of structures in Civil Engineering Department University of Patras

### **Career**

2005-2006: Structural modelling and analysis of the lattice roof structure of the archaeological excavation in Akrotiri Santorini (In cooperation with the scientific committee appointed to investigate collapse mechanism) and evaluation of partial collapse mechanism upon dead loading.

2006-today: Structural Designer for various Industrial and residential Buildings composing of different structural system (Steel/Concrete/Timber).

2008-today: Monitoring engineer for Structural Dpt of Rion Antirion Bridge, involved in the maintenance of Structural Health Monitoring system instrumentation, as well as with the data analysis and engineering interpretation of the records. Engaged with the structural design of Building and maintenance equipment for Rion Antirion Bridge.

### **Research Interests**

Structural modelling, analysis and design of structures, Earthquake structural design, Modal Identification, Ambient structural vibration. Modal Operational Analysis. Sensor technology. Data acquisition. Data analysis Technics.

### **Publications And Services**

Olivier Flamand, Fabrice De Oliveira, Aris Stathopoulos-Vlams, Panagiotis Papanikolas, Akis Panagis, Using non continuous records from full scale monitoring system for fatigue assessment, EWSHM2014, July 08-11, 2014, Nantes, France

Panayotis Papanikolas, Aris Stathopoulos-Vlams, Akis Panagis, Alain Pecker, Samuele Infanti, The behavior of Rion-Antirion Bridge during the Earthquake of “ACHAIA-ILIA” on June 8, 2008, 3rd fib International Congress – 2010



## **Dora Katsonopoulou**

Director  
The Helike Project

eliki@otenet.gr

### **Education**

Dora Katsonopoulou received a B.A. degree in Archaeology and History with Distinction and a Second Degree in Byzantine and Modern Greek Studies from the University of Athens. She studied and received a PhD in Classical Archaeology from Cornell University, USA.

### **Career**

1988-1990	T.A., Classical Archaeology, Department of Classics, Cornell University
1991-1994	Instructor, Classical Archaeology, The American University of Athens
1996-1998	Assoc. Professor, Classical Archaeology, The American University of Athens
2003-2013	Instructor, Graduate program, Department of Geology, University of Patras
2006-today	Adjunct Professor, Greek and Roman Studies, Department of Languages, Literatures and Cultures, University of Windsor

### **Research interests**

Research interests include (a) field archaeology and application of geosciences in the field of archaeology, (b) studies of Classical Greek sculpture, especially sculptors of the fourth century BC, (c) ancient religion and particularly Poseidon's cult in Helike and the Peloponnese, (d) Cycladic studies, especially the archaeology and art of the island of Paros.

### **Publications and services**

A significant number of articles has been published in international journals and Proceedings of International Conferences on the results of the excavation and geoarchaeological work in Helike including presentation of new collected data on topography, geomorphology and historical seismology of the region; other publications concern Aegean Archaeology, especially the archaeology and art of Paros and the Cyclades. The research and scientific work in Helike has also been the subject of scientific documentaries by the BBC, ZDF and Discovery Channels.

### **Awards and honors**

Greek National Scholarship for Academic Achievement.

Valedictorian for graduating Class of University of Athens.

Valedictorian for graduating Class of Graduate Seminars of Greek Ministry of Education.

Cornell University Scholarship.

National Award for promotion of Greek culture & heritage, Society of Greek Benefactors.



## Spyros Sergiou

Marine Geologist

Laboratory of Marine Geology and Physical Oceanography, Department of Geology,  
University of Patras, 26504 Rio Achaia

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### Education

- 2022 PhD in Marine Geology & Paleoceanography. PhD thesis: *‘Paleoceanographic and stratigraphic investigation in two semi-closed basins during Late Quaternary: The southern Red Sea and the Gulf of Corinth. Effects of sea-level changes and regional climate dynamics’*
- 2015 MSc in Environmental Oceanography, Dep. of Geology, Univ. Patras. Title of MSc thesis: *‘Recent sedimentary processes in the Western gulf of Corinth, Greece’*. In co-operation with: University of Savoy (ISTerre - Institut des Sciences de la Terre), France and University of Liege, Belgium.
- 2012 B. Sc. in Geology, University of Patras, Greece

### Career

- 2014-today Research Associate in the Laboratory of Marine Geology and Physical Oceanography, Dept. of Geology, University of Patras

### Research Interests

Marine geology, sedimentology, paleoceanography

### Publications and services

- Sergiou, S., Geraga, M., Rohling, E.J., Rodríguez-Sanz, L., Prandekou, A., Noti, A., Paraschos, F., Sakellariou, D., Bailey, G. (2022) The evolution of seafloor environmental conditions in the southern Red Sea continental shelf during the last 30 ka. *Marine Micropaleontology*, 177, 102181  
<https://doi.org/10.1016/j.marmicro.2022.102181>
- Sergiou S, Geraga M, Rohling EJ, Rodríguez-Sanz L, Hadjisolomou E, Paraschos F, Sakellariou D, Bailey G (2022). Influences of sea level changes and the South Asian Monsoon on southern Red Sea oceanography over the last 30 ka. *Quaternary Research* 1–19. <https://doi.org/10.1017/qua.2022.16>
- Pechlivanidou S, Sergiou S, Geraga M, Gawthorpe R, Antoniou D, Angelopoulou D, Ford M, Fabregas N, (2020). Controls on stratigraphic variability in a semi-closed rift basin over the Late Quaternary, Gulf of Corinth, Greece. *EGU General Assembly 2020*. <https://doi.org/10.5194/egusphere-egu2020-11898>
- McNeill, L.C., Shillington, D.J., Carter, G., Everest, J., ...Sergiou, S., et al, (2019). High-resolution record reveals climate-driven environmental and sedimentary changes in an active rift, *Scientific Reports*, 9 <https://doi.org/10.1038/s41598-019-40022-w>
- Sergiou S, Beckers A, Geraga M, Papatheodorou G, Iliopoulos I, Papaefthymiou H, 2017. ‘Recent sedimentary processes in the western gulf of Corinth, Greece. Seismic and aseismic turbidites’ *Bulletin of the Geological Society of Greece*, 50, 383-391

He is Assistant tutor for undergraduate and graduate courses, and BSc and MSc theses. He has participated in research & industrial projects. He is member in both offshore and onshore science parties of ‘IODP Expedition 381- Corinth Active Rift Development’ serving as a sedimentologist.

### Awards And Honors

VISTA Visiting Scholar 2018, 2019. Department of Earth Science, University of Bergen, Norway.

PhD scholarship of General Secretariat for Research and Technology (GSRT) – Hellenic Foundation for Research and Innovation (HFRI).



## **Ioannis Iliopoulos**

Professor  
Department of Geology, |  
University of Patras (UP), Greece

ilios@upatras.gr

### **Education**

Dr Ioannis Iliopoulos is a Professor at the Department of Geology, University of Patras, Greece. He conducted his PhD Thesis in the field of Metamorphic Petrology.

### **Career**

2019 – today	Director of the Science & Technology Museum, School of Natural Sciences, UP
2022 – today	Professor, Department of Geology, UP
2008 – 2022	Associate Professor / Assistant Professor / Lecturer, Department of Geology, UP
2003 – 2008	Laboratory Assistant (ETEP), Department of Geology, UP
1998 – 2001	Researcher, Dipartimento di Chimica e Fisica della Terra, University of Palermo, Palermo, Italy

### **Research interests**

His research focuses on the systematic application of analytical techniques for the study of archaeomaterials and earth raw materials from the wider Mediterranean area (Italy, Spain, Greece) and Latin America (Ecuador, Peru) and he leads the KERAMos Research Group. He has published in peer reviewed international journals and edited volumes (h-index: 14).

### **Publications and services**

He is an external collaborator of the Institut d'Arqueologia de la Universitat de Barcelona (IAUB) Spain and a scientific consultant of the Academy of Institutions and Cultures, Greece. Since 2019 he has been elected as the Director of the Science and Technology Museum at the University of Patras and has supervised several thematic exhibitions and educational programs for students of primary, secondary and higher education under a participatory framework.

### **Awards and honors**

He was awarded the Picker Interdisciplinary Science Institute research award (Colgate University, USA) and was appointed as Researcher at the Dipartimento di Chimica e Fisica della Terra (CFTA), University of Palermo, Italy, under the auspices of the interdisciplinary European Geo-archaeological Research Project "GEOPRO".



## Vayia Xanthopoulou

Research Associate/ XRF, SEM and Raman technician  
University of Patras, Department of Geology and Laboratory of Electron Microscopy  
and Microanalysis (L.E.M.M.)

vxanthopoulou@upatras.gr

### Education

Dr. Vayia Xanthopoulou is a research associate at the Department of Geology, University of Patras, Greece. She conducted her MSc. and PhD theses in Archaeometric studies and issues that deal with the ceramic analysis and the raw material prospection for the ceramic manufacture.

### Career

	WDXRF, SEM and micro-RAMAN technician, Laboratory of Electron
2015-today	Microscopy and Microanalysis, School of Natural Sciences, UP
2020-today	Research Associate, Department of Geology, UP
2020-2023	Post-doctoral research, IKY, UP
2011-2013	Principal investigator at in C. Caratheodory Funding Programme. Project, UP

### Research interests

Her research interests are focused on the characterization of clayey raw materials in terms of their suitability for ceramic production, using various analytical techniques. The raw materials come mainly from Greece (northern Peloponnese, western Greece, western Crete, and Ionian Islands). As a technician in L.E.M.M is responsible for the daily maintenance, calibration and running of samples using the Scanning Electron Microscope (SEM), the elemental spectrometer (WD-XRF) and the spectrometer micro-RAMAN.

### Publications and services

She has published ten articles in International Peer-reviewed Journals (some recent are given below) and has participated in more than twenty International Conferences.

I Liritzis, I Iliopoulos, M Kokkaliari, V Xanthopoulou. Novel archaeometrical and historical transdisciplinary investigation of early 19TH century hellenic manuscript regarding initiation to secret" Philike Hetaireia. *Mediterranean Archaeology & Archaeometry*, 2023

Xanthopoulou, V.; Iliopoulos, I. An Insight into the Suitability of Clayey Raw Materials: The Ceramic Provinces of the Northern Peloponnese and South Epirus, Greece. *Buildings* 2023, 13, 473. <https://doi.org/10.3390/buildings13020473>

Xanthopoulou, V., Iliopoulos, I., Katsonopoulou, D. and Katsarou St. (2022). Standardized patterns in the ceramic craft at Early Bronze Age Helike, Achaea, Greece. *Archaeol Anthropol Sci* 14, 154 (2022). <https://doi.org/10.1007/s12520-022-01621-3>

# ABSTRACTS

## Why CRL?

Pierre Briole

Ecole Normale Supérieure, Paris Sciences et Lettres Research University, Département des Géosciences

The Western part of the Gulf of Corinth (WGoC) presents a high level of seismic activity known since the ancient times. The geology, sedimentology and tectonics of the Corinth Gulf is studied since the 1970's. After several seismological and geodetic campaigns carried out in the 1990's, the Corinth Rift Laboratory network (CRLnet) was established in the early 2000's, covering first a 30 km × 30 km area with the installation of local networks around Aigio. Due to the important seismicity and aiming to a better understanding of the fault system, the networks increased progressively towards the west, with the participation of many institutions. The present state of the network was reached in 2013 and allows to address scientific questions on the deformation of the crust and the potential for large earthquakes as, for example:

- Migration of the deformation towards onshore and offshore faults.
- Clustering of microearthquakes: dimensions and relationships with the related fault segments and with the occurrence of the main events?
- How can the observed deformation be explained? What is the part controlled by the seismicity?
- What is the role of fluids in the seismicity triggering?
- Can we observe creeping on low dipping normal faults?

To address these questions, CRLnet comprises 80+ permanent stations, equipped with seismometers, accelerometers, Global Navigation Satellite Systems (GNSS), tide gauges and strainmeters. It enables detailed monitoring of the fluctuations of the intense microseismicity and deformation. The seismicity in the WGoC is clustered in time and space, with episodic seismic sequences, for example, the 2003–2004 offshore, the 2013 Helike and the 2015 Malamata swarms, and the most recent 2020-2021 crisis. GNSS recordings and Interferometric Synthetic Aperture Radar (InSAR) revealed the deformation sources of moderate earthquakes and the likely existence of aseismic slip at shallow depth in some places. In addition, significant research has been performed on fault mapping, geomorphology, sedimentology. It is also proposed to specific very detailed studies and methodological experiments. The large number of observations accumulated over the last 10 years has also made it possible to address questions on a wider scale, such as the connection between the WGoC and the Ionian subduction/collision to the west.

CRL is one of the Near- Fault Observatories (NFO) of the European Plate Observing System (EPOS), and the only with an international status. It is administered and maintained by the Centre National de la Recherche Scientifique (CNRS-France), the National and Kapodistrian University of Athens (NKUA-Greece), the University of Patras (UPAT-Greece), and the National Observatory of Athens (NOA-Greece), with the participation of Charles University Prague (CUP-Czech Republic).

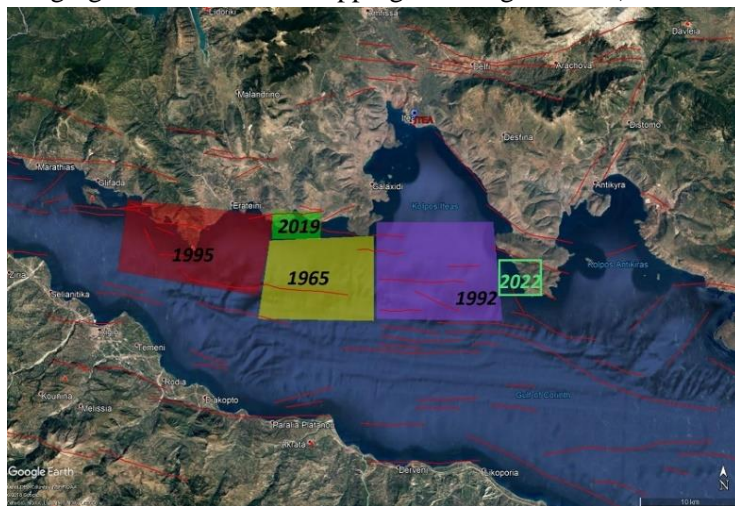


# Understanding the physics of earthquakes from the smallest to the largest and the growth of faults in the western gulf of Corinth

Athanassios Ganas

NOA, Institute of Geodynamics, Athens, 11810 Athens, Greece

The Gulf of Corinth is a back-arc extensional basin of the Hellenic Arc that started to develop since Upper Miocene. The western – central Gulf of Corinth (see Figure below) has not experienced a strong earthquake since 1995 (the  $M_w=6.5$  event of Aigion on 15 June 1995), although the Gulf is extending fast (over 12 mm/yr of N-S extension from continuous GPS data spanning a period of 20 years) and its seismic history since 1769 exhibits twelve (12) shallow events with  $M>6.0$ . The lecture will present the latest results across several disciplines in solid Earth Science indicating a) the existence of normal fault zones with decreasing activity away from the rift axis, b) the continuation of the 1995 low-angle fault towards the west (Psathopyrgos area) and east (Galaxidi), c) the occurrence of earthquake swarms in the hanging wall of the north-dipping, low-angle fault d) new GNSS / InSAR results mapping ground motions and patterns



of crustal extension. The uniqueness of the Corinth rift is revealed by the updated geological & geophysical datasets (active fault maps, fault geometry, fault slip rates, trenching data on past earthquakes, historical and instrumental seismicity, InSAR data) and recent models for earthquake generation processes suggested from observed seismicity patterns, magnitude-frequency distributions and fluid migration.

# **Global Positioning System: from the planning of a monitoring network to the data analysis and the interpretation of the relative results**

Panagiotis Elias

National Observatory, Athens, Greece

During the last two decades, the scientific community observed a growing number of permanent GPS networks developed for monitoring the evolution of the deformation in active tectonics and volcanic areas. This development was performed at different spatial scales depending on the investigated target, i.e. from a single fault system or a volcano to regional or plates kinematics. Furthermore, thanks to the continuous technical development of the instrumentation, the frontiers of the studies on the deformation have been pushed also at different temporal scales, i.e. from years for the detection of long-term strain accumulation to seconds (and even below) for observing and modeling earthquake sources or dike intrusions and for early warning applications. The capability to observe a target geophysical phenomenon (i.e. plate movement, earthquake deformation or ground motion, volcanic deformation) strongly depends on the effort for planning the monitoring network and on the characteristics of the chosen instrumentation. Further steps are represented by the data analysis and the interpretation of the results. Different GPS data analysis strategies can be adopted for monitoring the deformation of a given target (Precise Point Positioning, Double-Difference, Real-time Kinematic). All of these strategies have their advantages and disadvantages, in terms of noise level (and then accuracy) and reliability with respect to the investigated phenomenon, that should be taken into account for an actual, aware and rigorous interpretation of the obtained results and products. In this presentation, some examples of science-driven GPS monitoring networks will be shown, from their conceptualization to the instrumentation. Examples of data analysis strategies, related accuracies and results will be also described.

# Seismic Parameters and Microseismicity in the Gulf of Corinth

Vassilis Karakostas & Eleftheria Papadimitriou

Aristotle University of Thessaloniki

School of Geology

Geophysics Department

The Gulf of Corinth is one of the most seismically active areas in the Mediterranean area, associated with extensional crustal faulting. The Gulf has the general shape of an asymmetric half-graben with the southern footwall being uplifted. Its western end is connected through the Rio–Antirrio strait to the Gulf of Patras, which does not have any major faults comparable to the ones affecting the Gulf of Corinth. The eastern part truncates the Megara basin through a complex pattern of faults with a more NE–SW strike. The geodetically measured N–S extension is about 15 mm/yr in the western part, around Rio, and about 10 mm/yr in the eastern part, around Corinth. A comparison between several GPS surveys measured over shorter duration gives slightly higher values, but with the same difference between the western and eastern ends of the Gulf. It therefore seems clear that the present deformation is relatively well confined in the center of the Gulf on a very narrow deforming zone.

Information on the strong ( $M \geq 6.0$ ) earthquakes in the study area is available for more than 25 centuries. They may be considered as characteristic ones, associated with certain fault segments independently of their epicentral uncertainties. Their occurrence rate reveals that all  $M \geq 6.0$  earthquakes are included in the regional catalog since 1700 AD, and they occur in clusters. The dimensions of the fault segments do not exceed 20 – 25 km, which implies an upper limit for the magnitude of the earthquakes that can occur on an individual fault segment. The last  $M \geq 6.0$  earthquake to rupture the area occurred in 1995 and is associated with Aigion fault segment.

Accurate determination of the source parameters of microseismicity is crucial in understanding the seismicity evolution. The spatial and temporal evolution of the abundant low magnitude shocks can be used to define thoroughly the seismotectonic properties of the area which are related with the occurrence of strong earthquakes. We use the P and S phase picks of the recordings at the stations of the Hellenic Unified Seismological Network (HUSN), which is rather dense in the broader area particularly in the central and western part of the gulf. Initially shocks are located by the hypoinverse program using a one dimension local velocity model of the P waves, the  $V_p/V_s$  ratio and travel time corrections to take into account lateral heterogeneities of the model. Then, the double difference technique is applied to relocate the events. In the final step, cross-correlation differential travel times derived from phase-picked data and waveform cross-correlation are included. Jointly relocated data have reliable relative positions. Focal mechanisms based on the first motion polarities exhibit mostly normal faulting on almost E–W striking nodal planes. For the  $M > 3.0$  moment tensor solutions are determined. Both, the spatial distribution of the earthquakes and their focal mechanisms, show a dominant strike of  $270^\circ$  in the westernmost part changing to  $270^\circ - 290^\circ$  at the center of the Gulf, perpendicular to the almost N–S extension of the rift. Further to the east, a gradual change in fault orientation is observed. In the easternmost part, the strike becomes  $240^\circ$ , in agreement with the geometry of the rift.

The spatial and temporal evolution of the microseismicity is thoroughly investigated and remarkable characteristics, among which similarities and differences have been found. To better understand the microseismicity evolution both the seismicity rate change and the static stress changes due to the coseismic slip of the stronger earthquakes are examined. Since the early days of detailed seismic monitoring of the area, frequent earthquake clusters or swarms have been recorded. These swarms are mostly located in the western part of the study area, in shallow depths and associated with different north or south-dipping fault segments. The seismicity in the shallow north-dipping seismic zone is continuous and free of earthquake clusters, probably defining the boundaries between brittle and ductile layers.

# Large Earthquakes and Focal Mechanisms in the Gulf of Corinth

George Kaviris

Associate Professor of Seismology-Seismic Anisotropy,

Section of Geophysics and Geothermics, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens

The Gulf of Corinth is a “natural laboratory” for seismology and geosciences, as it is characterized by high tectonic activity, with the bulk of earthquakes occurring close to its western border. Active normal faults, oriented in an approximately E-W direction, dominate in the Gulf of Corinth. Regarding the morphology of the gulf, it is an E-W trending asymmetric graben, with the major active faults outcropping at the southern coast and dipping north, resulting in a long record of rifting in the center of the gulf and an upward displacement of the main footwalls at both the northern and southern sides. GNSS measurements at the Gulf of Corinth have revealed a high extension rate in a NNE-SSW direction, which increases from the east to the west, i.e. from 11 mm/yr to 16 mm/yr.

Since the historical era, moderate to strong earthquakes have occurred in the western part of the Gulf, including destructive ones, as the 373 BC Helike earthquake that was accompanied by a tsunami wave. Large events have also occurred during the instrumental period, causing severe damage to urban areas in the broader region, e.g. Eratini,  $M=6.3$ , 1965; Antikyra,  $M=6.2$ , 1970; Galaxidi,  $M=5.8$ , 1992; Aigion,  $M_s=6.2$ , 1995. Regarding the eastern part of the gulf, large earthquakes are also present, however more rare. In 1981, on February 24, 25 and March 4, a seismic sequence with three major earthquakes of surface magnitudes  $M_s = 6.7$ , 6.4 and 6.4 occurred in the Alkyonides Gulf, causing significant damage to Athens. It is worth noting that the seismicity in the WGoC is mostly expressed through the occurrence of seismic swarms, as the one close to Helike in 2013. A seismic crisis occurred at the western part of the Gulf during 2020–2021, which evolved in three stages. It started with an  $M_w$  4.6 event near the northern shore of the Gulf, opposite of Aigion, then migrated eastward toward Trizonia Island after an  $M_w$  5.0 event, and eventually culminated with an  $M_w$  5.3 event, ~3 km northeast of the Psathopyrgos fault.

The intense seismicity in the Gulf of Corinth has resulted in the installation of a permanent network in the area, with stations belonging to the Hellenic Unified Seismological Network (HUSN). Furthermore, the international initiative of the Corinth Rift Laboratory (CRLN) has greatly increased the density of local station coverage and has led to the prompt provision of seismological data to the scientific community.

Data recorded in the gulf are used in a daily basis to locate earthquakes with high resolution. This permits the identification of seismogenic faults through seismological observations, in combination with GNSS and tectonics.

Another important application of the recorded waveforms is the determination of focal mechanisms. This is achieved either with the well-known method of first-motion P-wave polarities, enabled by the dense local station coverage, or through waveform modeling and moment tensor inversion (especially for the stronger events). The majority of the reliable fault-plane solutions indicate normal faulting in an approximate E-W direction, in agreement with the major active faults. However, focal mechanisms in NW Peloponnesus, and some in the Gulf of Corinth, indicate strike-slip faulting.

## **Opposing development practices within the Delphic landscape**

Christos Merantzas

University of Patras

In our communication we discuss opposing development practices within the Delphic landscape regarding the mining, transportation and exploitation of bauxite, the installation of aquaculture and wind farms, but also the creation of a marine park for the development of mild diving tourism.

## Off-shore faults imaging and monitoring in the Corinth Rift

Maria Geraga, George Papatheodorou

School of Natural Sciences, Department of Geology, University of Patras, Greece

Acoustic is fundamental energy to the mapping of seafloor. Sophisticated equipment produces sound waves which radiate in all directions away from the source. When the sound waves moving through water hits the sea floor, some of it is reflected, some is transmitted to the seafloor, some is refracted, and some is scattered. The basic components of a sound wave are frequency, wavelength and amplitude. Sound energy is used for the acquisition of seismic profiles and for the seafloor topography and texture. During the seismic profiling the transmitted acoustic energy is reflected from boundaries developed by changes in the acoustic impedance of the subsurface geology. Changes in acoustic impedance (density of the medium times the velocity of the sound within that medium) can generally be thought of as changes in density which indicate transitions from one stratigraphic layer to another. The sub-bottom profilers operate at different frequencies and this has an effect on the depth of acoustic penetration into the seabed and the resultant resolution. The reflected acoustic signal is received by hydrophones or by a transducer. Sidescan sonar is an acoustic device used to provide wide-area, high-resolution 2D images (called “sonographs”) of the seafloor. A towing sonar (usually called “tow-fish”) emits and later receives the acoustic energy in a specific frequency range. The acoustic energy received by the sidescan-sonar (backscatter) provides information for the morphology of the seafloor and the texture of the sediments covering the seafloor.

In the area of the Corinth gulf, the application of marine geophysical techniques together with extensive onshore studies have revealed significant findings in relation to seismic stratigraphy of the gulf, the rifting development and the evolution of the basin.

Sources:

1. Fish, J.P. and H.A. Carr, 1991, *Sound Underwater Images, A guide to the generation and interpretation of sidescan sonar data*, second edition, Lower cape Publishing, Orleans, MA,
2. Trabant, P.K. *Applied High-Resolution Geophysical Methods Offshore Geoengineering Hazards*; D. Reidel Publishing Company: Boston, MA, USA, 1984; p. 265
3. Nixon, C.W., McNeill, L.C., Bull, J.M., Bell, R.E., Gawthorpe, R.L., Henstock, T.J., Christodoulou, D., Ford, M., Taylor, B., Sakellariou, D., Ferentinos, G., Papatheodorou, G., Leeder, M.R., Collier, R.E.L., Goodliffe, A.M., Sachpazi, M. & Kranis, H. (2016) Rapid spatiotemporal variations in rift structure during development of the Corinth Rift, central Greece. *Tectonics*, 35, 1225– 1248.
4. Gawthorpe, Rob & Leeder, Mike & Kranis, Haralambos & Skourtsos, Emmanuel & Andrews, Julian & Henstra, Gijs & Mack, Greg & Muravchik, Martin & Turner, Jenni & Stamatakis, Michael. (2017). Tectono-sedimentary evolution of the Plio-Pleistocene Corinth rift, Greece. *Basin Research*. 30. 10.1111/bre.12260.

# **Tectonics, structural setting and tectono-sedimentary processes in the Corinth rift**

Haralambos Kranis

National and Kapodistrian University of Athens

Department of Geology and Geoenvironment

The Gulf of Corinth (GoC) Rift, one of the most active continental rifts worldwide, which develops within the broader plate convergence context of the Hellenic Arc. Extension and strain localization within the overriding Aegean Plate has led to the formation of this rapidly extending domain. The available data so far point to its inception at ca (?)5 Ma most probably linked to two interrelated processes, namely (i) the onset of the pronounced curvature of the Hellenic Arc; (ii) the propagation of the North Anatolian Fault into the Aegean domain.

The GoC rift has developed in two phases, namely the Rift 1 phase, from 5.0-3.6 to 2.2-1.8 Ma and Rift 2, from 2.2-1.8 Ma to present. Rift 1 is recorded in a >3 km thick syn-rift succession, (Lake Corinth) which shows upward deepening from fluvial to lake-margin conditions and finally to sub-lacustrine, deposited in a 30 km-wide zone of distributed normal faulting. Rift 2 marks a 39 km northward shift in the locus of rifting, accompanied by footwall and regional uplift, which destroyed Lake Corinth in the central and eastern parts of the rift, while giant Gilbert deltas in the west built into a deepening lake depocenter in the hanging-wall of the newly developing border fault system. Self-organization and strain localization along co-linear border faults are considered to be responsible for the growth, linkage and death of normal faults during these two rifting phases. The major Patras dextral strike-slip fault controls the interaction between the GoC and the Patras rifts; this led to the opening of the Rio Straits at c. 400-600 ka.

The overall landscape and stratigraphic evolution of the rift was strongly influenced by factors related to structure of the Hellenide fold and thrust basement, which controlled regional palaeotopographic variations and local antecedent drainage, the latter especially visible at the southern shoulder of the rift. Along-strike, regional topography north and south of the rift is relatively high in the west, compared to the east; this exerted a first-order control on the depositional environments during rifting. The majority of sediment to the CoC rift has been supplied by north-flowing antecedent catchments on the southern flank. However, the contribution of S-flowing catchments appears to be increasing over time.

On a crustal scale, the extensional thinning of the Hellenide nappe stack, which is observed in the Peloponnesos, is overprinted by the high-angle normal faulting that controls the GoC rift inception and evolution. The interplay between these two processes is another major factor and geochronological and structural data are sought to further constrain rift evolution.



## **Historical elements for sciences and observatories**

Fiori-Anastasia Metallinou

National Observatory of Athens, Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS)

The National Observatory of Athens was established in 1842 and it is the first Research Institute in Greece. An important service it used to provide to public, from 1846 until 1964 was the calculation of the “Official Time of Greece”. The “Service of Time” used to be one of the most important services provided by observatories, as well as meteorological measurements and geodynamic studies. During the current talk historical instruments, scientific measurements, data and services provided by an observatory, during the previous centuries, will be presented.

## **Hand on simple seismic software packages provided on-line in the CRL portal**

George Kaviris & Ioannis Spingos

National and Kapodistrian University of Athens

Department of Geology and Geoenvironment

Section of Geophysics and Geothermics

### **Introduction to Phase Picking with SeisGram2K**

Accurately identifying and determining the arrivals of seismic phases is one of the fundamental analysis routines in seismology. From event location to seismic tomography, arrival times of different phases (commonly called “picks” in the seismological community) form the basis of most advanced processing techniques and statistical analyses. In this exercise, we will learn to identify the arrivals of longitudinal (P) and shear (S) waves in local recordings of the Corinth Rift Laboratory Network. We will then use their arrival times to locate an earthquake. The goal of this exercise is to pick the arrival times of P and S phases in at least three stations and, then, find the epicenter of the earthquake.

Triangulating the location by using travel-time curves is one of the simplest (and least accurate) methods to find the position of an earthquake. Modern location techniques involve sophisticated software that use tens or hundreds of phase arrivals.

## **Sky gazing**

Fiori-Anastasia Metallinou

National Observatory of Athens, Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS)

During this activity we are going to observe the constellations of the night sky and some planets of our solar system. The brightest stars visible by naked eye and their characteristics will be mentioned. The connection between the constellations and the Greek mythology will be presented.

# **A concise overview of the lithostratigraphy architecture and its implications to the Quaternary evolution of the Gulf of Corinth (Greece)**

Petros Koutsovitis

University of Patras, Department of Geology

The Gulf of Corinth is located in central Greece, is a bathymetrically restricted marine elongated embayment, extending as long as ~105 km at an E-W direction. It displays a width of ~320 km, with the deepest water depths being identified at the central parts of the Gulf, reaching even up to 1 km. It comprises of Quaternary marine terraces, as well as hanging-wall surface subsidence and Gilbert-type fan deltaic sedimentary formations. It is considered as one of Earth's most active basin systems that includes three basement offsets, namely the Akrata-Derveni, Sithas and Xylocastro. Specifically, regarding that of the Akrata-Derveni, the common tripartite has been identified, which includes the topset, foreset and bottomset formations. The large Gilbert-type fan deltas correspond to the Middle Group of the Corinth Rift infill, with their lithostratigraphy being highly affected by the active evolution of the rift structure. Eight facies associations have been identified, denoting an evolution from deep to shallow marine environment. Thus, the Lower and Middle Groups (fluvio-lacustrine deposits and thick alluvial fan conglomerates) are characterized by an overall increase in accommodation space at the deposition stages, followed by a significant decrease in sediment supply during deposition of the Upper Group (mainly uplifted terrace deposits and slope breccias).

# Data mining at school: some examples to address geosciences cases studies at school with online data

Jean-Luc Berenguer

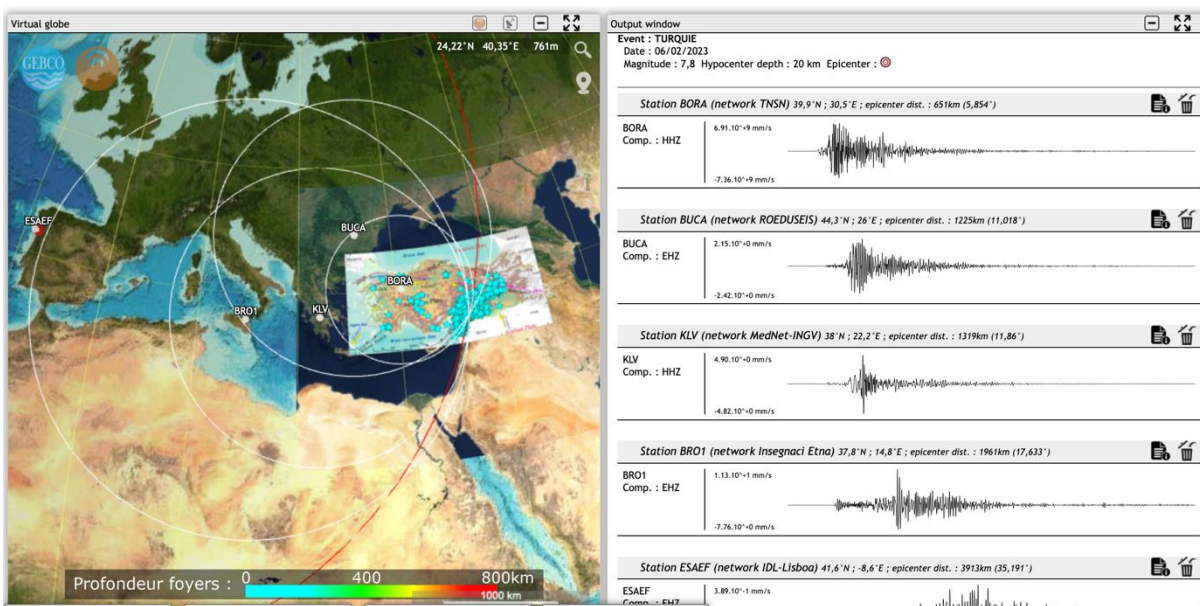
GEOAZUR Education & Outreach – University Côte d’Azur

Whether from the atmosphere or from the dynamics of the earth's crust, populations are exposed and vulnerable to brutal and violent episodes and events.

This is the case for earthquakes whose magnitude and location constitute a real risk because of the populations exposed to this hazard.

On 6 February, two earthquakes along the Anatolian Fault shook the populations of southern Turkey and Syria. In this densely populated region, which is also cross-crossed by numerous faults, the seismic risk is very high. The damage is even greater when the event occurs at night or affects buildings that are not very resistant to vibrations.

These two seismic events have been widely recorded in Europe, particularly by seismological stations in Greece. The data available online can be used to build knowledges to understand earthquakes with students.



Seismic event – 2023 February 6<sup>th</sup> – Magnitude 7.8

This hands-on workshop presents examples of a case study that can be conducted in the classroom with students, using online data.

This 'data mining' exercise is an opportunity to look back at a natural hazard with the case of the very recent 6 February earthquake in Turkey/Syria.

## **The earthquake suitcase**

Vasiliki Kouskouna

National and Kapodistrian University of Athens

Department of Geology and Geoenvironment

Section of Geophysics and Geothermics

The **Earthquake Suitcase**, an educational system for information about - and familiarization with – earthquakes, was designed and integrated in the Laboratory of Seismology, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens.

The multiple goals achieved with this educational module are to educate the schoolchildren on what an earthquake is, where, how and why earthquakes occur, and the preventive measures that can be taken. The schoolchildren gain experience through earthquake simulation, familiarize themselves with the feeling of an earthquake, and learn to take the necessary self-protection measures.

The educational material is included in the “Earthquake Suitcase”, which contains interactive educational toys, an experiential shake table for earthquake simulation, a model accelerometer recording in real time the simulation, books, leaflets and an earthquake emergency bag.

The training is conducted by the specialized staff of the project’s scientific team. During the training and, in collaboration with the educators in charge, the effectiveness of the earthquake suitcase is evaluated, with the schoolchildren drafting their own individual emergency plan.

Results from educational applications to schools in Greece (Athens, Lixouri) and the US (Boulder, CO) are presented.

The project was sponsored by the Hellenic Petroleum Group and the US State Department.

# **Innovative ideas and activities for Earth Science Environmental and Physical Geography teaching and learning, «E.L.I.»**

Fotios Danaskos

8<sup>th</sup> Junior High School in Chalandri

EGU GEFO HELLAS

Among the different STEM subjects, Geosciences are probably the most neglected, both in school curricula and in the teaching practices of many countries too.

Earth learning idea, began as an idea on 6th May 2007 and from 2008 to 2023, has spread across the Geosciences Teaching world more than 400 activities with explanatory videos, translated into different languages.

There have been visits from 213 countries and over 6 million downloads. ELI is publishing FREE Earth-related teaching ideas, designed to be practical resources for School Teachers and Teacher-trainers all over the world.

A new Earth Learning Idea is published every two weeks. The ELI Blog is updated every Monday and new videos are uploaded all the time.

New ideas and activities are very well designed and explained and of these activities require the use of some basic school laboratory equipment and some include abstract ideas, labeled ELI+ activities. Each activity is designed to create pupil participation for maximum learning.

All activities are free to download and most require minimal cost and equipment. Best of all, they are fun and bring fun and happiness to the school classroom.!

The original inspiration came from Professor Chris King, who sadly passed away on February 17, 2022. The team behind this idea today consists of 3 experts (**Peter Kennett, Elizabeth Devon, Pete Loader**) and is currently trying to maintain his credentials, so the wealth of experience and his dedication to the teaching of Geosciences, to spread throughout the world.

You can find ELI:

<https://www.facebook.com/earthlearningidea>

[https://twitter.com/ELI\\_Earth](https://twitter.com/ELI_Earth)

<http://earthlearningidea.blogspot.com>



## Creating school seismology labs (SEISMO-Labs) for the development of students' competences

Dragos Tataru, Eduard Nastase

National Institute for Earth Physics, Romania

Earth sciences and seismology, specifically the subject of earthquakes, are a perfect starting point for countless opportunities for cross-curricular activities.

SEISMO-Lab is an initiative that supports the creation of Competence Development Labs, developed and run by teachers that will then be able to create “bottom-up” STEAM curricula for their schools, that are enabling students to practice competencies and skills that go beyond STEM: learner independence – and interdependence – through collaboration, mentoring, and through providing opportunities for learners to understand and interrogate their place in the world. Students take on the important part as peer enquirers/researchers and this project promotes their active involvement.

During the workshop, teachers will learn by doing activities like “How to build a seismometer” or “Print your shake table and build a better wall” and how to create bottom-up innovative and cross-curricular STEAM curricula, that include modern student-centered pedagogies and competency-based learning. Using a set of participatory, inclusive, cross-curricular STEAM-based scenarios they will support students in increasing their problem-solving skills, and creativity, and promote a learning-by-doing attitude.

The presented activities will help to reinforce key skills and competencies through meaningful and motivating inquiry activities on seismic risk mitigation and at the same time help teachers to set up STEAM activities in which students learn, practice, and utilize scientific instruments and methods while they have to communicate the outcomes of their work.

SEISMO-lab activities have been created in the framework of the project that has received funding from the European Union's ERASMUS+ Programme under agreement No 2021-1-EL01-KA220-000032578.



## Teaching Earthquakes in classroom using stem tools

Fotios Danaskos

8<sup>th</sup> Junior High School in Chalandri

EGU GEFO HELLAS

For school students, most Geological processes and Geotectonic phenomena remain quite abstract concepts, especially in countries where Geology is not adequately covered in the School curriculum.

Traditional teaching methods do not allow students to adequately understand and get the necessary explanations for the various Geotectonic phenomena, often creating misunderstandings.

The solution to the problem is given, to a large extent, with the laboratory approach to the phenomenon and the physical processes that accompany it.

The Seismobox educational tool combines scientific knowledge, know-how and STEM in the classroom with three main goals:

- To motivate the students, as future active citizens, in the knowledge of the natural phenomenon and the possibility of predicting them.
- To know the consequences of the phenomenon on the surface of our planet and on man-made constructions in relation to the type of soil on which the buildings are located, as well as the type and quality of buildings in the areas already most affected by earthquakes;
- Stimulating students to participate in modern practical STEM laboratory activities, through the creation of experimental devices and the awareness of teachers, Primary and Secondary Education, in the use of new educational techniques and tools regarding the education of students

Scientific research on earthquakes, in countries with strong seismicity, is of very high quality and leads to significant development of knowledge about seismicity. If this knowledge is transmitted to the population (starting with young students), seismic risk will become part of the culture. If the same knowledge is effectively transmitted to all social and political levels you will start a new spatial and urban planning combined with the laws and rules of the state.

When these aspects are combined then perhaps we can talk about prevention, because all citizens know the area where we live and are part of it, respecting the rules and becoming active citizens.

# Teaching Earthquakes in classroom using open data, case study: active fault bases

Kyriaki Makri,

Institute of Environmental Research, National Observatory of Athens, Penteli

Open data is “digital data that is made available with the technical and legal characteristics necessary for it to be freely used, reused, and redistributed by anyone, anytime, anywhere”.

Natural hazards and their management are a major subject of research in the applied/technological, social, and human sciences. The object of the proposed educational scenario is, in harmony with the objectives of the Sendai Framework, it deals with the development, implementation and evaluation of an educational proposal in the field of Seismology. The main objective of the proposed teaching action is to introduce to the students the research and investigative way of thinking so that they can understand, clarify, and relate the principles of natural sciences they receive in their analytical curriculum with the concepts of Seismology and in particular active faults. The scenario is aimed at students aged 10-15. The basic tool of the educational scenario is the database of active faults in Greece by Institute of Geodynamics [NOAFaults v4.0](#) and the [Greek Database of Seismogenic Sources \(GreDaSS\)](#). Also, this teaching example can be implemented using similar databases.

# Introduction to the Differential SAR Interferometry for measuring ground deformation

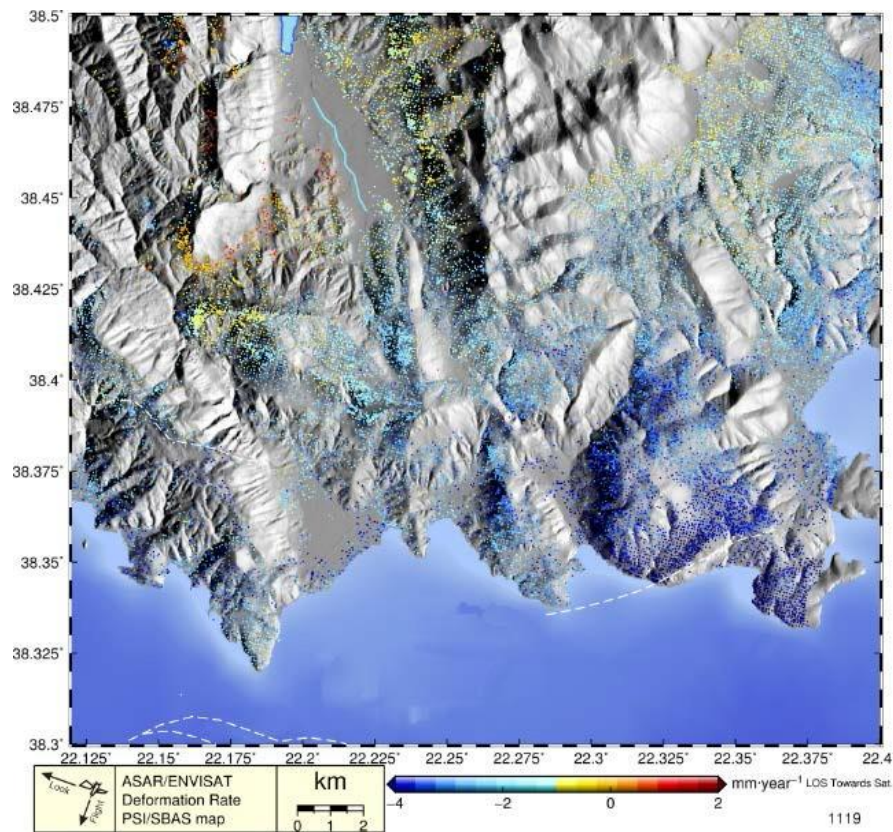
Panagiotis Elias

National Observatory, Athens, Greece

How can we measure a seismic fault buried many kilometres under the ground from 600km away? How can we map a displacement of a few mm or cm from such distances? The technological advancements of the recent decades in the remote sensing permitted the sensing and measuring of the deformation of the earth crust due to earthquakes, aseismic tectonic processes, volcanoes and landslides but also to manmade activities. How can we link the deformation of the surface to the fault in depth through modelling? The basics of the satellite Synthetic Aperture Radar (SAR) characteristics and properties of its provided data as well as the basics for differential and multi-temporal interferometry methodologies will be presented. Links with the presentation of GNSS will be shown. We will focus on the case of the Corinth Rift Observatory area and present our findings so far.

The Corinth Rift is one of the narrowest and fastest extending continental regions worldwide and has one of the highest seismicity rates in the Euro-Mediterranean region. At its western termination, several active faults are located beneath the city of Patras and the surrounding area, a region of major socio-economic importance to Greece.

Apart from moderate earthquakes striking often, additional non sudden geological phenomena, such as slow and continuous ground displacements, are occurring. Both are being provoked by the movement of the tectonic plates. In many cases slow displacements are part of the seismic cycle occurring before an earthquake.



Velocity map produced from ASAR/ENVISAT Multitemporal interferograms of Psaromita and Galaxidi area in the North Gulf of Corinth. The coast of Central Greece is moving away from the coast of North Peloponnesus with a maximum velocity of about 1.5 cm per year.

# **Quantification of N. Peloponnese shoreline displacement using very high spatial resolution remote sensing**

Emmanuel Vassilakis

National and Kapodistrian University of Athens

Department of Geophysics and Geothermics

The radical displacement of the shoreline during time is one of the most important factors to be taken under consideration when designing infrastructure along the coastal zones. Serious changes in the topography along the southern Corinth Gulf shoreline, as well as severe erosion phenomena have been recorded and therefore it is an ideal location for studying coastline displacement.

The area selected for the application of the described methodology is a very characteristic segment of the Corinth Gulf and has an overall length of 12 km. It lies between the Town of Sykea (east) and the Town of Kamari (west) including the entire waterfront of the Town of Xilokastro, where significant residential and tourist development has occurred during the last decades.

This methodology aims to quantify the shoreline displacement rate by involving the processing of different remote sensing data types such as historical aerial photographs, satellite imagery and unmanned aerial system image data, as long as in-situ observations for validating the geo-statistic calculations. Several photogrammetric techniques were used in order to ortho-rectify, co-register and homogenize a quite dense time series of remote sensing data acquired from 1945 to 2017, representing a rapidly relocating coastal zone at the southern part of Corinth Gulf. All images were digitally processed and optically optimized in order to produce a highly accurate representation of the shoreline at the time period of each acquisition.

The data were imported into a Geographic Information System platform, where they were subjected to comparison, measurements and eventually geo-statistical analysis. High erosion rates were calculated, reaching the order of 0.18 m/year on average whilst extreme rates of 0.70 m/year were also observed in specific locations leading to the segmentation of the coastal zone according to its vulnerability and consequently the risk for further development as well as the effectiveness of measures already taken by the authorities.

All the steps of the applied methodology will be described in this presentation, as it introduces a simple but very convenient way of combining a dataset containing all the available shoreline traces throughout a given time period, in order to quantify its displacement rate for certain segments and therefore evaluate the risk or vulnerability of a coastal zone.



# **Ground Deformation Studies in Seismic Active Areas using Local GPS/GNSS networks. The Case of Central Ionian Islands and Patras Gulf**

Vassilis Sakkas

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Department of Geology and Geoenvironment

Section of Geophysics and Geothermics

Satellite geodesy (GPS/GNSS) and satellite radar Interferometry (InSAR) are the main techniques that are been used over the last few decades to study ground deformation in tectonic active areas. In early 90's the Department of Geophysics and Geothermics of NKUA started to install several local benchmark GPS networks in tectonic active areas of Greece in an effort to study and monitor the ground deformation due to tectonic and seismic forces. On the framework of this work small local GPS networks were established in Patras Gulf (1994) in Cephallonia and Ithaca Islands (2001) and to Zakynthos Island (2005). These networks were designed aiming to study the ground deformation in both local and regional scale. The number of the benchmark stations and their position was selected in a way to fully cover the study areas, measuring the ground deformation along major/regional and minor/local faulting zones and also to study motion of the neotectonics blocks that were defined in the selected areas. The networks were remeasured periodically, and after few re-measurement periods that lasted 5-10 years, provided sufficient evidences of both the regional and local kinematic regime of the study areas. When strong seismic events occurred in the vicinity of the GPS networks the results offered more insight on the activated faults. The displacement vectors associated with the co-seismic motions as well as with the post-seismic relaxation period were the main elements to describe the motions along the seismogenic fault planes, via modelling procedures. Moreover, special effort was given to define pre-seismic displacements that could be associated with the forth coming seismic events, in order to contribute to the earthquake prediction studies.

Based on the GPS results from the local networks in Patras Gulf and in central Ionian Islands regional and local scale motions were detected and interpreted jointly with the tectonic, geologic, seismic and interferometric data that were available aiming to define the seismic status of the study areas. Pre-seismic motion patterns were defined, co-seismic displacements were calculated and post-seismic relaxation behavior was identified in the complex tectonic environment of the western Greece.

Since 2008 in the broader area of Patras Gulf and Central Ionian islands permanent GNSS stations were started to established providing a daily image of the ground motion, and accurately define the velocity field of the area. The data from the permanent GNSS stations were elaborated with the campaign data providing a more detailed image of the ground deformation occurred in this area, as well as the strain filed that is controlled by the local and regional tectonism.

The combination of the satellite geodetic data (GPS/GNSS) with the interferometric results succeed to accurate map the spatial and temporal ground deformation and kinematic status of the Central Ionian and Patras Gulf, providing crucial tools towards the better understanding of the current seismic status of the area. The results are expected to enable the scientists to better evaluate the seismic and associated hazards, in such tectonically active areas and planning processes in respect to minimis damages from future strong seismic events.

# Open Seismic Data Retrieval through EIDA Nodes and Automated Moment Tensor Analysis

Christos P. Evangelidis

Institute of Geodynamics, National Observatory of Athens

ORFEUS (Observatories and Research Facilities for European Seismology) EIDA (European Integrated Data Archive) is a collaborative initiative aimed at facilitating access to seismological data across Europe. It serves as a centralized platform for storing and distributing seismic data collected by numerous research institutes and observatories within the European seismology community. EIDA implements webservices to provide standardized and open access to data. These include FDSN standardized webservices for mSEED waveform data, station metadata and data availability. Additional EIDA specific standardized webservices for routing between services and for waveform metadata ensures a centralized point of entrance into the federated infrastructure and user specific quality checks on the actual data. EIDA plays a crucial role in promoting data sharing, fostering international collaborations, and enabling advanced research in seismology. By providing a standardized and easily accessible data infrastructure, EIDA contributes to a deeper understanding of Earth's structure, seismic hazard assessment, and earthquake monitoring efforts.

The availability of near-realtime seismic waveform data from many European countries with dense seismic networks allows the application of semi-automatic fast processing workflows that can be triggered after significant earthquakes. GISOLA is one tool that determines automatically moment tensors (MT), essential for real-time seismological applications. It is a highly evolved software for MT determination, oriented toward high-performance computing. It employs enhanced algorithms for waveform data selection via quality metrics, such as signal-to-noise ratio, waveform clipping, data and metadata inconsistency, long-period disturbances, and station evaluation based on power spectral density measurements in parallel execution.

The National Observatory of Athens (NOA) functions as a primary EIDA node, catering to seismic networks in Greece, Cyprus, and Montenegro. It plays a crucial role as the developer of GISOLA software and has integrated it into the datacenter, enabling quick determination of moment tensor (MT) solutions for earthquakes in Greece and the surrounding areas with magnitudes exceeding 3.5Mw. The MT database contains numerous solutions starting from 2012 onwards.



## Physical mechanisms behind seismic site response - Some examples from Aegion

Olga-Joan Ktenidou

National Observatory of Athens, Institute of Geodynamics

This short lecture will show us how analyzing a large number of earthquakes recorded at a seismic station can reveal particular characteristics of that site's seismic response. Coupling such an analysis of recorded data with numerical tools -where the site's geometry and soil properties are modeled in 2 dimensions as a grid and a seismic input is propagated through it- can help us validate our observations on the data and explain the physical mechanisms behind the observed site response.

We will look at examples from a study performed on over 500 earthquake records from a vertical array of accelerometers in Aegion, Greece. The array is installed inside an alluvial basin and it includes five stations all at different depths, so as to record ground motion in various kinds of soil as well as in the underlying rock. Aegion, which is situated in the Gulf of Corinth, is a location of high seismicity and so during a few years, hundreds of earthquakes were recorded by this array. The array was installed inside the basin in order for the recordings to shed light on how this complex geological feature affects seismic ground motion at the surface, which in turn can affect the seismic response of the structures and infrastructure in the vicinity.

We estimate site effects using the technique of empirical spectral ratios, with and without a reference site (standard and horizontal-to-vertical spectral ratio). We find significant site amplification which cannot be accounted for by 1D model predictions, and also a significant difference between the two horizontal components. These are indications that the response is dominated by 2D effects, due to strong surface waves generated at the basin edge and propagating laterally towards its interior. Our numerical model simulations corroborate the results of our empirical data analysis and can help inform us about the geological features that cause the various features of the site response. The strongest amplification takes place in the direction parallel to the basin edge, and is up to 2 times higher than in the perpendicular direction. We link this to the nature of surface waves, the Love waves generated being stronger than the Rayleigh waves. We also consider different time windows to study the effect on different wave packages, such as S-waves and coda.

Finally, we make some comparisons with the way the European seismic design code (Eurocode-8) addresses and -of necessity- simplifies such complex phenomena. We compute soil-to-rock amplification factors for peak ground acceleration and find they are significantly higher than what is predicted by current design codes. With that opportunity, we make a short overview of the limitations in predicting complex ground motion based on simple proxies.

# Seismic hazard in Greece with a focus in the Western Gulf of Corinth

Angelos Zymvragakis

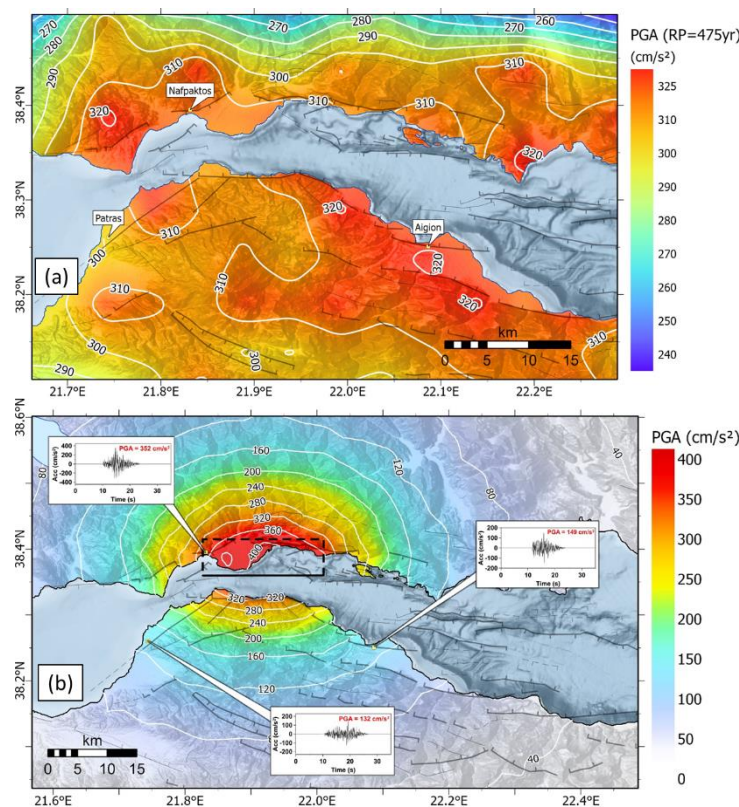
National and Kapodistrian University of Athens

Department of Geology and Geoenvironment

Section of Geophysics and Geothermics

Seismic hazard describes the natural phenomena generated by an earthquake, such as ground movement and fault rupture. The catalyst of possible secondary phenomena is ground motion. Seismic Hazard Assessment (SHA) is an effort to quantify seismic hazard and its associated epistemic uncertainties. This quantification process is executed by the computation of Peak Ground Acceleration, Velocity (PGA, PGV) and others. There are two main ways to perform SHA. The first is called Probabilistic Seismic Hazard Assessment (PSHA), and the second is Scenario-Based Seismic Hazard Assessment. The first, uses an earthquake catalog and a seismotectonic model and the results are generated for certain return periods. On the other hand, Scenario-Based considers a single fault rupture without a specific time frame.

Greece possesses a significant seismic hazard (Danciu et al., 2021). This can be attributed to the direct contact of the European and African tectonic plates in Southern Greece, with Africa subducting beneath Europe. Positioned to the north of this subduction zone is the Gulf of Corinth, which is an active rift that is expanding in a North-South direction. This particular seismotectonic configuration is accountable for the frequent occurrence of numerous earthquakes, positioning Greece among the European countries if the highest seismic hazard. As a result, the entire nation, or specific areas within, have served as focal points for numerous seismic hazard studies.



In recent study conducted by Kaviris et al. (2022) the seismic hazard of western Gulf of Corinth was assessed using both the probabilistic and the scenario-based methodology. In the initial approach, a range of input data variations were considered to address epistemic uncertainties through computational variability. The outcomes of the PSHA demonstrated that the land in proximity to the gulf exhibit elevated PGA values, which decrease towards the south and north for a 475-year return period (Figure a). The subsequent approach comprised two main components. The first involved parameter optimization, wherein simulated and recorded PGA values of the most recent strong ( $M_w \geq 6.0$ ) earthquake in the study area; namely, the 1995 Aigion  $M_S = 6.2$  mainshock were compared. This comparison was conducted to adjust input data such as the stress parameter. The second component pertained to simulating strong ground motion for hypothetical rupture scenarios, one of which was the Psathopyrgos Fault (Figure b). The results indicated that the highest PGAs, situated at the surface projection of the fault or in close proximity, exhibited relatively consistent values ranging from approximately 350 to 450  $\text{cm/s}^2$ .

## References

- Danciu, L., Nandan, S., Reyes, C., Basili, R., Weatherill, G., Beauval, C., Rovida, A., Vilanova, S., Sesetyan, K., Bard, P.-Y., Cotton, F., Wiemer, S., Giardini, D., 2021. ESHM20 - EFEHR Technical Report The 2020 update of the European Seismic Hazard Model - ESHM20: Model Overview. EFEHR European Facilities of Earthquake Hazard and Risk. <https://doi.org/10.12686/A15>
- Kaviris, G., Zymvragakis, A., Bonatis, P., Kapetanidis, V., Voulgaris, N., 2022. Probabilistic and Scenario-Based Seismic Hazard Assessment on the Western Gulf of Corinth (Central Greece). *Applied Sciences* 12. <https://doi.org/10.3390/app122111152>

## Use of CRL Data for Detailed Seismological Studies

Efthimios Sokos

University of Patras

Department of Geology

The Corinth Rift Laboratory Near Fault Observatory (NFO) is located within one of the most seismically active zones in Europe. Thus, it provides the perfect setup for detailed studies of seismic events, even for small ones, that would be almost impossible to study with regional networks. All the modern seismological instruments exist in this NFO, starting of course from a dense seismological network, including weak and strong motion sensors, and continuing with geodetic networks, either real time or campaign based. This infrastructure allows us to accurately locate the seismic events and invert for their source details. Although in regional networks this kind of scientific work is possible for events roughly larger than 6M, in the CRL even events one order of magnitude smaller, can be studied in detail. Furthermore, networks of strainmeters, tide gauges, InSAR etc, can provide further data when additional constraints are needed.

In this talk a detailed analysis of the last seismic crisis in the CRL area is presented. The crisis occurred between December 2020 and February 2021, with thousands of small earthquakes and two  $M_w > 5$  events. The crisis was studied in detail by the CRL research team, using all the available data in the area. The space – time evolution of the crisis will be presented; moreover, details will be given about the source process of the mainshock (February 17, 2021). Using all the available CRL data it was possible to reveal interesting details about the source process of this moderate size event. Indeed the  $M_w 5.3$  mainshock was peculiar, while it nucleated at a depth of  $\sim 8$  km, most of the slip occurred at unusually shallow depths of  $\sim 0-5$  km. This major rupture segment, well constrained by seismic, geodetic, and tide gauge data, was interpreted as a rare shallow activation of a south-dipping offshore fault. This continuation is most likely the Mornos fault, lying opposite (antithetic) to the major north-dipping Psathopyrgos fault which outcrops on the southern coast. The gained knowledge, supplemented by new offshore measurement techniques, will improve seismic and tsunami hazard assessment in the CRL area.

## **Relative sea level changes in the Corinth Gulf during the late Holocene**

Niki Evelpidou & Anna Karkani

National and Kapodistrian University of Athens

Department of Geology and Geoenvironment

Remains of past sea levels, such as tidal notches, benches, beachrocks, etc. may provide valuable information for the investigation of relative sea level changes of eustatic and/or tectonic origin. Tidal notches are usually formed in limestone cliffs in the mid-littoral zone, are well known as precise sea-level indicators and they can attest to the modality of sea level change (rapid or slow) allowing to identify palaeo-seismic events.

In this presentation, we focus on case studies of earthquake-driven coastal changes from the Corinth Gulf, where impacts of past earthquakes can be traced mainly through tidal notches. A reanalysis of published measurements of submerged and uplifted tidal notches in the Corinth Gulf may provide useful indications concerning the long-term tectonic trends that are active in the study area.

# Earthquake structural response of Rion Antirion Bridge: 15yrs of continuous structural surveillance through permanent instrumentation system

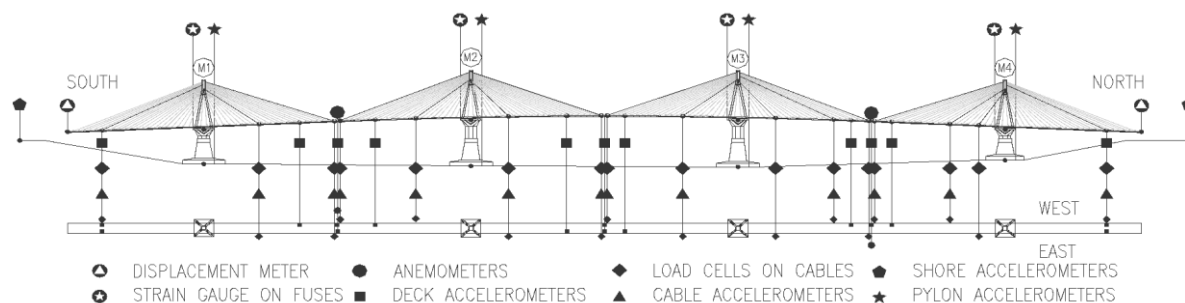
Akis Panagis

GEFYRA SA

Rion-Antirion Bridge is a multi-span cable-stayed bridge with a total deck length of 2,252m fully suspended from the pylons top located on an area of significant seismicity (West Corinth Gulf). During structural design phase unique solutions were implemented to mitigate consequences of a major earthquake event and to allow significant ground displacement without extensive restoration actions.

Rion Antirion bridge in in operation since 2004 and over this period more than 30 earthquake events, yielding to noticeable structural excitation, have been recorded through the instrumented monitoring system that is permanently installed. The intensity of events ranges from small events at the vicinity of the structure –having epicenter distance less than 10 km to major events at an epicenter distance exceeding 250 km (JAN 8th 2006 Kythira Event).

Current presentation discusses the structural response of Rion Antirion Bridge focusing on apparent differences observed for different earthquake events while JUN 08th 2008 Achaia-Ilia EQ consequences are extensively presented since this was the most severe event up to now.



Rion Antirion Bridge SHM Instrumentation

# Natural Catastrophes in the Helike Delta: From Prehistory to Late Antiquity

Dora Katsonopoulou

The Helike Project & The Helike Society

The most impressive destructive event occurred in ancient times in the area of Helike on the southwestern shore of the Gulf of Corinth, was undoubtedly the 373 BC earthquake and flood. To this catastrophic event has been compared the earthquake that happened in the same area in the winter of 1861.

In the search for Helike's lost site, our team located the ancient city's settlement(s) buried from about 2-4 m, in today's coastal plain about 7 km southeast of Aigion, mainly in the zone between the Selinous and Kerynites Rivers. Archaeological data from the excavations and geoarchaeological studies have provided evidence on recurrence of earthquake phenomena in the Helike region since prehistoric times, thus augmenting our knowledge on the seismic history of the area.

It is noted that apart from the discovery of ruined Classical buildings in mid-plain that seem to be associated with the famous 373 BC earthquake, excavations brought to light evidence on the occurrence of unknown earthquakes that caused the destruction and abandonment of settlements in the Helike area. Among them, the most important refer to:

- a. The destruction of the coastal proto-urban town of Early Helladic Helike ca. 2100 BC by an earthquake accompanied by extensive fire,
- b. The destruction and abandonment of Geometric Helike ca. 700-680 BC,
- c. The abandonment of the revived Late Classical-Hellenistic Helike settlement ca. 130/120 BC,
- d. The destruction of Roman Helike by an earthquake ca. 400-450 AD.

On the basis of the collected scientific data, a final observation can be made about the close interaction between people and their natural environment, in a region of high seismic activity and intense geological processes over a long period of time. By correlating and interpreting the physical remains, we are able to trace the settlements' relocation/shifting, with reference to natural catastrophes that befell in the area.

## **Recent sedimentary processes in the western Gulf of Corinth, Greece: seismic and aseismic**

### **Turbidites**

Spyros Sergiou

Laboratory of Marine Geology and Physical Oceanography, Geology Department, University of Patras,  
Greece

The Corinth rift is counted among the most active tectonic grabens in the world, with extension rates up to 15 mm/yr (Western part). These high extension rates are associated with very strong seismic events that are, occasionally, responsible for submarine mass movements. These movements, their consequential bottom currents, and the differential river-discharging sediment accumulation in the whole gulf, strongly affect the modern marine sedimentary processes. The definition and understanding of these processes is the main aim of this project. This is attempted through via sedimentological, mineral and geochemical analyses on two gravity sediment cores from a WE submarine canyon (10 km long, 3 km wide) that lies in the Western tip of the gulf. The general sedimentation motif reveals the presence of hemipelagic deposits which are occasionally interrupted by sandy turbidites. A number of these turbidites correlate with past seismic events. The sedimentation rates range between 2.57 mm/yr in the western part and 0.67 mm/yr in the eastern part.



## **Laboratory class: Study of Archaeomaterials in**

### **"KERAMos Lab**

Ioannis Iliopoulos<sup>1</sup> and Vayia Xanthopoulou<sup>1,2</sup>

<sup>1</sup>Department of Geology, University of Patras, Greece

<sup>2</sup> Laboratory of Electron Microscopy and Microanalysis, University of Patras, Greece

The KERAMOS research group adopts an interdisciplinary approach to tackle archaeological challenges by conducting scientific investigations into material culture and the related Earth's mineral resources. For the past decade, the group has been actively engaged in Archaeometric research at the Department of Geology, University of Patras. Our research endeavours encompass the study of cultural artefacts from diverse regions and historical periods, spanning from the Paleolithic to the modern era. Accredited methods are employed to sample, analyse, and assess clays, sands, and rocks, determining their suitability as raw materials for ceramic production and their use for stone artefacts. To address archaeological inquiries, the group utilizes non-destructive and minimally destructive analytical techniques for ceramics, stones, metals, glass objects, and historical manuscripts.

In our lecture, we are going to present you briefly how an archaeometric research is conducted through several case studies, which are either completed or on going. We will begin from the sampling campaigns, the laboratory processes, the applied analytical techniques, the results and how these contribute to responding to the archaeological questions.

## Field trip to the Helike fault

Emmanuel Vassilakis

National and Kapodistrian University of Athens

Department of Geophysics and Geothermics

The Helike fault is the most prominent high-angle, normal fault on the south side of the western Gulf of Corinth (Fig. 1). It is well visible in satellite images, air-photos, DEMs and it forms impressive footwall landscapes. Its seismic potential is  $M=6.8$  (Doutsos and Poulimenos, 1992) and its probabilistic rupture forecast for the next 30-yr is among the highest in this region of central Greece (Ganas et al., 2014). It is divided into two north-dipping segments with a right step near the exit of the gorge of the Kerynitis river (Koukouvelas et al 2001; Pavlides et al. 2004). The western fault segment bounds a thick sedimentary basin (a few hundred metres) and it has cut across incised streams, however the fault scarp is less pronounced. The eastern fault segment has a total length 24-26 km (20 km onshore and 4-6 km offshore).



It ruptured on 26 December 1861 during the famous Helike earthquake that created surface breaks for a distance of 13 km (mapped from Julius Schmidt, then NOA Director) with a vertical displacement up to 1 m. Paleoseismological data showed that the eastern segment was activated three times during the last 2000 years, including that of the 1861 event. The event magnitude was estimated at  $M=6.7-6.8$  and most probably they occurred sometime between 190BC-110AD the former, and around 600AD the latter. Based on the radiocarbon dating of the sediments the slip rate increased dramatically after a strong earthquake event near 1400BP. The faster slip rate evidently increased the sedimentation rate. The average slip rate on the fault over the past 2000 years is estimated at about 1.5 mm/year while the horizontal extension accommodated from this fault is about 1 mm/year. The field visit will focus on scarp morphology (Fig. 2; sketch by Koukouvelas and Papoulis), fault plane geometry and kinematics of one prominent site (Kalanteri), to the east of village Selinountas.

Figure SEQ Figure \\* ARABIC 1. Field view of the eastern Heliki fault. Source: helikeproject.gr

### References in text

Doutsos, T. and Poulimenos, G. 1992. Geometry and Kinematics of Active Faults and Their Seismotectonic Significance in the Western Corinth-Patras Rift (Greece). *Structural Geology*, 14, 689-699.

Ganas, A., T. Parsons, M. Segou, 2014. Fault-based Earthquake Rupture Forecasts for Western Gulf of Corinth, Greece. AGU 2014 Fall Meeting, 15-19 December 2014, San Francisco, CA, USA (abstract T13C-4666).

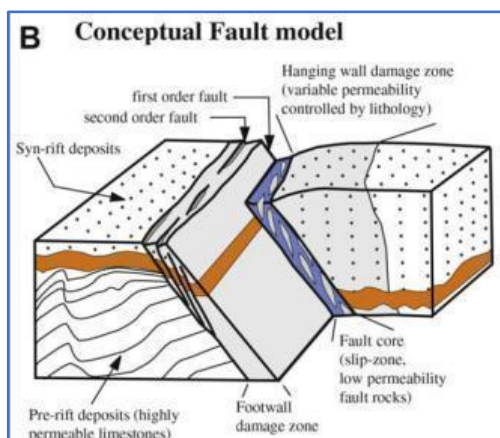


Figure SEQ Figure \\* ARABIC 2. Fault scarp model of the Helike fault. Not to scale

Koukouvelas, I., Stamatopoulos, L., Katsonopoulou, D. and Pavlides S. 2001. A palaeoseismological and geoarchaeological investigation of the Elikei fault, Gulf of Corinth, Greece, *J. of Structural Geol.* 23, 531-543.

Pavlides, S., Koukouvelas J., Kokkalas S., Stamatopoulos L., Keramydas D., Tsodoulos J. 2004. Late Holocene evolution of the east Elikei Fault, Gulf of Corinth, (central Greece). *Quaternary Int.* 115/116, 139-154.

<https://en.wikipedia.org/wiki/Helike>

[https://en.wikipedia.org/wiki/Johann\\_Friedrich\\_Julius\\_Schmidt](https://en.wikipedia.org/wiki/Johann_Friedrich_Julius_Schmidt)