CRL School 2019

Corinth Rift Observatory

Patras-Nafpaktos, Greece

20-24 September 2019

Welcome!!!

Dear teachers and students, welcome to the 2019 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 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 scientific committee. We encourage the students and it is foreseen as their duty to initiate communication.

For now, please enjoy your CRL-School 2019 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 Scientific Committee
CRL-School

Acknowledgments

The CRL School 2019 has been organized by the Scientific Committee, but also benefitted from the generous help of:

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 invaluable, efficient and kind action in the organization of the School

And we thank all the speakers who have contributed to the School and their institutions.

Scientific Committee

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pelias@noa.gr

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Corinth Rift Laboratory School – 2019

(Patras-Nafpaktos September 20-24, 2019)

Program

Friday September 20, 2019

Department of Physics, University of Patras

Chairperson: Anna Serpetsidaki

13:30 – 14:00 Welcome to the CRL School 2018

Panagiotis Elias, National Observatory, Athens, Greece, Organiser of the CRL School
[CV: page 15, Abstract: page 40]
Vassilis Anastassopoulos, University of Patras, Greece
[CV: page 16]
George Papatheodorou, University of Patras, Greece
[CV: page 17]

14:00 – 14:45 Why the Corinth Rift Observatory? – Understanding the physics of earthquakes from the smallest to the largest and the evolution of the faults in the western gulf of Corinth

Athanassios Ganas, National Observatory, Athens, Greece
[CV: page 18, Abstract: page 41]

14:45 – 15:30 The seismic monitoring in the Corinth Rift Observatory

George Kaviris, National & Kapodistrian University, Athens, Greece
[CV: page 19, Abstract: page 42]

15:30 – 16:00 Break

Chairperson: Simon Bufferal

16:00 – 16:45 The geodetic monitoring of the Corinth Rift Observatory with GPS and SAR interferometry

Pierre Briole, CNRS, Paris, France
[CV: page 20, Abstract: page 44]

16:45 – 17:30 The Corinth Rift through the use of marine remote sensing techniques

Maria Geraga, George Papatheodorou, University of Patras, Greece
[CV: page 21 & 17, Abstract: page 45]

17:30 Departure to Nafpaktos (Akti Hotel/Afroditi Hotel)

Saturday September 21, 2019

Nafpaktos municipality room at the old harbor

This event is open to the public

08:30 Departure from Akti Hotel

Chairperson: Christian Beck

08:45 – 09:00 Welcome by the Mayor and local authorities of the city of Nafpaktos

09:00 – 09:45 Tectonics, structural setting and tectono-sedimentary processes in the Corinth Rift
Haralambos Kranis, National and Kapodistrian University, Athens, Greece
[CV: page 22, Abstract: page 46]

09:45 – 10:30 Age, origin and history of the rocks that can be found along the north coast of the Corinth Rift, preparation in the classroom of the geological field trip of Sunday morning
Christian Beck, Université de Savoie, France
[CV: page 23, Abstract: page 47]

10:30 – 11:00 Break

Chairperson: George Kaviris

11:00 – 11:45 Ground acceleration produced by earthquakes and their local amplifications depending on the properties of the underlying soils
Ioannis Kassaras, National & Kapodistrian University, Athens, Greece
[CV: page 24, Abstract: page 48]

11:45 – 12:30 Tsunami in the Corinth Rift and the Ionian Sea
Philippe Heinrich, Commissariat à l'énergie atomique et aux énergies alternatives, France
Simon Bufféral, École Normale Supérieure, Paris, France
[CV: page 25 & 26, Abstract: page 50]

12:30 – 14:00 Lunch Break

Chairperson: Pierre Briole

14:00 – 16:00 Hand-on GNSS instruments – learn how to manipulate a GNSS instrument
Emilie Klein, Centre National de la Recherche Scientifique, Paris, France
Panagiotis Elias, National Observatory, Athens, Greece
[CV: page 27 & 15, Abstract: page 51]

16:00 – 16:30 Break

16:30 – 17:30 Hand-on a simple code to model simple tsunami waves
Philippe Heinrich, Commissariat à l'énergie atomique et aux énergies alternatives, France
[CV: page 25, Abstract: page 51]

17:30 – 19:30 Presentations by the students (introduction to their posters)

The posters will be exposed until Sunday evening

Sunday September 22, 2019

08:30 Departure from Akti Hotel

08:30 – 13:00 Field trip at Psaromita (GNSS and seismic station), geologic stops along the journey

Thanassis Ganas, National Observatory, Athens, Greece
[CV: page 18]
Christian Beck, Université de Savoie, France
[CV: page 23]
Emilie Klein, Centre National de la Recherche Scientifique, Paris, France
[CV: page 27]

13:00 – 14:30 Lunch Break

Afternoon: Nafpaktos municipality building at the old harbor

Chairperson: Panagiotis Elias

14:30 – 15:45 Hand-on the GIPSY software package for GNSS and processing of the data acquired during the morning

Pierre Briole, Centre National de la Recherche Scientifique, Paris, France
[CV: page 20, Abstract: page 51]

15:45 – 16:30 The QGIS software a free and powerful geographical information software – Plotting the routes of the morning GNSS survey with that software

Antonios Mouratidis, Aristotle University, Thessaloniki, Greece
[CV: page 28, Abstract: page 52]

16:30 – 17:00 Break

Chairperson: Carlo Laj

17:00 – 17:30 Earthquakes in the classroom – Part 1 overview

Francesca Cifelli, Università Roma Tre, Italy
[CV: page 29, Abstract: page 53]
Fotios Danaskos, 8th Junior - Senior High School in Halandri
[CV: page 30, Abstract: page 53]

17:30 – 19:00 Earthquakes in the classroom – Part 2 hand on:

Francesca Cifelli, Università Roma Tre, Italy
[CV: page 29, Abstract: page 53]
Fotios Danaskos, 8th Junior - Senior High School in Halandri
[CV: page 30, Abstract: page 53]

19:00 – 20:00 Open discussion among participants: science, didactics, organization of the CRL School

Monday September 23, 2019

Nafpaktos municipality room at the old harbor

08:30 Departure from Akti Hotel

1st Session for Secondary education teachers

09:00 – 12:30 Presentation of the Seismobox at the 1st Gymnasium of Nafpaktos in front of the high-school students and their teachers

Francesca Cifelli, Università di Roma Tre, Roma Italy

[CV: page 29]

Fotios Danaskos, 8th Junior - Senior High School in Halandri

[CV: page 30]

2nd Session for University students:

Chairperson: Pierre Briole

09:00 – 09:45 How the seismic data of the Corinth Rift Observatory are processed, theory and examples

Efthimios Sokos, University of Patras, Greece

[CV: page 31, Abstract: page 54]

09:45 – 11:00 Hand on seismic instruments

Ioannis Kassaras, National & Kapodistrian University, Athens, Greece

[CV: page 24, Abstract: page 51]

11:00 – 12:30 Hand on simple seismic software packages provided on-line in the CRL portal

George Kaviris, National & Kapodistrian University, Athens, Greece

[CV: page 19, Abstract: page 51]

12:30 – 14:00 Lunch Break

Chairperson: Nikos Roukounakis

14:00 – 16:00 Hand-on the SNAP ESA software package for InSAR

Panagiotis Elias, National Observatory, Athens, Greece

[CV: page 15, Abstract: page 51]

16:00 – 16:30 Break

Chairperson: Antonios Mouratidis

16:30 – 18:00 Hand on the Geohazards Exploitation Platform (GEP) with presentation the merging of remote sensing data and field observations made during the field survey of the previous day

Emmanuel Mathot, TerraDue, Italy

[CV: page 32, Abstract: page 55]

18:00 – 19:00 Break & Poster session

19:00 – 19:30 The Etna Volcano Observatory, similarities and differences with the Corinth Rift Observatory and synergies in the context of EPOS

Alessandro Bonforte, Istituto Nazionale di Geofisica e Vulcanologia, Italy

[CV: page 33, Abstract: page 56]

20:30 Official dinner of the CRL School 2019

Tuesday September 24, 2018

08:45 **Departure from Akti Hotel**

Laboratory of Seismology, University of Patras

Chairperson: George Kaviris

09:30 – 10:00 **Presentation of the Seismology Laboratory, University of Patras**
Anna Serpetsidaki, University of Patras, Greece
[CV: page 34, Abstract: page 57]

10:00 – 10:30 **Structural morphology and geometric control of the Rio-Antirrio bridge**
Akis Panagis, GEFYRA, Greece
[CV: page 35, Abstract: page 58]

10:30 – 11:00 **Paleomagnetic studies of rotational deformations in western Greece: at large and small geographic scale.**
Carlo Laj, École Normale Supérieure / European Geosciences Union
[CV: page 36, Abstract: page 59]

11:00 – 11:30 ***Move from Seismology Laboratory to Department of Geology***

Department of Geology, University of Patras

Chairperson: George Kaviris

11:30 – 12:30 **30 Recent sedimentary processes in the Gulf of Corinth. Seismic and aseismic turbidites**
Spyros Sergiou, University of Patras, Greece
[CV: page 37, Abstract: page 61]

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

13:30 – 14:30 ***Drive to the Helike Fault***

14:30 – 15:30 **Visit of the Helike fault near Aigion**
Athanassios Ganas, National Observatory of Athens, Greece
[CV: page 18, Abstract: page 62]

15:30 – 16:30 **Visit of the ancient city of Helike**
Dora Katsonopoulou, The Helike Project, Director
[CV: page 38, Abstract: page 63]

16:30 – 17:30 **Visit of a site of paleomagnetic measurements on the road from Nikolaika to Kato Fteri**
Carlo Laj, École Normale Supérieure / European Geosciences Union
[CV: page 36]

End of the CRL 2019 School

Departures from Aigion to Athens or back to Nafpaktos

Curricula Vitae

Panagiotis Elias

Scientific staff
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

2005-today 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 20 peer refereed publications in international journals, 5 peer refereed proceedings of SPIE and more than 60 presentations in international conferences.

Selected publications and services

1. Ganas, A., Elias, P., Kapetanidis, V., Valkaniotis, S., Briole, P., Kassaras, I., Argyrakis P., Barberopoulou A. and Moshou A., (2018). The July 20, 2017 M6. 6 Kos Earthquake: Seismic and Geodetic Evidence for an Active North-Dipping Normal Fault at the Western End of the Gulf of Gökova (SE Aegean Sea). Pure and Applied Geoph., 1-35.
2. Elias P. and Briole P., 2018. Ground deformations in the Corinth rift, Greece, investigated through the means of SAR multi-temporal interferometry. Geochemistry, Geophysics, Geosystems.

Co-responsible for the operation of 22 GNSS stations of the CRL observatory

Awards and honors

Member of the ESA Living Planet Symposium Scientific Committee for the years 2010 and 2013.
Member of the executive secretary of the Remote Sensing and Space Applications Committee of the Geological Society of Greece.

Vassilis Anastassopoulos

Professor
Electronics Laboratory, Physics Department,
University of Patras

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Education

He was born in Patras, Greece, in 1958. He received the B.Sc. degree in Physics in 1980 (8.41) and his Ph.D. in Electronics in 1986, both from the University of Patras, Greece. His Ph.D. Thesis was on Digital Signal Processing and Delta Modulation Systems. From 1985 until 1987 he served in the Greek Army as a Research Scientist in Communications and Information Department (CID) of the Hellenic National Defence General Staff (HNDGS).

Career

Since 1987 he has been a faculty member in Electronics Laboratory, University of Patras, where in 2005 he was elected as a full professor. He worked for two years in Canadian Universities (Toronto 1989-1990, and Quebec City 1994-1995) in cooperation with Canadian Defense dealing with Non-linear Filters, Pattern Recognition, Information Fusion and Signal Detection in Noise.

Research interests

His research interests are within the scope of Digital Signal and Image Processing, Radar Signal Detection, Pattern Recognition and Remote Sensing. He has given emphasis on processing Multi-spectral, SAR and Infrared Imagery, in Handwritten Analysis and Biometrics, in Information Fusion including Image Fusion, Decision Fusion and Sensor Fusion Architectures. He has also carried out work on Super-Resolution and Inverse Problems. Lately, he was involved in image processing techniques for Astro-Particle Physics.

Publications and services

His publication record contains over 130 journal and conference papers with over than 2000 citations. (http://scholar.google.gr/citations?user=BYcshrUAAAAJ&hl=en&oi=ao).

Awards and honors

He has been Associate Editor in the IEEE Transactions on Circuits and Systems II and in the Pattern Recognition Journal. He was involved in ESA activities and he was appointed as an Advisor in AFC ESA Committee (2005-2010). He was member of the Greek Space Organization (ELDO). He is also an IEEE member. He has coordinated 17 research and development projects.
He is the Head of Physics Department, University of Patras, while he was also the Head of the Physics Department for the biennium 2001-2003 and 2005-2007. He is responsible for coordinating the Andreas Mentzelopoulos Scholarships for the University of Patras. He was the Vice Rector for Strategic Research Planning and Development in the University of Patras from 2006 to 2010. His contribution to the creation of the Center for Bone Marrow Volunteer Donor Recruitment was decisive. He undertook (2011-2013) the establishment of the Innovation and Technology Transfer Office of the University of Patras. At that time, he substantially contributed in establishing the innovation exhibition IQ. He is currently the president and CEO of Patras Science Park.

George Papatheodorou

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

gpapathe@upatras.gr

Education

1990	PhD in Oceanography, Department of Geology, University of Patras, Greece. Title of thesis: 'Recent sedimentation processes in the Gulf of Corinth'
1982	B. Sc. in Geology, University of Patras, Greece

Career

2013-today	Professor, Dept. of Geology, University of Patras, Greece
2009-2013	Assistant Professor (permanent), Dept. of Geology, University of Patras, Greece
2003-2009	Assistant Professor (adjustment), Dept. of Geology, University of Patras, Greece.
1999-2003	Lecturer in "Geological and Environmental Oceanography", Dept. of Geology, University of Patras, Greece
1995-2002	Under Appointed Lecturer in Department of Department of Ichthyology and Aquatic Environment, University of Thessaly.
1984-1999	Research Associate in the Laboratory of Marine Geology and Physical Oceanography, Dept. of Geology, University of Patras.

Research interests

Submarine gravitational mass movements, Seabed fluid flows, Marine Pollution, Marine hazards, Marine natural and cultural heritage sites

Publications and services

More than 100 articles in journals of Science Citation Index, peer reviewed scientific journals and chapters in scientific books and more than 100 publications in International Conferences in the field of Marine Sciences. More than 2000 citations with an h-index 24-30 (Scopus, Google scholar). Scientist in charge for several national and EU projects. Member of the organizing committee of several national and international congresses. Supervisor of undergraduate and postgraduate dissertations and PhD dissertations. He has served as chairman of the Geology Department (2013-2017) and he has elected Dean of the School of Natural Sciences of University of Patras (2018-2021).

Athanassios Ganas

Research Director
Institute of Geodynamics, National Observatory of Athens

aganas@noa.gr

Career

2012	Research Director NOA
2006	Senior Researcher NOA
2003	Assistant Researcher NOA
2000	Junior Researcher NOA

Research interests

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

Publications and services

Ganas, A., Elias, P., Kapetanidis, V, Valkaniotis, S., Briole, P., Kassaras, I., Argyrakis, P., Barberopoulou, A., Moshou, A., 2019. The July 20, 2017 M6.6 Kos Earthquake: Seismic and Geodetic Evidence for an Active North-Dipping Normal Fault at the Western End of the Gulf of Gökova (SE Aegean Sea), Pure and Applied Geophysics, https://doi.org/10.1007/s00024-019-02154-y

Ganas, A, et al, 2018. Coseismic Displacements from Moderate-Size Earthquakes Mapped by Sentinel-1 Differential Interferometry: The Case of February 2017 Gulpinar Earthquake Sequence (Biga Peninsula, Turkey). Remote Sens., 10, 1089, http://www.mdpi.com/2072-4292/10/7/1089

Since May 2009 he serves as Member of the Greek National Committee for Seismic Hazard Assessment. On March 2010 he was elected Member of the Executive Board of the Geological Society of Greece (position held until currently). He is the Editor-in-Chief of BGSG https://ejournals.epublishing.ekt.gr/index.php/geosociety. During 2010-2017 he served as regular member at the Board of Directors of the EPPO (Earthquake Planning and Protection Organisation, Greece). Since 2010 is involved with the Geodetic Data group of the EPOS project https://epos-ip.org/

Awards and honors

In 2016 he received the best Geodesy paper of the Academy of Athens (with Kostas Chousianitis). In 1998 he received the Ktenas Prize from the Academy of Athens and in year 2002 he received the special prize of the Academy of Athens for his work on the Athens earthquake (together with S. Pavlides and G. Papadopoulos). 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.

George Kaviris

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

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http://dggsl.geol.uoa.gr/cv/en_kaviris.html

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

2016 – today: Assistant Professor of "Seismology – Seismic Anisotropy", Department of Geophysics and Geothermics, Faculty of Geology and Geoenvironment, NKUA

2013 – 2016: Lecturer of "Seismology", Department of Geophysics and Geothermics, Faculty of Geology and Geoenvironment, NKUA

2006 – 2013: Research Associate (IDAX) at the Laboratory of Seismology, Department of Geophysics and Geothermics, Faculty of Geology and Geoenvironment, NKUA.

2004 – 2007: Post-Doc Researcher in the Research Project "Pythagoras" entitled: «Identification of Anisotropic Media in Greece using body and surface waves».

Research interests

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

Publications and services

Supervisor of 14 MSc and 16 BSc students. I am currently supervising 2 PhD Theses.
I have more than 130 publications in international scientific journals and congress proceedings. Publications for the Gulf of Corinth:

1. 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.

2. 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 the publication "Karst collapse susceptibility mapping considering peak ground acceleration in a rapidly growing urban area" in which I was a co-author. This publication was awarded being among the five (5) most cited works of the international journal "Engineering Geology" for the period January 2014 - June 2016. The award was given in recognition for the contribution of this work to the quality of the scientific journal "Engineering Geology". A certificate has been issued by Elsevier.

Pierre Briole

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

briole@ens.fr

Education

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

Career

2007-today	Research Director CNRS Ecole Normale Supérieure/Paris Sciences et Lettres Research University - Département des Géosciences - Laboratoire de Géologie 09/2008-2009: Directeur des études, 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 or 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

Maria Geraga

Associate Professor,
Laboratory of Marine Geology and Physical Oceanography, Department of Geology, University of Patras

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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

2015-today	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

36 papers in scientific journals of science citation index and peer reviewed International journals, 10 book chapters and Special Publications, over of 55 full-length papers in Proceedings of International and National Conferences and 50 abstracts. More than 800 citations with an h-index 15-18 (Scopus, Google scholar). Scientist in charge for several national and EU projects. Member of the Science Party of IODP Expedition 381 Corinth Rift. Member of the organizing committee of several national and international congresses. Supervisor of undergraduate and postgraduate dissertations and PhD dissertations.

Haralambos Kranis

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

hkranis@geol.uoa.gr

Education

Degree in Geology (NKUA), Post-graduate Diploma, in Seismology, (International Institute for Seismology and Earthquake Engineering), Ph.D. in Geological Sciences, (NKUA)

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

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

Christian Beck

Emeritus Professor
Earth Sciences Institute (*ISTerre*), Savoie-Mont-Blanc University, and
Grenoble Universe Sciences Observatory (*OSUG*)

beck@univ-smb.fr

https://isterre.fr/spip.php?page=auteur&id_auteur=136&lang=fr

Education

Master Sc. in Geology (1971, *Ecole Normale Supérieure de Saint-Cloud* and Pierre et Marie Curie University, Paris.), and *Agrégation des Sciences de la Vie et de la Terre* (1972)
PhD (1975) and *Habilitation* (1985) (University of Lille)

Career

Assistant Professor (University of Lille, 1978-1987)
Professor (Savoie-Mont-Blanc University, 1988 to 2013)
Advisor in Ministry of Research and Higher Education (*M.E.S.R.-D.G.E.S.I.P.,* 2010-2013)

Research interests

C.B. focused his research on the **sedimentary recording of tectonic processes at different space and time scales**, for long term processes as well as for instantaneous events as earthquakes (based on field work, coring, high-resolution seismic imagery, and laboratory analyses). Since 1991, he is dedicating his work to **recent paleoseismic sedimentary archives** (lacustrine and marine) within integrated projects dedicated to major seismogenic active faults systems, developing sedimentological tools to characterize earthquakes and tsunamis imprints and provide long term archives for hazards estimation.
Main investigated areas are: south-eastern Caribbean Margin (Boconó-San Sebastian-El Pilar transform boundary and Lesser Antilles subduction), Sea of Marmara (North Anatolian Fault), Gulf of Corinth. C.B. participated to different International Oceanographic Surveys: **O**cean **D**rilling **P**roject, Leg 110 (Barbados Accretionary Complex) aboard R/V JOIDES RESOLUTION, Turkish/French MARMACORE and MARMARASCARPS projects. C.B.'s last cruise participations were dedicated to earthquakes and tsunami hazards assessment in Lesser Antilles forearc (GWADASEIS and CASEIS Cruises, 2009 and 2014). Besides, he designed and conducted lacustrine coring campaigns (Chile, French Alps, Venezuela, Albania). Within the frame of SISCOR Project (2011-2013) C.B. conducted two offshore surveys on the western Gulf of Corinth. He is presently achieving analyses of recent sediments cored during I.O.D.P. Expedition 381 (Gulf of Corinth).

Selected publications

Beck, C., 2009. Late Quaternary lacustrine paleo-seismic archives in north-western Alps: Examples of earthquake-origin assessment of sedimentary disturbances. *Earth-Science Reviews*, 96:327–344.

Beck, C, et al., 2007. Late Quaternary co-seismic sedimentation in the Sea of Marmara's deep basins. *Sedimentary Geology*, 199:65–89.

Beck, C., 2012. Identification of deep subaqueous co-seismic scarps through specific coeval sedimentation in Lesser Antilles: implication for seismic hazard. *Natural Hazards and Earth System Sciences*, doi:10.5194/nhess-12-1-2012.

Chapron, E., Beck, C., et al., 1999. 1822 earthquake-triggered homogenite in Lake Le Bourget (NW Alps). *Terra Nova*, 11:86-92.

Campos, C., Beck, C., et al., 2013. Late Quaternary paleoseismic sedimentary archive from deep central Gulf of Corinth: time distribution of inferred earthquake-induced layers. *ANNALS OF GEOPHYSICS*, 56, 6, S0670:1-15; doi:10.4401/ag-6226.

Beckers, A., Beck, C., et al., 2016. Sedimentary impacts of recent moderate earthquakes from the shelves to the basin floor in the western Gulf of Corinth. *Marine Geology*, 384:81–102, doi.org/10.1016/j.margeo.2016.10.018

Ioannis Kassaras

National & Kapodistrian University of Athens
Department of Geology and Geoenvironment
Division of Geophysics-Geothermics

Kassaras@geol.uoa.gr

Education

Secondary school in Athens, BSc in Geology at Dept. of Geology, National & Kapodistrian University of Athens (NKUA), PhD in Seismology at Dept. of Geology, National & Kapodistrian University of Athens

Career

- July 2013 - today: Assistant Professor of Seismology, Dpt. Geophysics-Geothermics, NKUA.
- January 2009 - July 2013: Lecturer of Seismology, Dpt. Geophysics-Geothermics, NKUA.
- 2003-2009: Laboratory Teaching Staff, Dpt. Geophysics-Geothermics, NKUA.
- 1995-2003: Research, Technical and Administrative Staff, Dpt. Geophysics-Geothermics, NKUA.
- 1993-1995: Research Fellow, Dpt. Geophysics-Geothermics, NKUA.
- 1991: Research Fellow at LGIT (Grenoble, France).
- 1989-1991: Research Fellow, Dpt. Geophysics-Geothermics, NKUA.

Research Interests

- Earthquake source properties
- Seismotectonics and active deformation
- Seismic structure of the Earth's interior, surface waves
- Engineering seismology, microzonation
- Seismic Risk analysis

Educational activities

Undergraduate courses

- Seismology
- Plate Tectonics, Seismology of Greece
- Engineering Seismology
- Earth structure

Postgraduate courses

- Advanced Seismology
- Signal processing
- Data analysis
- Supervision of MSc and PhD dissertations

Publications (of educational purpose)

Kassaras I. & Kazantzidou-Firtinidou D. 2017. "Earthquakes", Chapter in N. Dalezios (Ed), "Environmental Hazards Methodologies for Risk Assessment and Management", IWA Publishing, Water Intelligence Online, 16, doi: 10.2166/9781780407135.

Kassaras I. & Kapetanidis V., 2018. Resolving the tectonic stress by the inversion of earthquake focal mechanisms. Application in the region of Greece. A TUTORIAL, Chapter in: "Moment Tensor Solutions A Useful Tool for Seismotectonics", D'Amico, S. (Ed.), Springer Natural Hazards, ISBN 978-3-319-77359-9.

Philippe Heinrich

Research Engineer
CEA, DIF
Laboratory of Detection and Geophysics
91297 ARPAJON, FRANCE

philippe.heinrich@cea.fr

Education

Ecole Centrale Paris, Doctorate in Fluid mechanics
HDR, 2014 Earth Sciences and Environment

Career

1993->now	Research Engineer
>2015	Development of tsunami models

Research interests

Tsunami modeling, Atmospheric transport of radionuclides, Gravity Waves in the high Atmosphere

Publications and services

Jamelot, A., Gailler, A., Heinrich, P. et al. (2019). Tsunami Simulations of the Sulawesi M_w 7.5 Event: Comparison of Seismic Sources Issued from a Tsunami Warning Context Versus Post-Event Finite Source Pure Appl. Geophys. https://doi.org/10.1007/s00024-019-02274-5

Paris, A., Okal, E. A., Guérin, C., Heinrich, P., Schindelé, F., & Hébert, H. (2019). Numerical Modeling of the June 17, 2017 Landslide and Tsunami Events in Karrat Fjord, West Greenland. Pure and Applied Geophysics, 176(7), 3035–3057. doi:10.1007/s00024-019-02123-5

Poupardin, A., Heinrich, P., Hébert, H., Schindelé, F., Jamelot, A., Reymond, D., & Sugioka, H. (2018). Traveltime delay relative to the maximum energy of the wave train for dispersive tsunamis propagating across the Pacific Ocean: the case of 2010 and 2015 Chilean Tsunamis. Geophysical Journal International, 214(3), 1538–1555. doi:10.1093/gji/ggy200

Poupardin, A., Heinrich, P., Frère, A., Imbert, D., Hébert, H., & Flouzat, M. (2017). The 1979 Submarine Landslide-Generated Tsunami in Mururoa, French Polynesia. Pure and Applied Geophysics, 174(8), 3293–3311. doi:10.1007/s00024-016-1464-z

Simon Bufféral

Civil servant, Associate Professor
Department of Geosciences
ENS Paris

simon.bufferal@ens.fr

Education

July 2019 **Associate professor (Agrégation) of Biology-Geology** (SVT); first rank.
2018 – 2019 Sorbonne Universités, Paris, France.
Master 2 - equivalent to a **MS of Sciences of Life, Earth and Universe** (first rank).
2016 – 2017 École Normale Supérieure
Université Paris 6 UPMC, Paris, France.
Master 1 of Geosciences (core in solid earth sciences - first rank).
2015 – 2016 École Normale Supérieure
Université Paris 6 UPMC, Paris, France.
Licence (equivalent to a BS in Geosciences).
Graduation July 2016.
July 2015 **Admitted to Ecole Normale Supérieure**, following a highly competitive selection process.
(Ecole Normale Supérieure is a prestigious institution of higher education providing specialized training for students. Formation includes field work and laboratory courses).

Research experience

Currently (9 months)
WHATsun (West Hellenic Arc Tsunamis) : Production of a catalog of historical tsunami-linked seisms in the western Peloponnese (Greece)
2018 (1 month) Corinth Rift Laboratory, Greece.
Geodetic monitoring of the Katouna block and Aigion fault of the Corinth Rift system.
2018 (3 months) Laboratoire de Géologie, ENS Ulm, France.
Deciphering of the structure and emplacement of the Zambales Ophiolite (Luzon, Philippines), from SRTM and petrologic data – *in review* realization of the geologic and tectonic maps of the west coast of Luzon in preparation to the Tectonic and University at see aspects of the offshore LIGHTENED campaign.
2017 (2 months) Institut de Sciences Exactes et Appliquées de l'Université de la Nouvelle-Calédonie and Service de la Géologie de Nouvelle-Calédonie, France.
Deciphering the geodynamical story of New Caledonia accretion prism from the structural study of low-grade units.
2017 (5 months) National Institute of Geological Sciences, UP Diliman, Philippines.
Sedimentary composition and dip applied to geodynamic considerations: Looking for clues of a collision between Palawan Continental Block and Central Luzon (Philippines).
2016 (1 month) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Catania, Italy.
Sampling and analyzing the tephra fallout from the recent lava fountains at Mount Etna (Sicily).
2015 (1 month) Laboratoire Magma et Volcans, Clermont Ferrand, France.
Influence of the different volcanic rocks on the soil formation at the Chaîne des Puys.

Research interests
Looking for field evidences to root geodynamic models

Emilie Klein

Research Engineer
Laboratoire de Géologie, ENS, CNRS, UMR8538, PSL Research University

klein@geologie.ens.fr

Education

2015 PhD in geophysics.
Laboratoire de Géologie, ENS, Paris, France
Supervisors: C.Vigny, L. Fleitout

2012 Engineer Degree from the National School of Geomatic (ENSG), Marne-la-Vallée, France (equivalent Master in 'Photogrammetry, Positioning and Deformation Measurements' (PPMD))

Career

01/2019 – Present Research Engineer, Laboratoire de Géologie, ENS, Paris

07/2017 – 31/2018 Postdoctorate fellowship, Scripps Institution of Oceanography, Institute of Geophysics and Planetary Physics (IGPP), La Jolla, CA, USA (funds **Caltrans** (*California Department of Transportation*), **NASA** et **NSF)**:
- *High rate GPS measurements on the Ross Ice Shelf, Antarctica:*
- *Kinematic Datum for California*

01/2016 – 06/2017 Postdoctorate fellowship at Institut Physique du Globe de Strasbourg, France. Interseismic deformation and coupling estimation using geodetic data of the North Anatolian Fault, in the region of the Marmara Sea.

09/2012 – 12/2015 PhD, ENS, Paris, France. Research project about the postseismic deformation following the Maule Earthquake (Mw8.8, Chile, 2010)

Research Interests

1. GPS data acquisition, processing and analysis
2. Study of the seismic cycle: postseismic viscoelastic processes, coseismic and aseismic slip inversions, stress transfer, interseismic coupling
3. Finite-element modelling
4. Bayesian modelling

Publications

Klein, E., Bock, Y., Xu, X., Sandwell, D. T., Golriz, D., Fang, P., & Su, L. (2019). *Transient deformation in California from two decades of GPS displacements: Implications for a three-dimensional kinematic reference frame*. Journal of Geophysical Research: Solid Earth, 124.

- **Klein, E.**, Duputel, Z., Zigone, D., Vigny, C., Boy, J.-P., Doubre, C., & Meneses, G. (2018). *Deep transient slow slip detected by survey GPS in the region of Atacama, Chile*. Geophysical Research Letters, 45.

Klein, E., Duputel, Z., Masson, F., Yavasoglu, H., and Agram, P. (2017), *Aseismic slip and seismogenic coupling in the Marmara Sea: What can we learn from onland Geodesy?* Geophysical Research Letter, 44.

Antonios Mouratidis

Assistant Professor
Aristotle University of Thessaloniki,
Department of Physical and Environmental Geography

amourati@geo.auth.gr

Education

Dr. Antonios Mouratidis graduated from the Aristotle University of Thessaloniki, Greece, with a diploma in Rural and Surveying Engineer and a B.Sc. in Geology. His post-graduate studies included an M.Sc. diploma in Geography and Environment and a PhD in Remote Sensing - GPS - GIS, focused on land applications in the domain of Geomorphology.

Career

2014-2018	Lecturer, Aristotle University of Thessaloniki, Greece
2015-2017	Assist. Prof. (visiting), Charles University in Prague, Czech Republic
2013-2015	Consultant, European Space Agency (ESA), Italy
2010-2013	Post-doctoral Research Fellow, European Space Agency (ESA), Italy
2007-2008	PhD student, Ecole Normale Supérieure de Paris, France
2005-2010	PhD student, Lecturer, Aristotle University of Thessaloniki, Greece

Research interests

Applications of Geospatial Science and Technology to Geosciences and Education [Earth Observation/Remote Sensing, Digital Elevation Models (DEMs), Global Navigation Satellite Systems (GNSS), Geographical Information Systems (GIS)]

Publications and services

1. Pennos, C., Lauritzen, S.-E., Vouvalidis, K., Cowie, P., Pechlivanidou, S., Gkarlaouni, C., Styllas, M., Tsourlos, P., and **Mouratidis, A.** (2019) From subsurface to surface: a multidisciplinary approach to decoding uplift histories in tectonically-active karst landscapes. Earth Surf. Process. Landforms, https://doi.org/10.1002/esp.4605.
2. **Mouratidis A.**, Ampatzidis D. (2019). European Digital Elevation Model Validation against Extensive Global Navigation Satellite Systems Data and Comparison with SRTM DEM and ASTER GDEM in Central Macedonia (Greece). ISPRS Int. J. Geo-Inf. 8, 108 DOI:10.3390/ijgi8030108.
3. Papageorgiou, E., Foumelis, M., Trasatti, E., Ventura, G., Raucoules, D., **Mouratidis, A**. (2019). Multi-Sensor SAR Geodetic Imaging and Modelling of Santorini Volcano Post-Unrest Response. Remote Sens., 11 (3), 259. DOI: 10.3390/rs11030259

Awards and honors

2011: Research grant for the project entitled “Contribution of earth observation data and geographical information systems to mapping and managing flood events in Greece’’, by the John S. Latsis Public Benefit Foundation

2011: Ranked first in the competition for a business proposal on GNSS, organized within the 2011 “ESA International Summer School on GNSS”, Berchtesgaden, Germany

2008: Award Grant from the Research Committee of the Aristotle University of Thessaloniki, for the scientific achievements within the PhD studies

2006: Award Grant from the Research Committee of the Aristotle University of Thessaloniki, for the scientific achievements within the PhD studies

2004-2010: I.K.Y. (Greek State Scholarships Foundation), postgraduate scholarship, in the field of "Remote Sensing and Geographical Information Systems in Geosciences”

Francesca Cifelli

Associate Professor
Department of Science, Roma TRE University

francesca.cifelli@uniroma3.it

Education

1997 Master degree in Geological Sciences at La Sapienza University, Rome
1999-2003 Ph.D. in Geological Sciences at Roma TRE University, Rome
2003–2006 Post-doc at the Department of Geological Science, Roma TRE University

Career

2006-2015 Non-permanent researcher in Structural Geology at the Department of Geological Science, Roma TRE University
2015 Associate Professor in structural geology at the Department of Geological Science, Roma TRE University

Research interests

My research activity mainly focuses on paleomagnetic studied applied to the reconstruction of the rotational history and structural evolution of curved mountain chains

Teaching and educational activities

Teaching activity includes support in the first year classes and field assistance in structural geology classes
Tutor and co-tutor of Master thesis and PhD thesis
High-school teacher training activity
Italian responsible of Educational Committee of Education of the European Geosciences Union (EGU) for the organization of the GIFT (Geophysical Information for Teachers) workshops.

Fotios Danaskos

Geoplogist, School Teacher
8th Junior - Senior High School in Halandri

fdanas@yahoo.gr

Education

- **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, 2008.
- **National and Kapodistrian University of Athens Hellas**, Department of Communication & Media Studies, Annual Teacher Training Seminar, "Professional Identity and Communication Counseling", 2004.
- **Technological Educational Institute of Athens Hellas**, Faculty of Health and Caring Professions, Physiotherapy Department, BSc, 1994.
- **National and Kapodistrian University of Athens Hellas**, Department of Geology, Athens, BSc, 1986.

Career

1997 – 2007	Freelance Physiotherapist
1994 - 2013	Physiotherapist School Teacher
2013- 2019	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

- 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.

Efthimios Sokos

Associate Professor
University of Patras, Department of Geology

esokos@upatras.gr

Education

BSc in Geology (1992, Univ. of Patras) and PhD in Seismology (1998, Univ. of Patras). From 2002 to 2005 he was a researcher at the Geodynamical Institute of the National Observatory of Athens. Since September 2005 he is faculty member at the Geology Department of the University of Patras.

Career

2002/12 – 2005/08 Researcher, National Observatory of Athens, Institute of Geodynamics
2005/09 – 2010/02 Lecturer, University of Patras, Geology Department
2010/02 – 2015/11 Assistant Professor, University of Patras, Geology Department
2015/11 – Associate Professor, University of Patras, Geology Department

Research interests

Seismic source studies, seismic hazard, strong ground motion synthesis, microseismic networks.

Publications and services (last 3 years)

Fojtíková, L., Kristeková, M., Málek, J., Sokos, E., Csicsay, K., Zahradník, J. Quantifying capability of a local seismic network in terms of locations and focal mechanism solutions of weak earthquakes (2016) Journal of Seismology, 20 (1), pp. 93-106.

Triantafyllis, N., Sokos, E., Ilias, A., Zahradník, J. Scisola: Automatic moment tensor solution for SeisComP3 (2016) Seismological Research Letters, 87 (1), pp. 157-163.

Behr, Y., Clinton, J.F., Cauzzi, C., Hauksson, E., Jónsdóttir, K., Marius, C.G., Pinar, A., Salichon, J., Sokos, E. The Virtual Seismologist in SeisComP3: A New Implementation Strategy for Earthquake Early Warning Algorithms (2016) Seismological Research Letters, 87 (2A), pp. 363-373.

Sokos, E., Tselentis, G.-A., Paraskevopoulos, P., Serpetsidaki, A., Stathopoulos-Vlamis, A., Panagis, A. Towards earthquake early warning for the Rion-Antirion bridge, Greece (2016) Bulletin of Earthquake Engineering, 14 (9), pp. 2531-2542.

Sachpazi, M., Laigle, M., Charalampakis, M., Sakellariou, D., Flueh, E., Sokos, E., Daskalaki, E., Galvé, A., Petrou, P., Hirn, A. Slab segmentation controls the interplate slip motion in the SW Hellenic subduction: New insight from the 2008 Mw 6.8 Methoni interplate earthquake (2016) Geophysical Research Letters, 43 (18), pp. 9619-9626.

Serpetsidaki, A., Sokos, E., Tselentis, G.-A. A ten-year Moment Tensor database for Western Greece (2016) Physics and Chemistry of the Earth, 95, pp. 2-9.

Sokos, E., Zahradník, J., Gallovič, F., Serpetsidaki, A., Plicka, V., Kiratzi, A. Asperity break after 12 years: The Mw6.4 2015 Lefkada (Greece) earthquake (2016) Geophysical Research Letters, 43 (12), pp. 6137-6145.

Zahradník, J., Cízková, H., Bina, C.R., Sokos, E., Janský, J., Tavera, H., Carvalho, J. A recent deep earthquake doublet in light of long-term evolution of Nazca subduction (2017) Scientific Reports, 7, art. no. 45153,

Liu, J., Li, L., Zahradník, J., Sokos, E., Plicka, V. Generalized source model of the North Korea tests 2009-2017 (2018) Seismological Research Letters, 89 (6), pp. 2166-2173. DOI: 10.1785/0220180106

Zahradník, J., Sokos, E. Fitting waveform envelopes to derive focal mechanisms of moderate earthquakes (2018) Seismological Research Letters, 89 (3), pp. 1137-1145. DOI: 10.1785/0220170161

Liu, J., Li, L., Zahradník, J., Sokos, E., Liu, C., Tian, X. North Korea's 2017 Test and its Nontectonic Aftershock (2018) Geophysical Research Letters, 45 (7), pp. 3017-3025. DOI: 10.1002/2018GL077095

Emmanuel Mathot

Reasearch and Innovation
Terradue

emmanuel.mathot@terradue.com

Education

After a master degree in computer science master at UCL in Belgium, I headed to Italy in Rome as a long term mission consultant for European Space Agency for ground segment applications in GRID distributed systems. For the last 10 years in space industry facing the new challenges of the earth science community, I enjoy building the innovative science exploitation platforms using new technologies of big data and massive processing

Career

From September 2010 **Head of Research and Innovation (Terradue)**

- Customer Project Architecture and Design
- Productivity and Quality Control & Team coordination
- Technology watch
- Earth Observation processing implementation for data production and dissemination
- Project development for cloud technology
- PaaS design and deployment

May 2006 - July 2010 **Earth Observation Project Engineer (European Space Agency)**

July 2005 - May 2006 **Software System Engineer (European Space Agency)**

Research interests

- Object oriented programming
- API and interface design
- Heterogeneous and distributed systems integration
- Virtualization and containerization
- Industrial trends and technology research and analysis
- Earth Observation Image processing products
- System specification and evolution study for operational deployment
- Systems and prototypes implementation

Publications and services

Thematic Exploitation Platform (https://geohazards-tep.eu/)
In the TEP framework program, Terradue provides a system to integrate PaaS for scientists around a specific thematic earth observation application. I lead the design and the architecture of the software components composing the system.
Ellip (https://ellip.terradue.com)
A Platform as a Service environment to integrate and test scalable processing chains, with control of code, parameters & data flows, embedding standard APIs to stage data, run jobs & and package Apps.

Alessandro Bonforte

Researcher
Istituto Nazionale di Geofisica e Vulcanologia
Sezione di Catania – Osservatorio Etneo

alessandro.bonforte@ingv.it

Education

Alessandro Bonforte achieved the Degree in Geology in 1994. He performed a National CNR fellowship in 1997-1998 participating also to the International course on Volcanic hazard assessment, monitoring and risk mitigation at University of Azores and, in the same year, to same stages at IPGP in France. Since 1999 he started his Doctorate course, achieving the PhD in 2002, by studying the ground deformation on volcanic (Etna) and tectonic (Hyblean Plateau) environments, followed by a Research Grant from 2002 to 2003; during this period, he participated to the volcanic emergencies due to Etna eruptions in 2001 and 2002-2003 and Stromboli eruption in 2002-2003.

Career

date	Position
1997-1998	Fellowship CNR-IIV
1998-1999	Cooperation contract CNR-IIV
1999-2002	PhD University of Catania
2002-2003	Research Grant INGV
2003-now	Researcher INGV

Research interests

Geophysicist, volcanologist. Interested in studying the geodynamics controlling volcanic and tectonic activity and the shallow and deep structure of volcanoes, such as their feeding system, structural assessment and flank instability, mainly through crustal deformation analysis by terrestrial and spatial techniques, remote sensing and integration of multidisciplinary (geophysical, geochemical, geological) data and computer modelling. Involved in all emergencies on Etna and Stromboli volcanoes.

Publications and services

Recent publications on international journals deal about the deformation affecting Sicilian volcanoes (Etna, Stromboli, Eolian islands) and measured by a multidisciplinary and integrated approach (ground and satellite techniques) and tectonic areas of eastern Sicily, modeling of the volcanic sources, comparison and integration with other multiparametric data (seismicity, gravity, geochemistry).
Since the beginning of his work at INGV he is involved in real-time surveillance in the control room, as well as in participation to external emergencies such as in El Salvador in 2014.

Awards and honors

In 2014 he was awarded by the Lifetime Achievement Award (Premio alla Carriera) by Telethon & ConfCulture, Catania (Italia).

Anna Serpetsidaki

Title: Dr.
Seismological Laboratory, Geological Department, University of Patras, Patras, Greece

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Education

BSc Geology (1999), Geological Department, University of Patras, Greece
PhD Seismology (2004), Applied Geology and Geophysics, Geological Department, University of Patras, Greece
Postdoctoral Research (2005), Faculty of Mathematics and Physics, Department of Geophysics, Charles University of Prague, Czech Republic.

Career

2013 – today: Faculty Member of Geology Department, Patras University
2000 – 2013: Researcher, Seismological Laboratory of Patras University

Research Interests

Ground Response Analysis, Seismic Hazard, Seismic Source Properties, Moment Tensor, Microsesmic networks, Seismotectonics.

Publications and Services

1. **Serpetsidaki, A**., Sokos, E., Tselentis, G.-A. A ten year Moment Tensor database for Western Greece (2016) Physics and Chemistry of the Earth, 95, pp.2-9.
2. **Serpetsidaki, A**., Elias, P., Ilieva, M., Bernard, P., Briole, P., Deschamps, A., Lambotte, S., Lyon-Caen, H., Tselentis, G-A. & Sokos, E. (2014), New Constraints from Seismology and Geodesy on the Mw=6.4 2008 Movri (Greece) Earthquake. Evidence for a Growing Strike Slip Fault System. Geophysical Journal Intenational, 198 (3), pp. 1373-1386.
3. **Serpetsidaki, A.,** Verma, N. K., Tselentis, G. A., Martakis, N., Polychronopoulou, K., & Petrou, P. (2013). Seismotectonics of Lower Assam, Northeast India, Using the Data of a Dense Microseismic Network. Bulletin of the Seismological Society of America, 103(5), 2875-2883.

Akis Panagis

Civil Engineer MSC University 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-Present Structural Designer for various Industrial and residential Buildings composing of different structural system (Steel/Concrete/Timber).

2008-Present: Monitoring engineer for Structural Dpt of Rion Antirrion 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.

Areas of interest

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-Vlamis, Panagiotis Papanikolas, Akis Panagis, Using non continous records from full scale monitoring system for fatigue assessment, EWSHM2014, July 08-11, 2014, Nantes, France

Panayotis Papanikolas, Aris Stathopoulos-Vlamis, 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

Carlo Laj

Emeritus Researcher
Ecole Normale Supérieure
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&
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European Geosciences Union

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Education

Secondary school in Italy and the USA (American Field Service Exchange Student). University studies at the University of Paris, PhD in Solid State Physics.

Career

I have done all my scientific career as an employee of the French Atomic Energy Commission, first as a researcher in the Physics Department then in the field of geophysics.
In 1985, I was appointed as Deputy Director of the Centre des Faibles Radioactivités and Head of the Department of Earth Sciences. I created and was first director of the Laboratoire de Modélisation du Climat et de l'Environnement, which was later united with the Centre des Faibles Radioactivités to form the present Laboratoire des Sciences du Climat et de l'Environnement (LSCE). After 3 terms as Head of Department (12 years) I stepped down to a researcher position again, until I retired. I have been an "emeritus" researcher since then, and gradually reoriented my activities towards education.

Research interests

After my PhD I spent a few years working with critical phenomena (scattering of laser light by critical fluids) then moved into the field of geophysics.
My main interests in this new field has always been linked to the magnetic properties of sediments and igneous rocks (paleomagnetism), used with several objectives: geodynamical reconstructions (particularly in the Eastern Mediterranean and the Andean Cordillera), reconstruction of the history of the Earth's magnetic field (including the morphology of field reversals) and more recently reconstructions of environmental and climatic changes on a global scale.
I have published over 200 articles in international scientific journals and a few general popular articles in different journals.
Supervisor of 12 PhD students, and 8 Masters of Science

Educational activities and honors

Founder and Chairman, Education Committee of the European Geosciences
Union Participant to different National and International Education Committees
Union Service Award for creating the Committee on Education of EGU
Excellence in Geophysical Education Award of the American Geophysical
Union Fellow of the American Geophysical Union (AGU). F. Holweck prize of
the French Academy of Science Holmes Medalist of the European Geosciences
Union

Spyros Sergiou

PhD student

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

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Education

2015-today	PhD student. Phd thesis: 'Upper Quaternary Chronostratigraphy of two sill-controlled, semi-closed basins. The Southern Red Sea and the Gulf of Corinth''
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 - Insitut 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

Quaternary Sedimentology, palaeoclimatology, paleoceanography, sedimentary geochemistry-mineralogy, tectonics

Selected publications

1. Geraga M, Sergiou S, Sakellariou D, Rohing E, 2018 (in press). Results of micropalaeontological analyses on sediment core FA09 from the southern Red Sea continental shelf. In ''Geological Setting, Palaeoenvironment and Archaeology of the Red Sea'' Springer.
2. 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
3. McNeill, L.C., Sergiou S., and the IODP Expedition 381 Participants, 2019. High-resolution record reveals climate-driven environmental and sedimentary changes in an active rift. Scientific Reports, 9, 3116

Services

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. 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).

Dora Katsonopoulou

Professor of Archaeology
The Institute for Archaeology of Paros
& the Cyclades, President
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Education

- Ph.D. in Classical Archaeology, Department of Classics, Cornell University, 1990.
  DOCTORAL DISSERTATION: *Studies of the Eastern Cities of Opuntian Lokris: Halai, Kyrtones Cities of Opuntian Lokris: Halai, Kyrtones, Korseia, Bumelitaia*
- Post-Graduate Degree in Byzantine and Modern Greek Studies, Department of Byzantine and Modern Greek Studies, University of Athens, 1984.
- Post-Diploma S.E.L.M.E., Teaching Training Graduate Seminars, Greek Ministry of Education, 1983 (Honors).
- B.A. in History and Archaeology, Department of History and Archaeology, University of Athens, 1973 (Class Valedictorian).

Career

2006-pres. Adjunct Professor, Classical Civilization, Department of Languages, Literatures and Cultures, Windsor University, Canada.
2002-pres. Instructor, Graduate School in Geoarchaeological Studies, Department of Geology, University of Patras.
1996-98 Assoc. Professor of Classical Archaeology, The College of Southeastern Europe, The American University of Athens.
1991-94 Ass. Professor of Classical Archaeology, The College of Southeastern Europe, The American University of Athens.
1988-90 T.A., Classical Archaeology, Department of Classics, Cornell University
1987 Instructor, Modern Greek, Department of Classics, Cornell University.
1976–93 Instructor of Ancient & Modern Greek Literature and History in Public Education, Greek Ministry of Education, Greece.
1975–76 Instructor of Ancient & Modern Greek Literature and History in Private Greek Education, High School, Aigion, Greece.

Publications and services

McConnan Borstad, C., S. Garvie-Lok and D. Katsonopoulou 2018. «Diet at Ancient Helike (Achaea, Greece) based on stable isotope analysis: From the Hellenistic to the Roman and Byzantine periods» *JAS Reports* 18:1-10.
Kormann, M., Katsonopoulou, D., Katsarou, S., and Lock, G. 2018. «Methods for developing 3D visualizations of archaeological data: a case study of the early bronze age Helike Corridor House» STAR: Science & Technology of Archaeological Research, 3:2, 478-489.
Katsonopoulou, D. 2018. «Famous Sculptures by Classical Greek Masters in Parion and the Troad». In *International Symposium of Propontis and the Surrounding Cultures – From Prehistory to the End of Antiquity*, 70. Biga-Canakkale.

Awards and honors

Greek National Scholarship for Academic Achievement, 1970-1973.
Valedictorian for graduating Class of University of Athens, 1973.
Valedictorian for graduating Class of Graduate Seminars of Greek Ministry of Education, 1983.
Cornell University Scholarship, 1986-1990.

ABSTRACTS

Welcome to the CRL School 2018

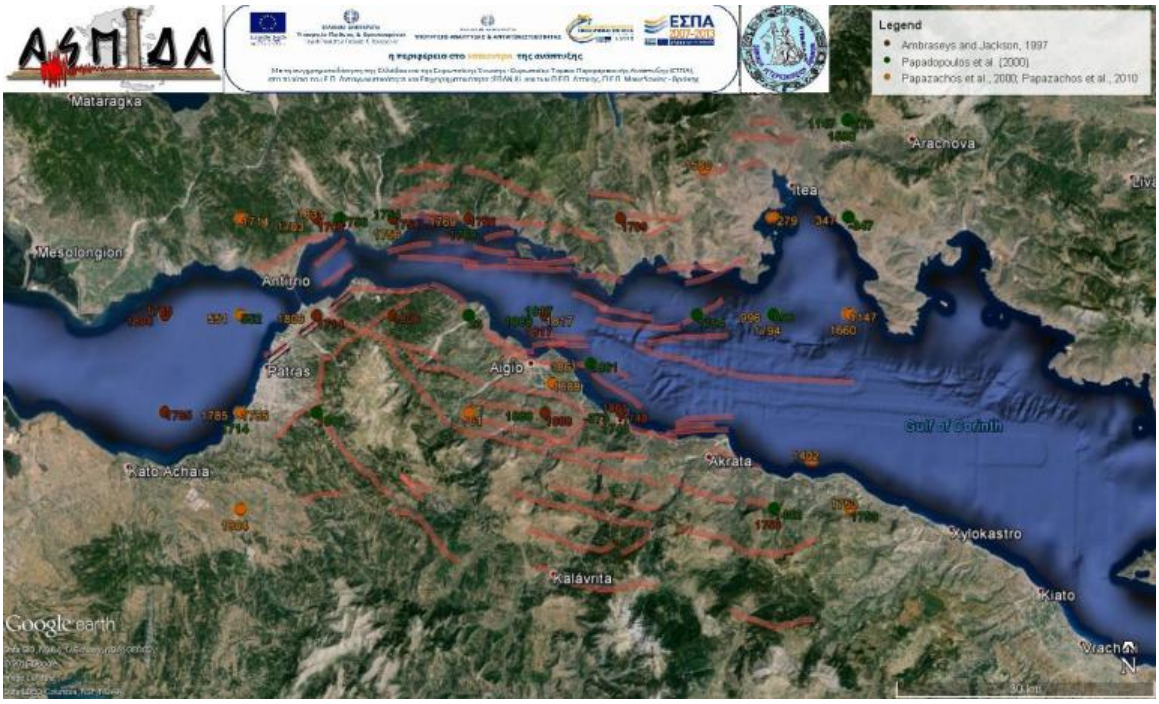
Panagiotis Elias, Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens
Vassilis Anastassopoulos, Electronics Laboratory, Physics Department, University of Patras
George Papatheodorou, Laboratory of Marine Geology and Physical Oceanography, Geology Department, University of Patras

This CRL School 2019 is the fourth edition of the CRL School. This School was created in 2016 as an educational component of the Corinth Rift Observatory (http://crlab.eu). This first edition in 2016 allowed us to test and validate the concept of the School, which duration was 5 days already. During the second and third edition of 2017-2018, 15 school teachers (from Italy, Portugal, France, Albania, Turkey, Russia and Greece) were invited and a strong link established with the GIFT program of the EGU, the CRL School offering a sort of GIFT in the field with hand-on many sensors and techniques in a real situation.
The main objective of the CRL School is however to gather master and early PhD students from the various universities collaborating in the Corinth Rift Observatory. This Observatory, the most advanced Near Fault Observatory in Europe, is a superb and very important place to observe, measure and model the evolution of hazardous seismic faults and therefore gain theoretical and practical knowledge about the genesis of earthquakes. The city of Patras and its surroundings is exposed to large earthquakes and related hazards (e.g. tsunami and landslides) and the CRL School is an important event for both the scientific community and the inhabitants of the area.

Why the Corinth Rift Observatory? – Large earthquakes and faults in the western rift of Corinth

Athanassios Ganas
NOA, Institute of Geodynamics, Athens

The western Gulf of Corinth (see Figure below) has not experienced a strong earthquake since 1995 (the Mw=6.5 event of Aigion on 15 June 1995; global CMT estimate), although the Gulf is extending fast (over 12 mm/yr of N-S extension from continuous GPS data spanning a period of 10+ 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 indicating: a) the existence of normal fault zones with varying activity, b) that the 1995 low-angle fault continues further west (Psathopyrgos), c) GNSS data mapping crustal extension of nearly 300 ns/yr d) unexplored kinematic links to the west Hellenic Arc and the Ionia-Akarnania block. The uniqueness of the Corinth rift is revealed by the updated geophysical datasets (active fault maps, fault geometry, fault slip rates, trenching data on past earthquakes, historical and instrumental seismicity, strain) and recent models for earthquake generation processes suggested from observed seismicity patterns, magnitude-frequency distributions and calculated earthquake rates vs. magnitude for individual faults.



The seismic monitoring in the Corinth Rift Observatory

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

The Gulf of Corinth (GoC) is considered a "natural laboratory" for seismology, given that it is characterized by high tectonic activity. The dominant structural feature is normal faulting. 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. GPS measurements in the GoC have revealed a high extension rate in a NNE-SSW direction, increasing from east to west.

Moderate to strong historical earthquakes (Fig. 1) have occurred in the western part of the Gulf (WGoC), including destructive ones, such as the 373 BC Helike earthquake, as well as during the instrumental period, with some 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 Rift (EGoC), on February 24, 25 and March 4, 1981, a seismic sequence consisting of three major earthquakes of magnitudes M_s = 6.7, 6.4 and 6.4 occurred in Alkyonides Gulf causing significant damage to Athens.

In addition, seismic swarms, such as the one that occurred in Helike in 2013, are a common phenomenon in the western part of the rift. Swarms are bursts of seismic activity lacking a distinct, strong event that would be characterized as a mainshock. Instead, they may contain several major events of comparable magnitude, while the strongest one often occurs in the middle or towards the end, rather than the beginning of the sequence.

The aforementioned seismic activity has piqued the interest of Greek and International research efforts. As a result, Hellenic Institutions have installed several seismological stations in the area, belonging to the Hellenic Unified Seismological Network (HUSN). Furthermore, the multinational 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.

Waveforms recorded in the GoC are utilized in locating earthquakes with high resolution, which permits the identification of seismogenic faults through seismological observations. The obtained data are also used in the determination of focal mechanisms, either with the method of first-motion P-wave polarities (enabled by the dense station coverage) or through moment tensor inversion (for the stronger events). Thus, we can infer the seismotectonic state of the GoC. The vast majority of the reliable fault-plane solutions indicate normal faulting in an approximate E-W direction (Fig. 1), in accordance with the major active faults. It is worth noting that focal mechanisms in NW Peloponnesus indicate strike-slip faulting.

Reliable estimation of seismic hazard parameters, in terms of maximum expected earthquake magnitude and acceleration, velocity and displacement, is vital for earthquake resistant planning and risk mitigation, especially for earthquake prone regions as the GoC. According to the current Greek Building Code, determined using Probabilistic Seismic Hazard Assessment (PSHA), the GoC belongs to Zone II, to which Peak Ground Acceleration (PGA) equal to 0.24g is assigned for a return period of 475 years.

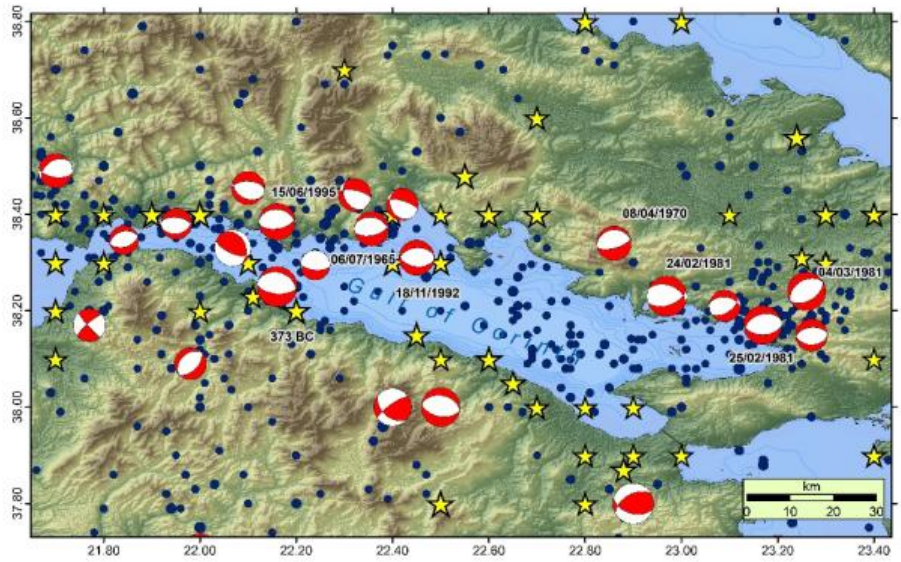


Figure 1: Seismotectonic map of the GoC. Stars represent epicenters of historical (M>6) and blue circles of instrumental (Mw>4) earthquakes. Beachballs are focal mechanisms of strong earthquakes.

Conditions in the GoC have permitted detailed shear-wave splitting studies of the upper crust. The dense seismological networks, especially CRLN, in combination with the intense seismicity, provide an optimal environment for such studies, where high rejection rate of data is commonplace. Exploring seismic anisotropy can lead to constraining fault-plane solutions and to understand the mechanisms that drive the phenomenon.

Most of the stations in the GoC showcase polarization directions of the fast shear-wave (S_{fast}) in a general WNW – ESE orientation (Fig. 2), in agreement with the direction of extension of the Gulf. The results are interpreted with the existence of microcracks, in accordance with the Extensive Dilatany Anisotropy (EDA) and the Anisotropic Poro-Elasticity (APE) models.

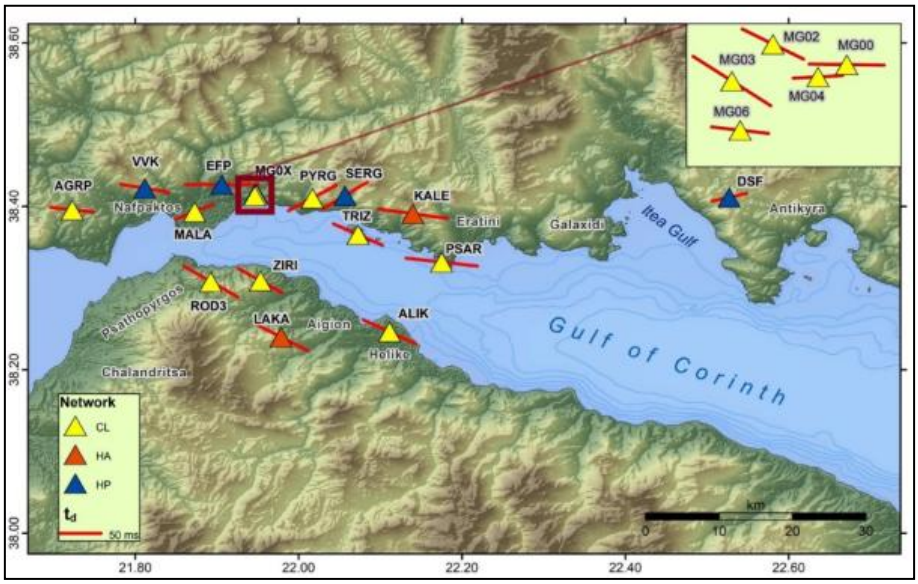


Figure 2: Map of the mean anisotropy direction in the WGoC. Stations are represented by triangles. Red lines indicate mean anisotropy directions and their length is proportional to the mean time-delay

The geodetic monitoring of the Corinth Rift Observatory with GPS and SAR interferometry

Pierre Briole
CNRS / Ecole Normale Supérieure / PSL Research University

Since 1990 the deformation of the western rift of Corinth is monitored using the Global Positioning System (GPS) technique. In the first decade the observations were made during campaigns and since 2001 a permanent network has been gradually installed in the area. This network is nowadays composed of ~30 stations. The campaign network was also gradually developed and it gathers now more than 200 points. The western rift of Corinth is the fastest extending area in Europe and one of the fastest in the world. In my presentation, I will show the main results obtained in the last three decades and I will explain the basics of the GPS observation technique. This lecture will also prepare the hand-on GPS instruments presented on Saturday and the GPS observations in the field presented on Sunday.

The Corinth Rift through the use of marine remote sensing techniques

Maria Geraga, George Papatheodorou
Laboratory of Marine Geology and Physical Oceanography, Geology Department, 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.

During the field trip the students will get experience of modern seafloor surveying techniques. They will have the opportunity to collect subbottom profiling data sets by the operation of a high resolution Chirp sub bottom profiling system (Fig. 1a, c, d) and at the same time to collect side scan sonar data operating a EG&G 272 TD dual frequency (100 and 500 kHz) side scan sonar system (Fig. 1b, c, d). The field trip has been designed to survey areas from the western Gulf of Corinth covering the resent deltaic deposits of Mornos river (Fig.2). The acquired data sets will be processed by sophisticated software for interpretation.

Sources:

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3. http://www.oceanus.upatras.gr/

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

Haralambos Kranis
Department Geology and Geoenvironment, National and Kapodistrian University of Athens, Greece

The Gulf of Corinth (GoC) Rift, is 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 fluviatile 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.

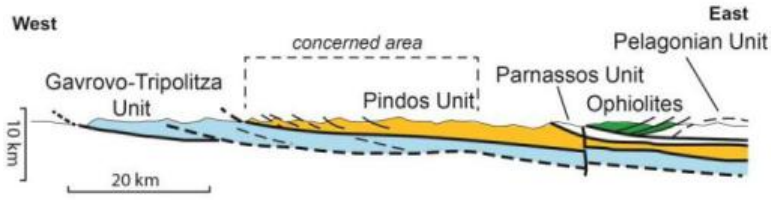
On a crustal scale, the extensional thinning of the Hellenide nappe stack, which is observed in the Peloponnesus, is overprinted by the high-angle normal faulting that controls the GoC rift inception and evolution. The interplay between these two processes is another major factor and geochronological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

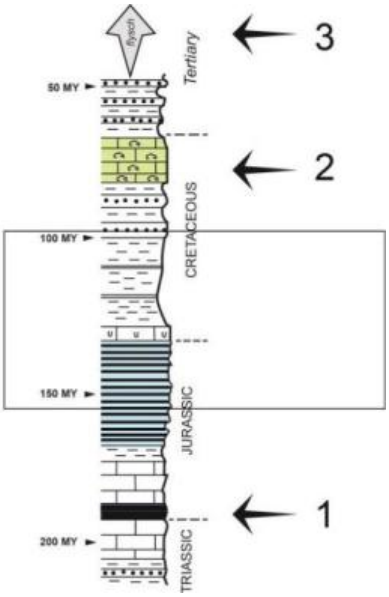
Age, origin and history of the rocks that can be found along the north coast of the Corinth Rift, preparation in the classroom of the geological field trip of Sunday morning

Christian Beck
Université de Savoie, France

The Corinth Rift (CR), which separates Peloponnese from "Continental" Greece, represents a major morphological discontinuity crosscutting the so-called Hellenic Chain (or Hellenides). This main extensional structure and its set of deep-rooted normal faults developed during the last 5 MY and probably most actively during the 2 last MY. The CR was overprinted, without any apparent inheritance and almost orthogonally, upon a much older collisional mountain chain system which long and complex story began at the Paleozoic/Mesozoic boundary (250 MY ago) resulting into huge horizontal shortening by mean of major thrusts (see oversimplified section here below). The whole plate tectonics evolution (birth and disappearance of the Tethyan Ocean) will be presented in order to precise the geodynamic setting of the different formations which will be observed on outcrops.

Both the CR's northern and southern sides exhibit a large variety - in age and in lithology of sedimentary rocks; additionally, in its eastern part, basic volcanic rocks and oceanic lithosphere remnants (ophiolites) are present. The northern CR coast from Antirion to Itea is mainly concerned by the Pindos Unit's Triassic to Oligocene pile. Several outcrops (numbered on the here-below lithostratigraphic succession), ranging from upper Triassic to Paleocene, will be provided to illustrate ***highly different depositional processes***, and, overall, to discuss their ***time equivalents***.





Ground acceleration produced by earthquakes and their local amplifications depending on the properties of the underlying soils. Case study the city of Aigion (W. Corinth Gulf)

Ioannis Kassaras
Department of Geophysics & Geothermics, National and Kapodistrian University of Athens

Earthquake hazards caused the deadliest natural disaster in the last two decades, resulting in over 800,000 deaths and 1.7 million injuries. The issue is particularly crucial nowadays, as manifested by extremely high losses during several recent seismic crises (i.e. Sumatra, 2004; Haiti, 2010; Christchurch, 2011; Japan, 2011; Nepal, 2015). Reason for this is in particular (a) the rapid urbanization of large parts of the population, resulting in growth of cities towards areas susceptible to earthquake hazards, (b) the economically driven reduction of the suburban construction behavior, as largely viewed in less-developed countries, (c) the increasing exposure into technological hazards in the developed countries, i.e. nuclear power plants (as it happened in the Fukushima nuclear plant during the 2011 Japan earthquake).

Such disastrous earthquake phenomena have proven that the generic provisions of the seismic codes, underestimate the seismic hazard potential in earthquake prone areas, and so, crisis management planning is often unrealistic, thus ineffective. Remedy to this is the reconsideration of seismic codes on the basis of small-scale risk models taking into account the local seismic potential, the site's structural and societal vulnerability, and also site conditions. In other words, site-specific estimates are prerequisite towards a tailored seismic risk assessment that will guide through effective risk mitigation policies and disaster management measures.

During the last years, our working group has elaborated intense work on seismic risk assessment in several Greek cities, targeting site-specific models and allowing for tailor-made management actions in case of a crisis. We present the core and the outcome of the applied methodologies, indicating pros and cons, and highlighting future perspectives. Our approach includes: (a) Deterministic seismic hazard assessment based on the stochastic simulation of ground motion taking into account the areas' seismotectonics and site conditions. To this, new data concerning the location, geometry, and the seismic potential of faults, together with free-field ambient noise recordings have been collected through numerous field surveys; (b) Vulnerability assessment of elements at risk informed by newly created observed damage databases and in-situ observations; (c) Development of physical risk models including structural damage, and economic loss for several earthquake scenarios.

Case study

Our basic example is a scenario-based seismic risk assessment for the earthquake prone city of Aigion (W. Corinth Gulf). Within this approach, the stochastic finite-fault method is applied towards simulation of strong ground motion for three near-field earthquake scenarios, capable of occurring given the well-established seismotectonics of the area. The three scenarios are: (a) a repetition of the June 15th 1995 (M_w = 6.4) devastating earthquake, (b) a repetition of the December 26th 1861 historical earthquake of M_w = 6.7, and (c) an earthquake of M_w = 6.0 on the nearest Aigion Fault, underlying the city. The stochastic model parameterization is validated by comparisons with available recordings from permanent accelerometric stations. Site amplification is approximated by the use of ambient noise Horizontal-to-Vertical-Spectral-Ratios (HVSR) derived from in-situ free-field measurements in Aigion.

The structural exposure model of the city is developed on a building-by-building level through in-situ inspection, census data, and satellite navigation tools. The macroseismic method of RiskUE-LM1 is applied for the estimation of the structural vulnerability of 3216 inspected buildings in Aigion, based on the vulnerability classes per EMS-98 and semi-empirical indexes, accounting for the buildings' typology and structural characteristics.

Three scenarios of structural damage are presented on a building block scale, in terms of EMS-98 Damage Grades and their probability of occurrence. The obtained risk assessment indicates that the northeastern and partly the southern part of Aigion are more susceptible to damage, in accordance with the real damage distribution from the most recent devastating M6.4 1995 earthquake, the site amplification inferred from HVSR, and the macroseismic vulnerability of the constructions.

In conclusion, the current building stock of Aigion demonstrates significantly enhanced seismic behavior compared to the pre 1995-era, due to rehabilitation after the 1995 earthquake, strengthening post-earthquake interventions to damaged buildings of 1995 and replacement of vulnerable ones with new constructions. Despite unavoidable uncertainties intrinsic to both the method and data, being open to future improvements, the inferred seismic risk assessment provided realistic and consistent results, thus allowing its exploitation towards loss evaluation and mitigation purposes for the city of Aigion.

Perspectives

Future improvements that fall in with, and/or are beyond the global state-of-the-art, include: (a) Implementation of technological capabilities of remote sensing towards buildings' inventory and vulnerability assessment; (b) Socioeconomic impact analyses towards the mitigation of risk, enhancement of preparedness and resilience of the social and economic fabric, and (c) Applications for near real-time damage assessment.

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Tsunami in the Corinth Rift and the Ionian Sea

Simon Bufféral and Philippe Heinrich
ENS CEA

The Mediterranean Sea is located at the convergence of the African and Eurasian tectonic plates, in a context of partitioned subduction of the Mesozoic Tethys Ocean under Europe. This setting produces in a small extent various geological frames that are as many opportunities to generate tsunamis. Indeed, tsunamis form when a submarine asperity moves rapidly enough to generate the displacement of a large volume of water in the form of massive long-period sea waves, reaching coastal areas with a high destruction power.

Yet, multiple offshore fault systems propagate in the Mediterranean Sea, with an active history of seismicity. For instance, the Ionian Sea is currently subducting below the Tyrrhenian Sea, forming the Aeolian Arc volcanoes and causing a substantial risk of subduction-linked seismicity with a vertical motion of high tsunamigenic potential. Farther east, the Mediterranean Ridge is an accretionary prism along which the shortening through a sequential relative slip of the slivers is also susceptible to generate water movements. Moreover, Nubia-Eurasia's slow convergence allows African's slab retreat, opening several back-arc basins such as the Tyrrhenian Sea, and hyperextension domains like the Aegean Sea. Both those great detachments and the local opening of grabens such as the Gulf of Corinth through normal faults and tilted blocs are susceptible to trigger a tsunamigenic vertical motion of the seafloor. Those diverse plate and micro-plate motions are also accommodated through a set of transform and strike-slip faults like the Kefallinia and North-Anatolian Faults, which are seismogenic and may displace the overlying water through the movement of seafloor asperities such as volcanoes or ocean-continent transitions.

Furthermore, most Mediterranean continental margins are currently overloaded with sediments, which favors a slope destabilization susceptible to produce massive tsunamis even around non-seismogenic islands. This phenomenon amplifies the risk of tsunamis triggered by potentially low-seismogenic faults, but can also arise from changes in load such as the sea-level rise or man-made structures like the Nice airport. Finally, the frequent occurrence of subduction-linked volcanoes such as the Stromboli in the Calabrian Arc or the Santorini in the Aegean Arc has been responsible for several historical tsunamis through major eruptions or flank collapse into the sea.

The distance separating the crests of the wave formed increases with the depth of the basin and exceeds 100 km in the deep sea. When it reaches shallow water, the wavelength declines to less than 20 km and its speed decreases from hundreds of km.h-1 to a few tens of km.h-1. This slow-down causes the wave crests to break and their amplitude, or run-up, to grow up to tens of meters above the reference sea level. Various parameters can influence the run-up for the same wave, such as the steepness of the slope, the absence of mangrove vegetation and the carving of the coast. In particular, around the Gulf of Corinth, the multiple coves can funnel the wave and increase the damage at their bottom.

Thus, tsunamis are still causing difficulties to model and their investigation requires a synergy of methods due to their birth through diverse and intricate mechanisms, their high dependence on the morphology of the coast, and the unpredictable smashing power of a wall of water coupled to a large amount of mud and debris.

Hand on Sessions

In the hand-on sessions the tutors will present some basic and practical aspects of the operation of the corresponding instruments/software. These will have immediate application to all the actions/tasks performed in the field and the laboratory as observation strategy, location selection, instrument installation, instrument operation, measurement acquisition and collection, data handling, processing and finally making interpretations and analysis. **The interaction among the tutors and the students of the School is considered crucial. It will be performed throughout the full duration of the School and will be depended not only from the type of the instrument/software but also from the students' availability of laptops, their preparedness and their proactiveness with the corresponding tutor/chairperson and the scientific committee. We encourage the students and it is foreseen as their duty to initiate communication.** This is also the reason why the organizers try to have all the tutors available throughout the full duration of the School.

The following hand-on sessions will be performed during the School:

- Hand-on GNSS instruments – learn how to manipulate a GNSS, by **Emilie Klein – Panagiotis Elias**
- Hand-on a simple code to model simple tsunami waves, by **Philippe Heinrich**
- Hand-on the GIPSY software package for GNSS and processing of the data acquired during the morning, by **Pierre Briole**
- Hand on seismic instruments, by **Ioannis Kassaras**
- Hand on simple seismic software packages provided on-line in the CRL portal, by **George Kaviris**
- Hand on the Geohazards Exploitation Platform (GEP), by **Emmanuel Mathot**
- Hand-on the SNAP ESA software package for InSAR, by **Panagiotis Elias**

The QGIS software a free and powerful geographical information software

Antonios Mouratidis
Aristotle University of Thessaloniki

- Introduction and overview of a GIS
- Issues and constraints of using a GIS
- Open source GIS – QGIS
- Demonstration of QGIS for handling 2D and 3D geospatial information from various sources (satellite imagery, Digital Elevation Models, GNSS data etc.)

Plotting the routes of the morning GNSS survey with QGIS

Earthquakes in the classroom

Francesca Cifelli, Università degli Studi di Roma TRE, Rome, Italy
Fotios Danaskos, 8th Junior - Senior High School, Halandri, Greece

To prevent population against seismic risk, people must know where earthquakes take places, when earthquakes occur and how much is the released energy. Despite several countries are located in a geodynamic framework that well explains the reason of the occurrence of earthquakes (like Greece and Italy), many of their citizens seem not to be aware of the seismic risk. This 'insensibility' mainly derives from the lack of education to the knowledge of the territory where citizens live. The only way forward is to educate new generations to a deep awareness of risk. This task can be reached effectively only by school, which is the best place for the growth and training of young people destined to occupy different positions in adulthood, including decision makers in society. University may play as well a fundamental role in the education on the awareness of the territory and prevention, starting from sensitization of young people to local territorial realities. That is in order to transform part of them into conscientious citizens able to work for the good of the community through the active protection of the territory.

Laboratories in teaching Earth Sciences are a fundamental in the learning process, since practical activities allow the 'visualization' of natural phenomena without resorting to abstraction. The seismo-box is an educational kit that combines knowledge and know-how, with three main objectives 1) to stimulate the students, intended as future citizens, to the knowledge of earthquake as a natural phenomenon, and in particular to the awareness of the consequences that an earthquake may have in relation to the sub-surface geology and the type and quality of buildings in the areas most affected by earthquakes; 2) to stimulate students to practical laboratory activities, also through the creation of experimental devices; 3) to promote in students the acquisition of methodological/didactic skills in the field of dissemination of scientific culture. The idea of proposing the 'Seismo-box' Educational Kit in school came from François Tilquin, a French teacher inventor of this educational kit (www.sismobox.com).

The experiments proposed in the seismo-box educational kit are of two types (Fig. 1): 1) a first set of experiments is dedicated to the physical understanding of an earthquake. Experiences such us the origin of an earthquake, the propagation of seismic waves and their recording, help students to visualize earthquakes and identify them as natural and unavoidable phenomena. 2) the second set of experiments is dedicated to the effects of an earthquake, depending on the type of construction and the subsurface geology on which the buildings are located.

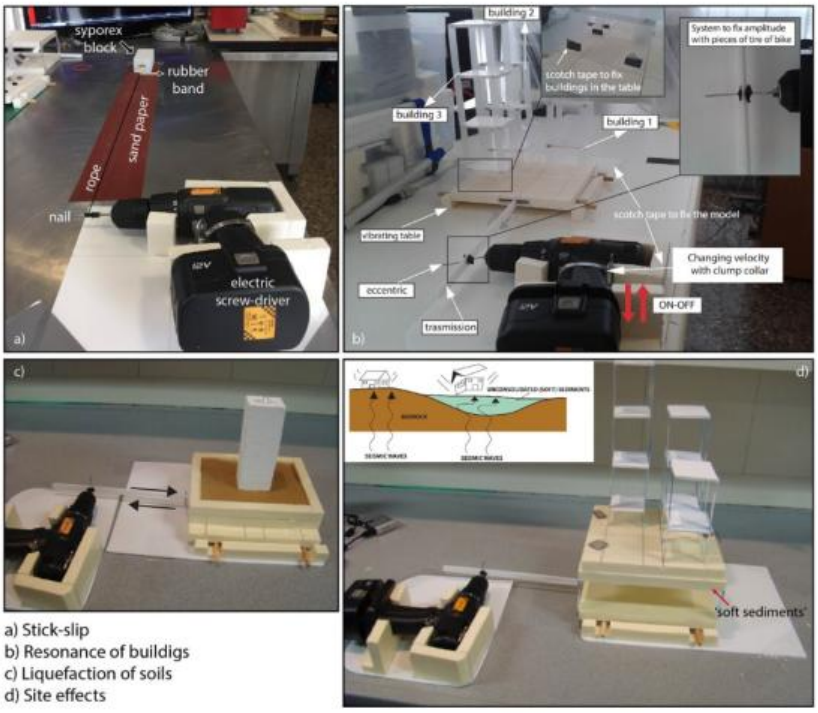

Figure 1 – Some examples of experiments we can do with seismo-box.

How the seismic data of the Corinth Rift Observatory are processed, theory and examples

Efthimios Sokos
University of Patras, Geology Department

The Corinth Rift Observatory seismic network is composed of short period, broad band and strong motion instruments (accelerometers). Special installations like an antenna of seven broad band stations, borehole instruments in deep boreholes, dilatometers etc. have been also installed. Seismic stations are operated by CNRS, France, Athens University, Patras University, Charles University Prague and the National Observatory of Athens. This international effort has made the western Corinth Gulf area the most accurately monitored place in Greece, since the network density is high. This results in a huge number of processed events – some thousands per year – and also in an accurate determination of their basic parameters i.e. source location, magnitude, focal mechanism. The processing is mainly based in automatic procedures, due to the large amount of data, but manual processing is also done. The outcome of the processing is the seismic catalogue of the area, focal mechanisms of strong events, shakemaps etc. In this presentation the structure of the network, the basic processing and a few examples will be presented.

Hand on the Geohazards Exploitation Platform (GEP) with presentation the merging of remote sensing data and field observations made during the field survey of the previous day

Emmanuel Mathot
Reasearch and Innovation, Terradue

On the Geohazards Thematic Exploitation Platform,students will work on tutorials and be able to fulfil jobs assigned to them by the teacherswith real data. Interferograms will be created using DIAPASON and SNAP toolbox for comparison of the processing chain, for educational reasons and for qualification of the products. The coherence is a limiting factor. In the targeted area co-seismic fringes are not always obvious (e.g.the case of the Cephalonia 2014 earthquake), and unwrapping software are not always reliable. We foresee careful analysis of this question and effort to raise the awareness of the students on that topic. Multitemporal maps of the area of CRL will be produced with CNR-IREA SBAS software. The Sentinel-1 (S1) swath covers almost all the CRL core area. On the field usage of Geohazards TEp is envisaged to compare with in situ datasets.

The Etna Observatory of INGV

Alessandro Bonforte
INGV

The Catania section of the Istituto Nazionale di Geofisica e Vulcanologia (INGV), also called "Etna Observatory", conducts research, monitoring and surveillance activities in the fields of geophysics and volcanology within the broader frame of INGV, which is the Italian reference institution for the seismic and volcanic surveillance and monitoring

The Etna Observatory significantly contributes to the monitoring of, and research on, the eruptive activity of Etna, the Aeolian islands and of the other Sicilian volcanoes, favoring a vivid exchange with researchers from Italy and abroad. Among its service duties, the continuous surveillance of the Sicilian volcanoes is carried out in close collaboration with the Italian Civil Defense system.

The Etna Observatory uses the most modern technological systems, applying multiparametric monitoring techniques for the monitoring and surveillance of the sites.

Of the more than 300 stations (seismic, GPS, infrasound, clinometry, geochemistry, surveillance cameras, gravimetry, magnetometry, extensometry, etc.), installed near the active volcanoes and the areas at seismic risk in Sicily, more than half are on Etna, one of the most thoroughly monitored volcanoes on Earth.

The collected data, most of which are being transmitted in real time, allow a rapid understanding of the phenomena in the various fields of geophysics, geochemistry, volcanology, etc. These valuable data on a such active geodynamic environment are used also for collaborating with researchers worldwide, sharing knowledge and experience in a very stimulating process, favored also by official international cooperations and data sharing, such as the EPOS infrastructure.

The University of Patras Seismological Laboratory - Data and Products

Anna Serpetsidaki
University of Patras Seismological Laboratory

The University of Patras Seismological Laboratory (UPSL), has a long history in seismicity monitoring in Western Greece, the area with the highest level of seismic activity in Europe. The Seismology Laboratory is focused in seismology research, i.e. source studies, microseismicity monitoring, seismotectonics, …The first network was installed in early 90's around the city of Patras and it was based on short period sensors with analogue telemetry, monitoring the regions of Patras and western Corinth Gulf for a few years. Latter it evolved into a regional network of more than twenty stations covering the entire area of western Greece. The modern network is based on three component broad band sensors and real-time telemetry. Real time data are transmitted to central station in Patras University and then stored and processed both automatically and manually. Phase picks, locations and moment tensor solutions are stored and distributed to various centres and the EMSC. The network is part of the Hellenic Unified Seismic Network (HUSN) where real time broadband data are shared among the various seismological monitoring centres in Greece. The UPSL is a CRLNET member and has a productive cooperation with Charles University Prague and CNRS. Moreover, the University of Patras Seismological Laboratory in certain time periods operate temporary networks which record the microseismicity in areas of special interest. The constant analysis of the PSLNET's data jointly with the cooperative network's data and also the temporary networks data provide a unique insight into the faulting characteristics of Western Greece and paves the way for detailed studies of stress tensor and stress transfer. Moreover, the study of the swarms and the calculation of weak events moment tensor can assist the comprehension of local seismotectonics and reveal the role of minor faults, which may be critical in seismic hazard.

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Structural Monitoring and Geometric control of the Rio-Antirrion Bridge

Akis Panagis
GEFYRA S.A.

This presentation focuses on the implementation of a complete monitoring scheme on the Rion-Antirrion Bridge that includes both permanent instrumentation, forming SHM system, and periodic Geometric control campaigns.

Initially the main characteristics of RA Bridge are presented (multi-span cable-stayed bridge with a total deck length of 2,252m fully suspended from the pylons top) focusing on unique engineering features such as the shallow foundation of the main piers at 65m below sea level.

Consequently, the permanently installed SHM system, in terms of instrumentation & operation process, is explained as well as the regular analysis of collected data focusing on deck vibration measurements particularities. Also the methodology of Geometric control is discussed, as implemented during the last 15 years of operation.

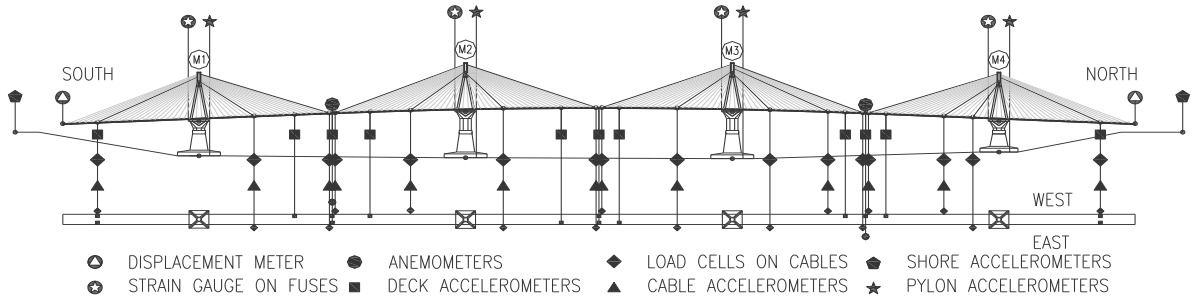

Figure 1. Rion Antirrion Bridge SHM Instrumentation

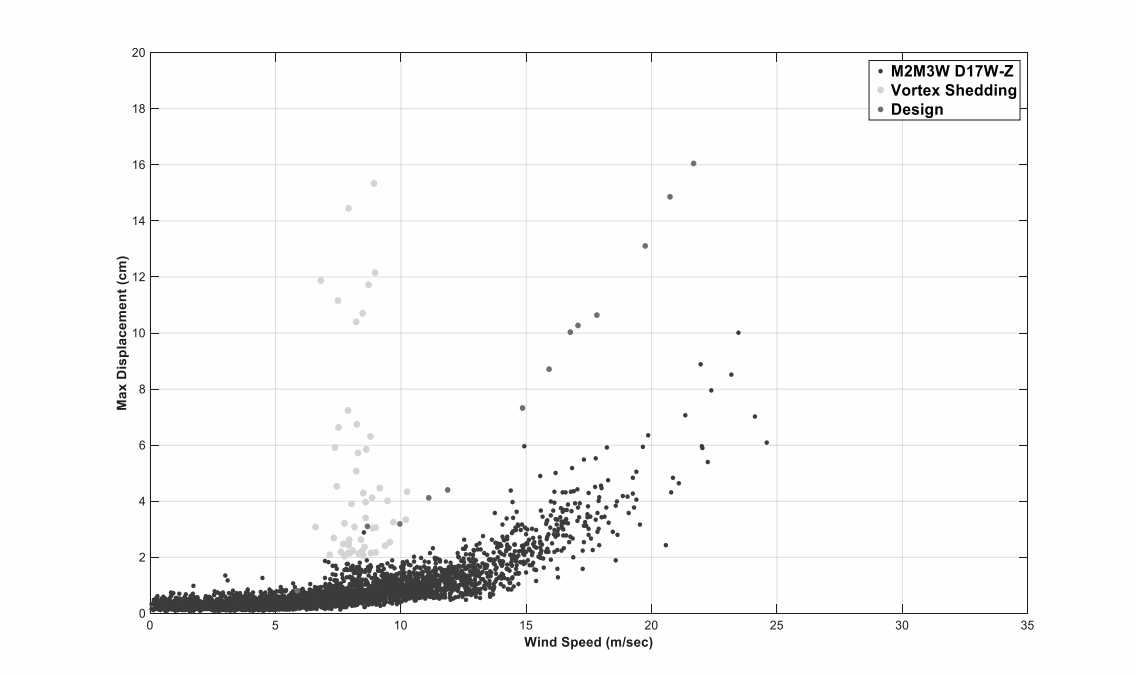

Figure 2. Deck vibration amplitude vs Windspeed

Paleomagnetic studies of rotational deformations in western Greece: at large and small geographic scale.

C. Kissel, M. Mattei and C. Laj

The geometry of the Mediterranean Alpine belt arises from the Upper Cretaceous-Cenozoic collision between the African and European plates. Large and small-scale deformations took place, among which rotations around vertical axis have had a large role. These can only be approached by paleomagnetic studies. Indeed, most of the rocks fossilize the earth magnetic field vector at the time of their formation (cooling or sedimentary deposition). Averaged on a sufficiently long time interval, the fossilized direction should be northward (or southward) directed. After applying adequate laboratory and field tests to check that the measured magnetization is the primary one, any deviation of the declination with respect to the north/south axis reflects a tectonic rotation of the block/structure/region (the scale depends on the geographical/ structural extent of the statistical coherency of the rotation).

The Aegean area is a seismically very active zone where we can expect large amplitude movements to occur in a short time interval. Two types of studies were conducted: one, focused on the external zones of the orogens and considering the large-scale rotations and their role in the acquisition of the curvature of the Aegean-Tauric arcs and the other one, focusing on the close surroundings of the Corinth gulf, considering the small-scale block rotations in this very tectonically active area.

On the large scale, an extensive paleomagnetic study has been conducted in the external zones of the Dinarides and Albano-Hellenides during the Cenozoic/Quaternary period.

The results show that two phases of clockwise rotation of roughly 25° each have successively affected the external regions. They were attributed to the middle Miocene (Langhian) and lower Pliocene tectonic phases recognized in this area on the basis of structural analyses. The external zones of the Albano-Hellenic Belt appear to have rotated virtually as a single entity from the Peloponnesus to northern Albania over a deep decollement level probably involving the basement itself. On the other hand, the Eocene to Mio-Pliocene external Dinarides, did not undergo any significant rotation.

The pivot point of the clockwise rotation is certainly located at the vicinity of Scutari-Pec (S-P) transverse zone, immediately north of the rotating region. The strong seismic activity recorded in this region and the anomalously high positive heat flow (documented by other authors) are also evidence for the recent activity of the S-P transverse zone. Moreover, it has been shown that both the basement and the nappes are involved in the Albano-Hellenic rotation, implying that the tectonic deformation within the S-P transversal zone certainly affects the deep crust. Considering, as a first approximation that the rotation is a semi-rigid one, as suggested by the remarkable consistency of the paleomagnetic results over the Albano-Hellenic belt and the absence of large-scale strike-slip faults, a simple triangulation, around the pivot pole at the S-P zone, indicates that the observed rotations imply a horizontal displacement of about 300 km over the last 15 Ma at the latitude of the Corinth Gulf.

These data thus bring the first experimental proof that the S-P line, considered until that time as a Mesozoic tectonic boundary on the basis of geological observations, is, in fact, a very important tectonic feature during the Cenozoic and probably until the late Pleistocene time acted as a wide and deep decoupling zone between two major orogens of the central Mediterranean.

In parallel, the easternmost units of the Aegean arc (23 sites from the Bey Daglari massif in southern Turkey) underwent a 25° post mid-Miocene counter-clockwise rotation.

Summarizing, the Lower Miocene arc was almost rectilinear with an E-W trend. Its curvature has been acquired tectonically in two major phases. During the Middle Miocene a first phase of deformation is characterized by rotations occurring at the two terminations of the arc, clockwise in the west (Epirus) anticlockwise in the east (south-eastern Anatolia). This phase brought the Dinarides and the Albano-Hellenides along the same axis. A second phase of rotation occurring in the last 5 Ma about a pole situated around the S-P line affected only the northwestern part. The Dinarides on the western part and the Antalya basin on the easternmost part have not been involved in the geodynamical evolution of the arc.

On a smaller scale, paleomagnetic data from Plio-Pleistocene sedimentary units from Corinth and Megara basins (Peloponnesus, Greece) show that Megara basin has undergone a vertical axis clockwise (CW) rotation since the Pliocene, while Corinth has rotated counter-clockwise (CCW) during the same period of time. Conversely, published GPS results show that these two basins belong today to the same crustal block (Peloponnesus), which is presently rotating CCW respect to the Boeotia-Locris block. The boundary between the two blocks is represented by a E-W oriented normal fault system which bounds the Corinth basin and the Megara basin to the north.

These results indicate that the overall deformation in central Greece has been achieved by complex interactions of mostly rigid, rotating, fault bounded crustal blocks. The comparison of paleomagnetic results

and existing GPS data shows that the boundaries of the rigid blocks in central Greece have changed over time, sometimes changing in orientation. The Megara basin belonged to the Boeotia-Locris block in the past but has now been incorporated into the Peloponnesus block, possibly because the faulting in the Gulf of Corinth has propagated both north and east (Fig. 8). Paleomagnetic and GPS data from Megara and Corinth basins have significant implications for the deformation style of the continental lithosphere. In areas of distributed deformation, the continental lithosphere behaves instantaneously like a small number of rigid blocks with well-defined boundaries.

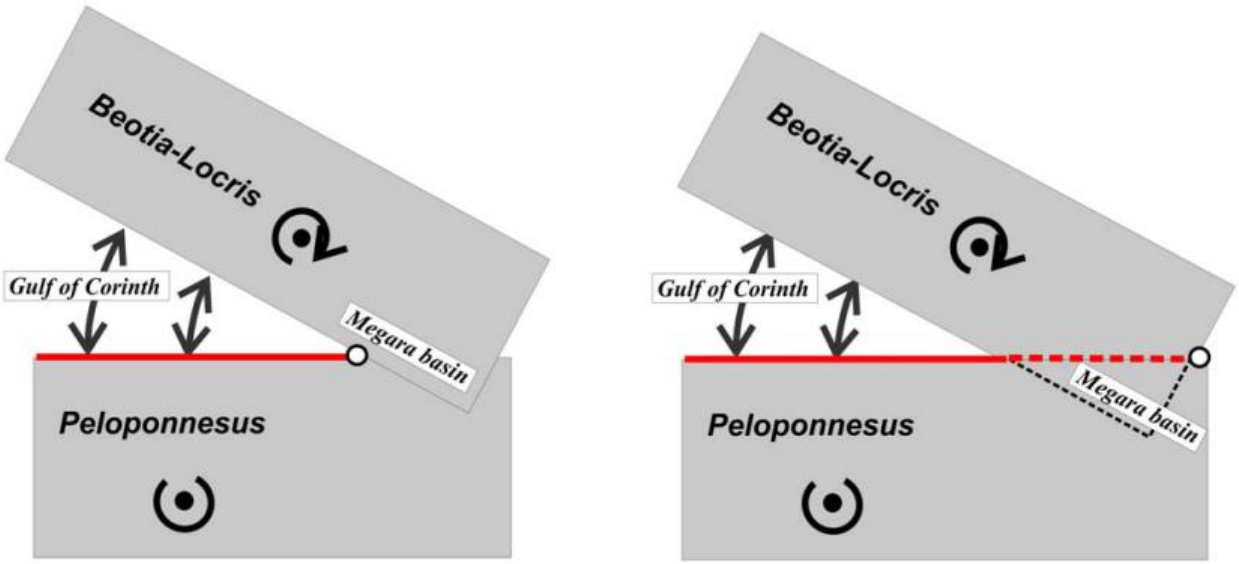

Figure 8: Schematic representation of the tectonic evolution of Central Greece. During the Plio-Pleistocene the Megara basin belonged to the CW rotating Boeotia-Locris block. As a consequence of the eastward migration of the E-W oriented normal fault system the Megara basin was incorporated into the Peloponnesus block, as demonstrated by GPS data.

Recent sedimentary processes in the Gulf of Corinth. 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 sediment samples from two ~1.1 m long, 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. Occasionally, these turbidites seem to have seismic origin. The sedimentation rates range between 2.57 mm/yr in the western part and 0.67 mm/yr in the eastern part.

Sources:

- Sergiou S., Becker A., Geraga M., Papatheodorou G., I. Iliopoulos and H. Papaefthymiou, 2017. Recent sedimentary processes in the western Gulf of Corinth, Greece: seismic and aseismic turbitides. Bulletin of the Geological Society of Greece, 50(1), 383-391. doi:http://dx.doi.org/10.12681/bgsg.11739.

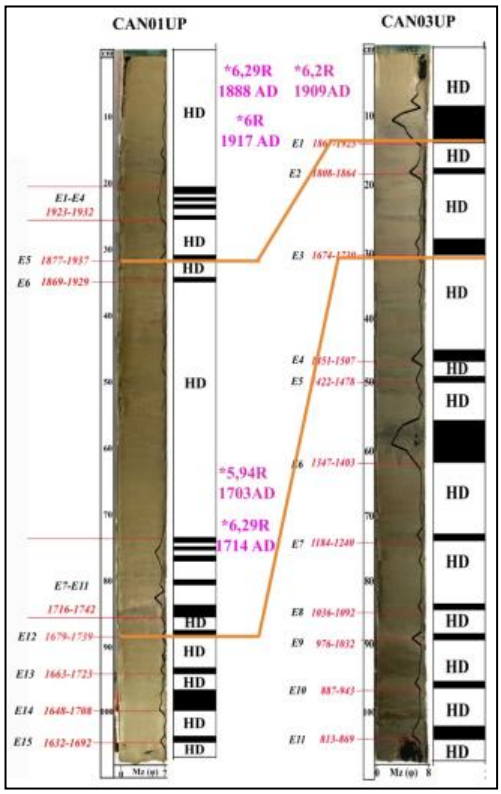

Fig. 1. Age model, turbidite events (E), hemipelagic sediments (HD) and the two stratigrafically correlated turbidite horizons in two sediment cores collected from Western Gulf of Corinth (Sergiou et al., 2017).

Field trip to the Helike fault

Athanassios Ganas
NOA, Institute of Geodynamics, Athens

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 3. Field view of the eastern Heliki fault. Source: helikeproject.gr

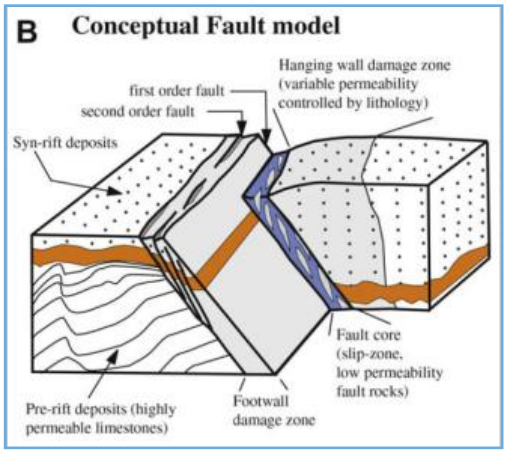

Figure 4. Fault scarp model of the Helike fault. Not to scale

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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).

Koukouvelas, I., Stamatopoulos, L., Katsonopoulou, D. and Pavlides S. 2001. A palaeoseismological and geoarchaeological investigation of the Eliki 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 Eliki 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

Visit of the ancient city of Helike

Dora Katsonopoulou
The Institute for Archaeology of Paros & the Cyclades, President
The Helike Project, Director

In the winter of 373/372 BC, a violent earthquake struck the southwest shore of the Gulf of Corinth and destroyed and submerged the Classical city of Helike. Helike was founded in the Mycenaean period by Ion, the leader of the Ionian race and became the capital of the Twelve Cities of ancient Achaea. The patron god of Helike, Poseidon Helikonios, god of the sea and the earthquakes, was worshipped in his famous pan-Hellenic sanctuary located in the area of Helike (Katsonopoulou 1999). In the 8th c. BC, Helike founded Sybaris in South Italy, the most famous Greek colony of the West. The city of Helike remained important in the Archaic and Classical periods until it was destroyed and lost by the earthquake of 373 BC, widely discussed by many ancient writers (Katsonopoulou 2005a). Few decades before its destruction, Helike struck her own coinage. Three bronze coins of Helike are known --two in the Berlin Museum, a third recently auctioned in Vienna--, showing on the obverse a fine Classical head of Poseidon and on the reverse the trident flanked by two dolphins in heraldic position.

Eratosthenes, a philosopher and mathematician of the 3rd c. BC, visited the area of Helike about 150 years after its destruction and talked with ferrymen who recounted to him the story of the bronze statue of Poseidon submerged in the poros. The term poros generally interpreted as indicating the Corinthian Gulf, was rightly re-interpreted by Katsonopoulou (1995) as referring to a lagoon formed in the area of Helike following the seismic event of 373 BC. The lagoon which Eratosthenes saw in the 3rd c. BC, had become partly dry land when the traveler Pausanias visited the site in the 2nd c. AD. In the remaining part of the lagoon, however, one could still see submerged ruins of the city, as Pausanias reports. The mention of submerged ruins in the area of Helike persists until the Middle Byzantine period (9th-10th c. AD). Today, the entire area of the ancient lagoon is completely covered under river-borne sediments.

The discovery of the lost city of Helike has been pursued by many archaeologists and researchers in the past. The most insistent attempt was made by the late Spyridon Marinatos between 1950-1973. Marinatos (1960) has stated that "with the excavation of Helice a great new light would be shed on both public and private life during the best period of Classical Greece".

Fifteen years after the end of the earlier inconclusive attempts, Dora Katsonopoulou (archaeologist) and Steven Soter (physicist) launched the Helike Project to locate and reveal the site of ancient Helike. First in 1988, an underwater sonar survey was carried out in collaboration with the oceanographer Paul Kronfield. The results showed no evidence of ruins of a city underwater. Consequently, since 1991 the search was shifted on land by using bore hole drilling (Soter & Katsonopoulou 1999). Since 1994 we employed geophysical surveys in collaboration with the University of Patras, the Radar Solutions International, the University of Oklahoma and the University of Thessaloniki (Soter & Katsonopoulou 2005). In 1995, excavations in the Klonis Field in Rizomylos brought to light a large Roman building, the first ever found in the coastal plain of Helike since the earliest research began in the middle of the 20th century (Katsonopoulou 1998).

Systematic excavations of the Helike Project started in 2000. The first trial trenches opened on the basis of evidence from topographical studies, bore holes and geophysical surveys, revealed buried remains in various locations along the plain dated on the basis of the excavation finds to the Early Bronze Age, Late Bronze Age, Geometric, Classical, Hellenistic, Roman and Byzantine periods (Katsonopoulou 2005b and report below).

Continuation of our excavations between 2001-2011 resulted in a number of important discoveries in the Helike area.

The Early Helladic settlement. In the middle of our area of investigations, in the contemporary village of Rizomylos, we brought to light the remains of a well-preserved coastal EH settlement, the first ever found in Achaia. Large rectilinear buildings flanking the sides of cobbled streets, including a rare type of building known as "corridor house", came to light preserving their rich contents, especially the pottery, intact. The assemblage of associated pottery includes a variety of shapes, such as two-handled bowls (kraters), pedestal-footed cups, cooking pots, narrow-necked jars, bass bowls, rim-handled and neck-handled tankards, flat-based cups, jugs, pyxides, wide-mouthed jars, one-handled and two-handled cups, and large pithoi decorated with finger-impressed, rope and overlapping disk bands decorations. Decorated pottery includes solidly painted and pattern-painted decoration Dark-on-Light with intersecting horizontal and vertical lines, zigzag, cross-hatching and paneled patterns. Incised "potter's marks" were found on pottery fragments. Remains of seeds were found inside some of the recovered vases. Among the rich pottery assemblage, we also discovered a rare drinking cup, a depas amphikypellon, with an engraved symbol above its base. For the unique Helike Early Helladic depas cup, see Forsen J. (2010). Our EH finds also include pointed bone tools, stone tools, objects of obsidian and flint for cutting and scraping activities, and terracotta objects, such as spindle whorls and spools. We also collected a great number of sea shells and animal bones. New outstanding walls, 0.80 m wide, preserved to the impressive height of 1.10 m came to light with the 2011 excavations at the EH site in Rizomylos. Recovered pottery was once again amazingly abundant including complete vases. Other finds from the excavated rooms include terracotta spindle whorls, stone tools, chipped stone artifacts, sea shells and animal bones. Among the most significant new finds from the EH settlement in 2011, we note an exceptional architectural feature found in one of the excavated rooms. It is a thick-walled, pi-shaped clay structure, 0.70 m high, found in a room where many storage vessels were discovered arranged in clusters around and near it suggesting that it might have served as a storage closet of some kind.