



# CORFU SUMMER INSTITUTE

22ND HELLENIC SCHOOL AND WORKSHOPS ON ELEMENTARY PARTICLE PHYSICS AND GRAVITY, CORFU, GREECE

2022

## MARE INCOGNITUM

A multidisciplinary approach to the marine geohazards threatening the Ionian Islands

Dr Dimitris Sakellariou & the MARE INOGNITUM consortium





**Hellenic Centre  
for Marine Research**



**Inst. Geodynamics  
National Observatory Athens**



**Ionian University**



**Dep. Geology  
Patras University**



**Dep. Geology &  
Geoenvironment, National  
Kapodistrian Univ. Athens**

*Εθνικόν και Καποδιστριακόν  
Πανεπιστήμιον Αθηνών*



**Ionian Islands Region**



**Earthquake Planning &  
Protection Organization**



**National Technical  
University Athens**



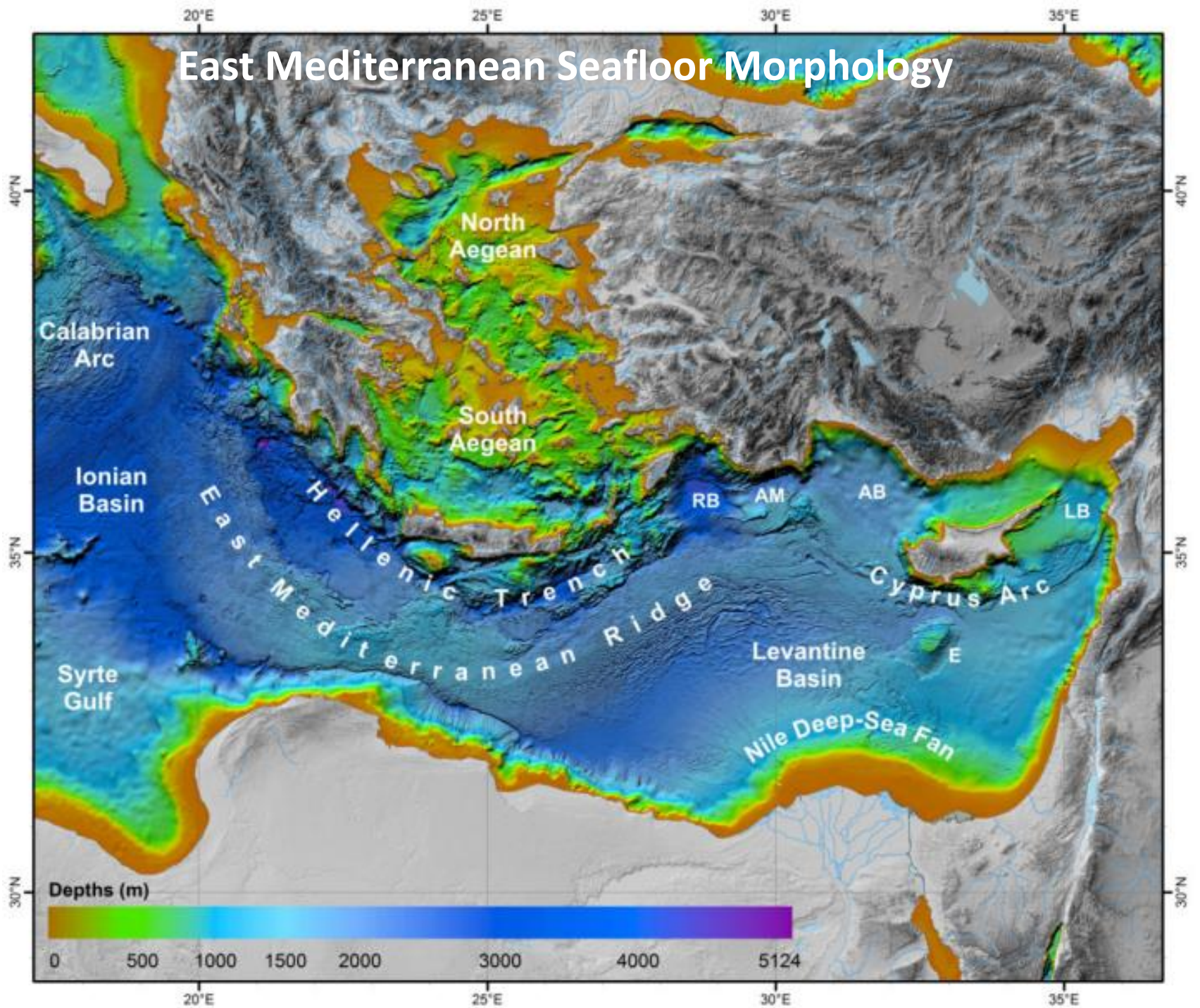
**Hydrographic Service**



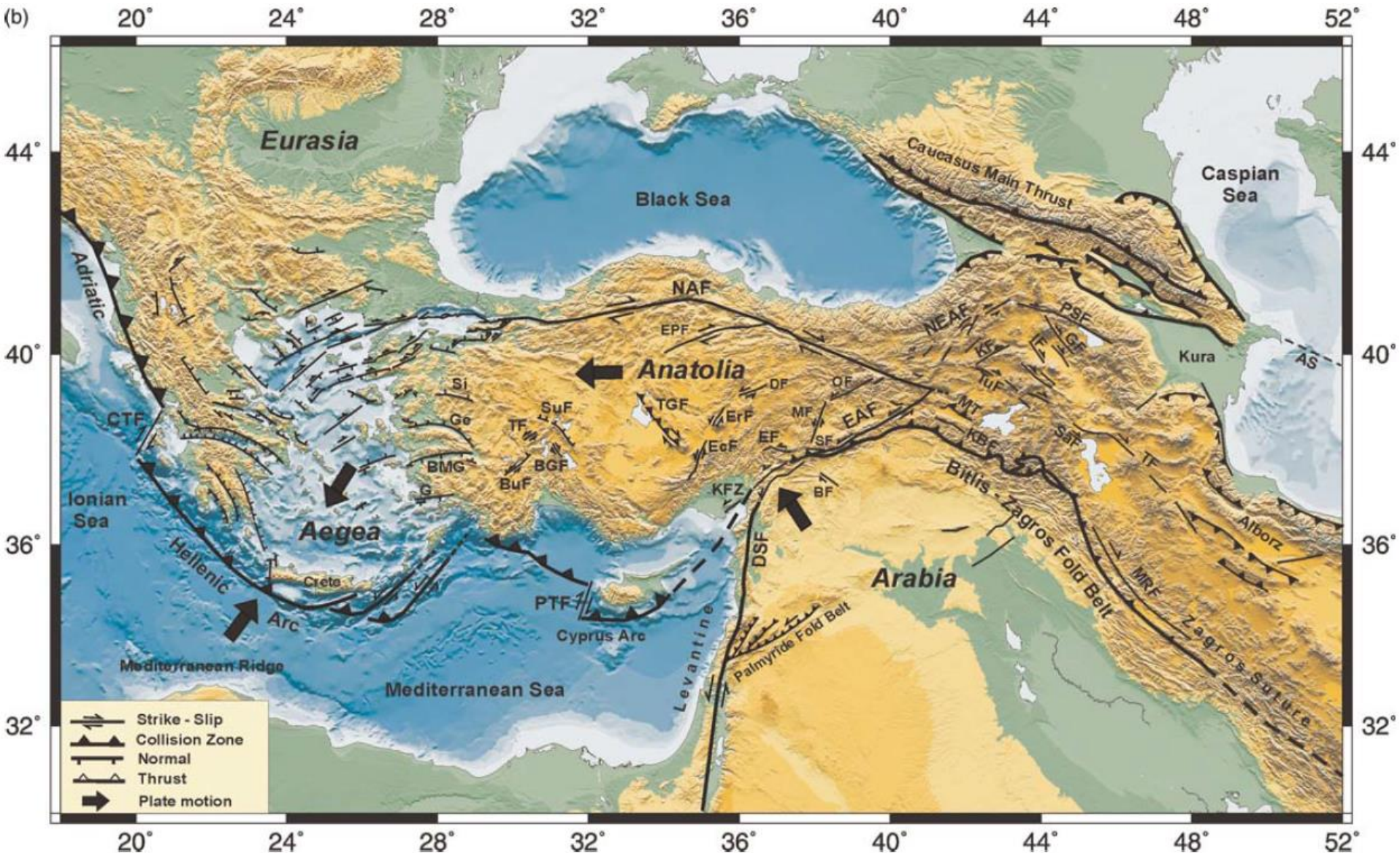
**ΓΕΩΠΟΝΙΚΟ  
ΠΑΝΕΠΙΣΤΗΜΙΟ  
ΑΘΗΝΩΝ**

**Agricultural Univ. Athens**

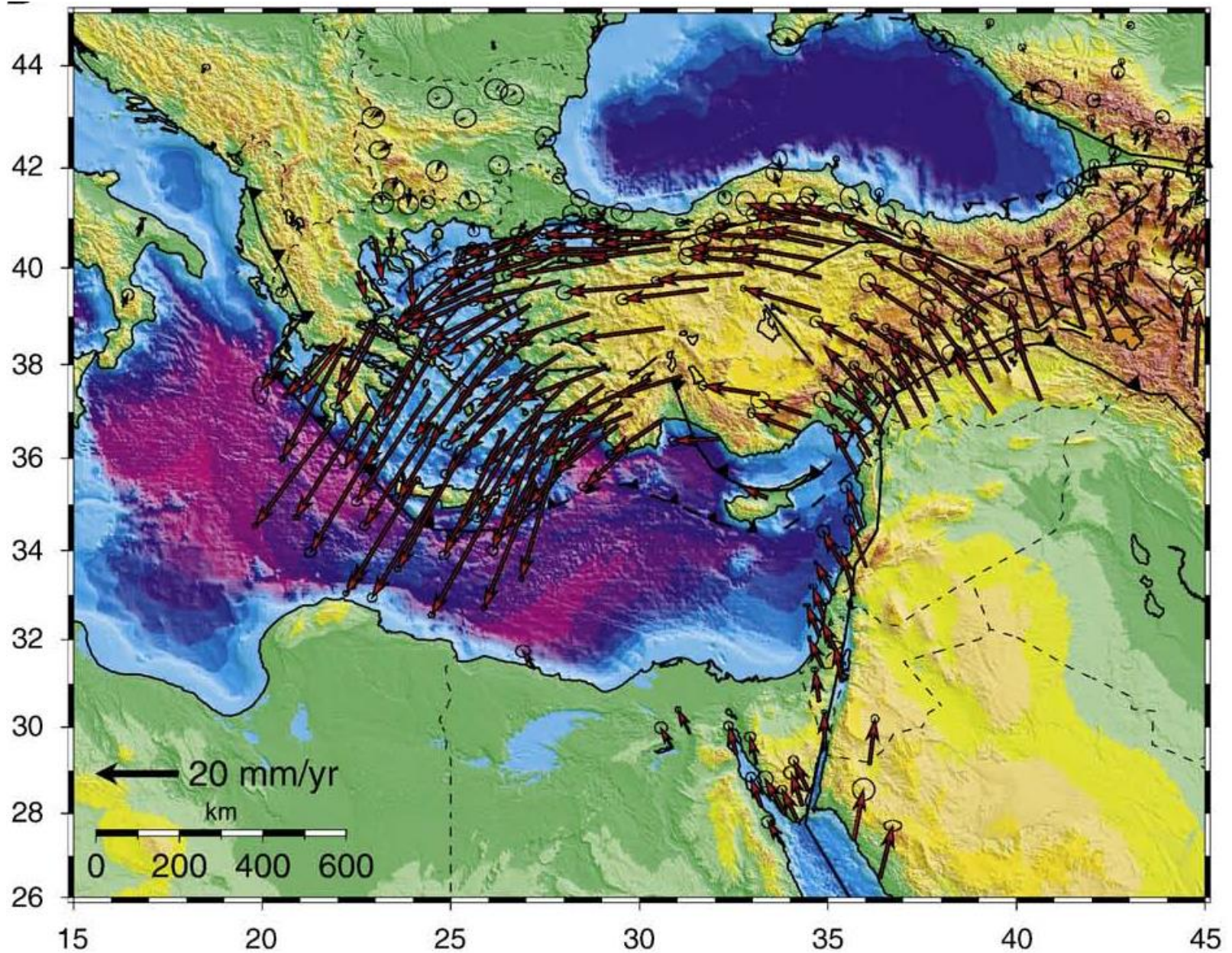
# East Mediterranean Seafloor Morphology



# East Mediterranean Seismicity & Geotectonic Features



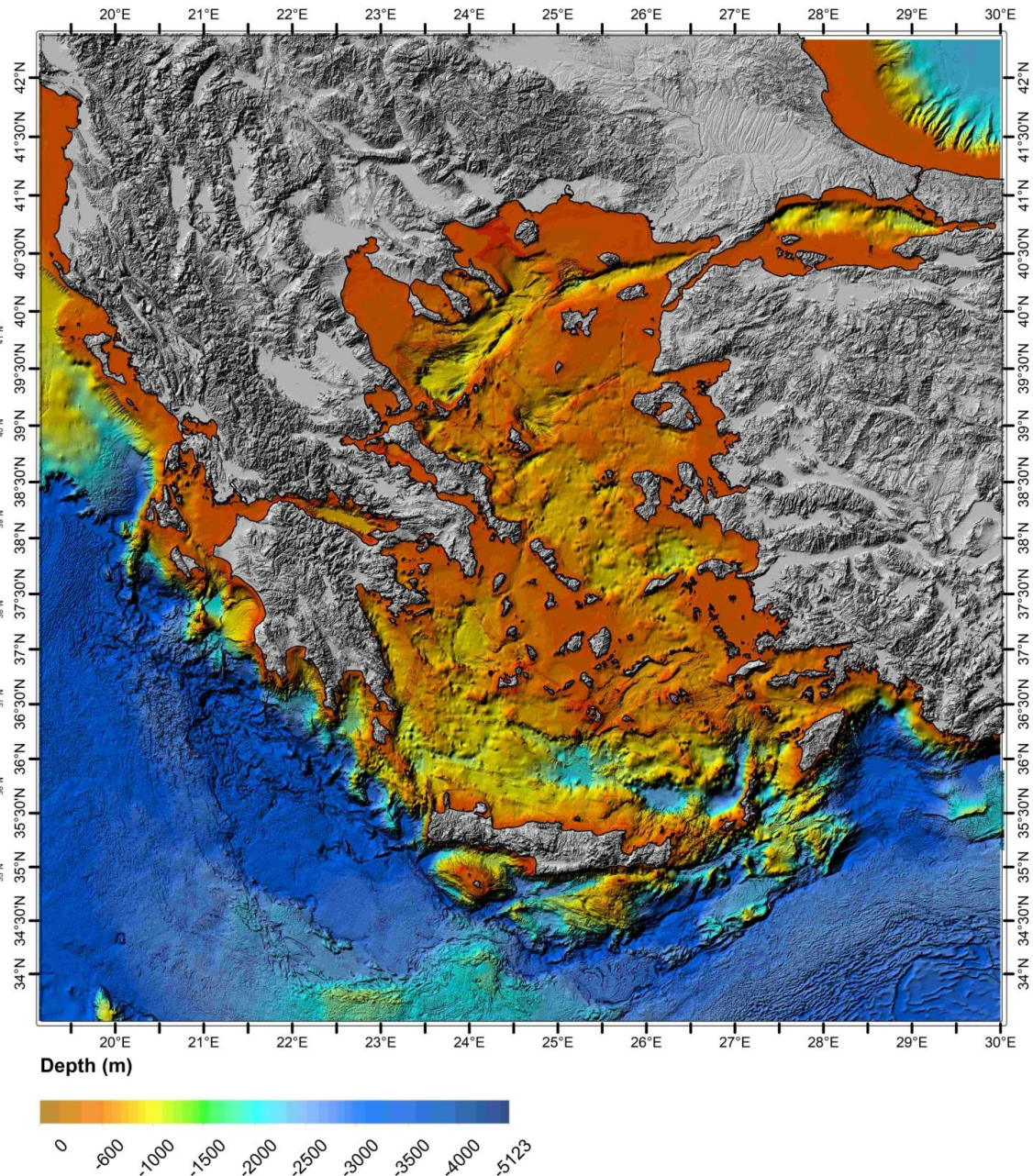
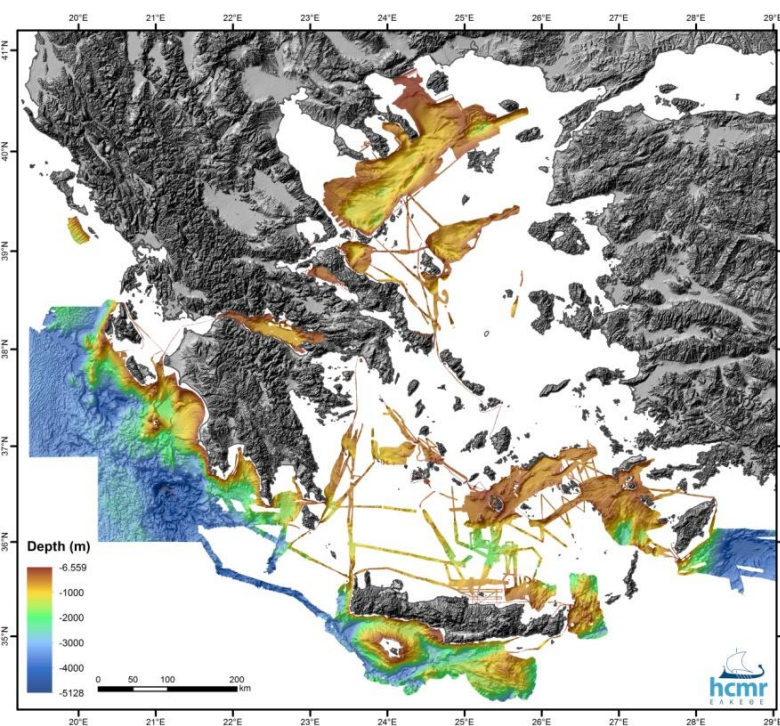
# East Mediterranean Kinematics



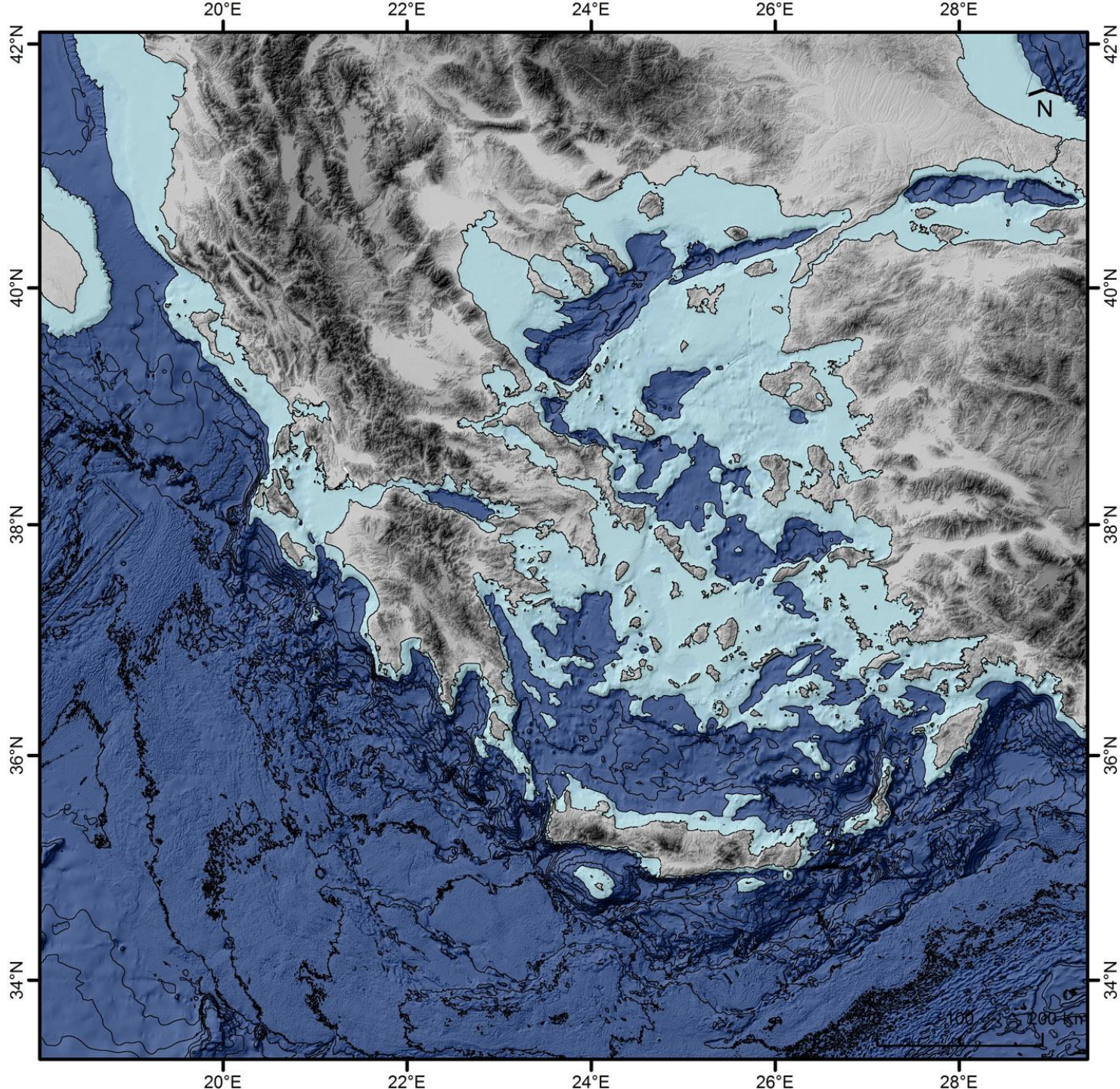
# Morphology of the seafloor of the Greek Seas

**EMODnet Bathymetry 2021,  
100 m resolution**

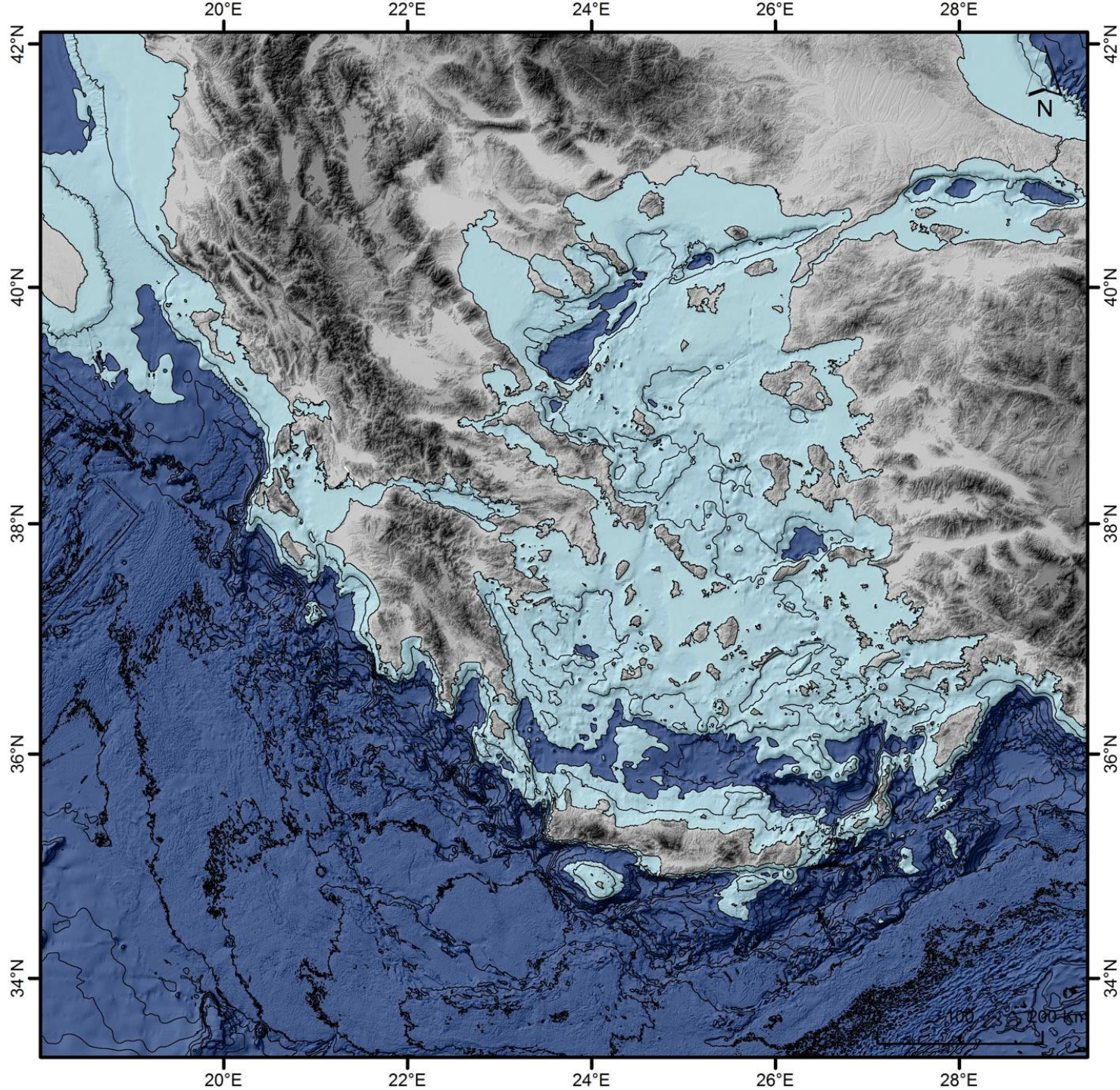
**HCMR swath bathymetry,  
50 m resolution**



**> 500 m  
depth**

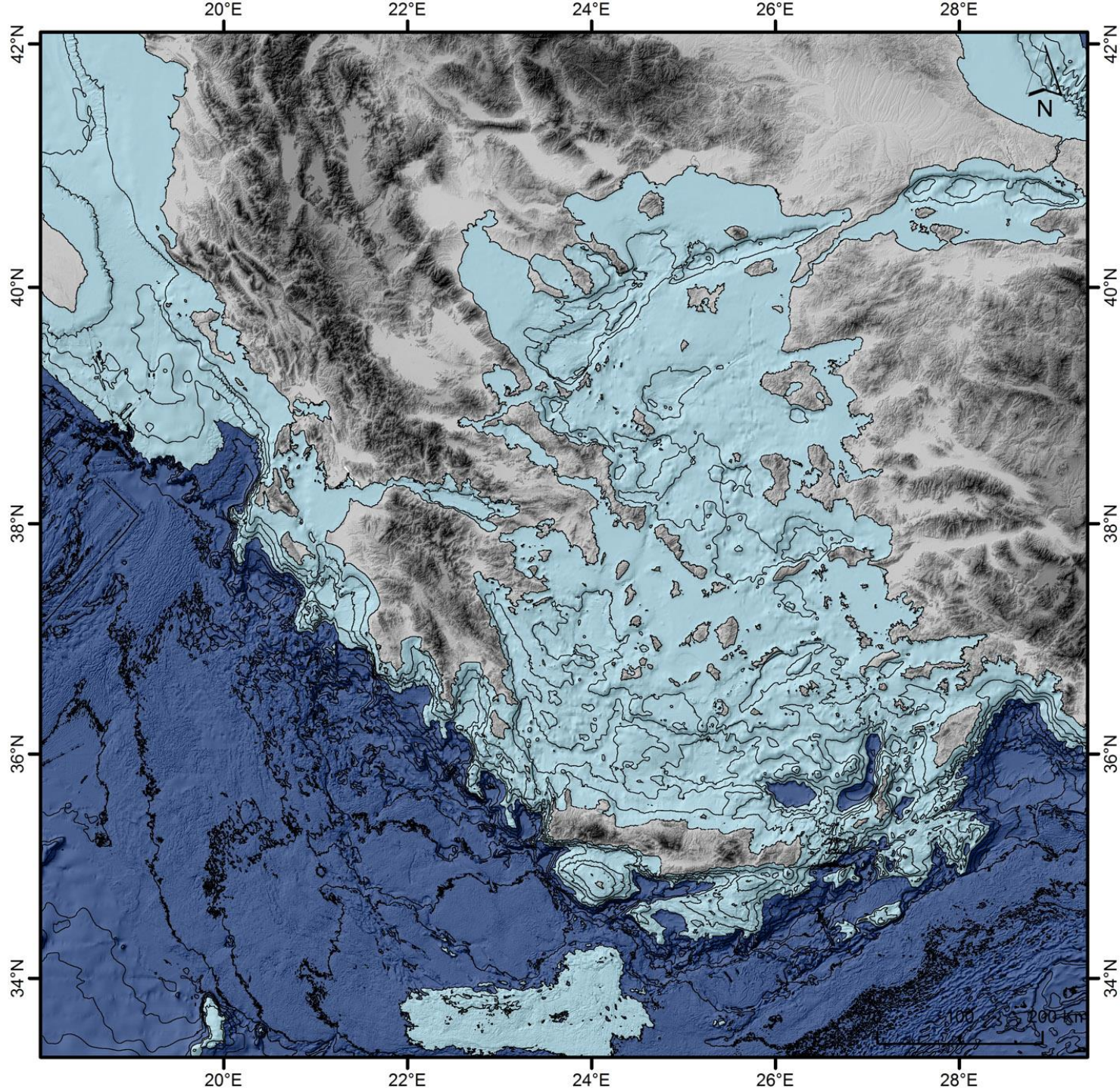


**> 1000 m  
depth**

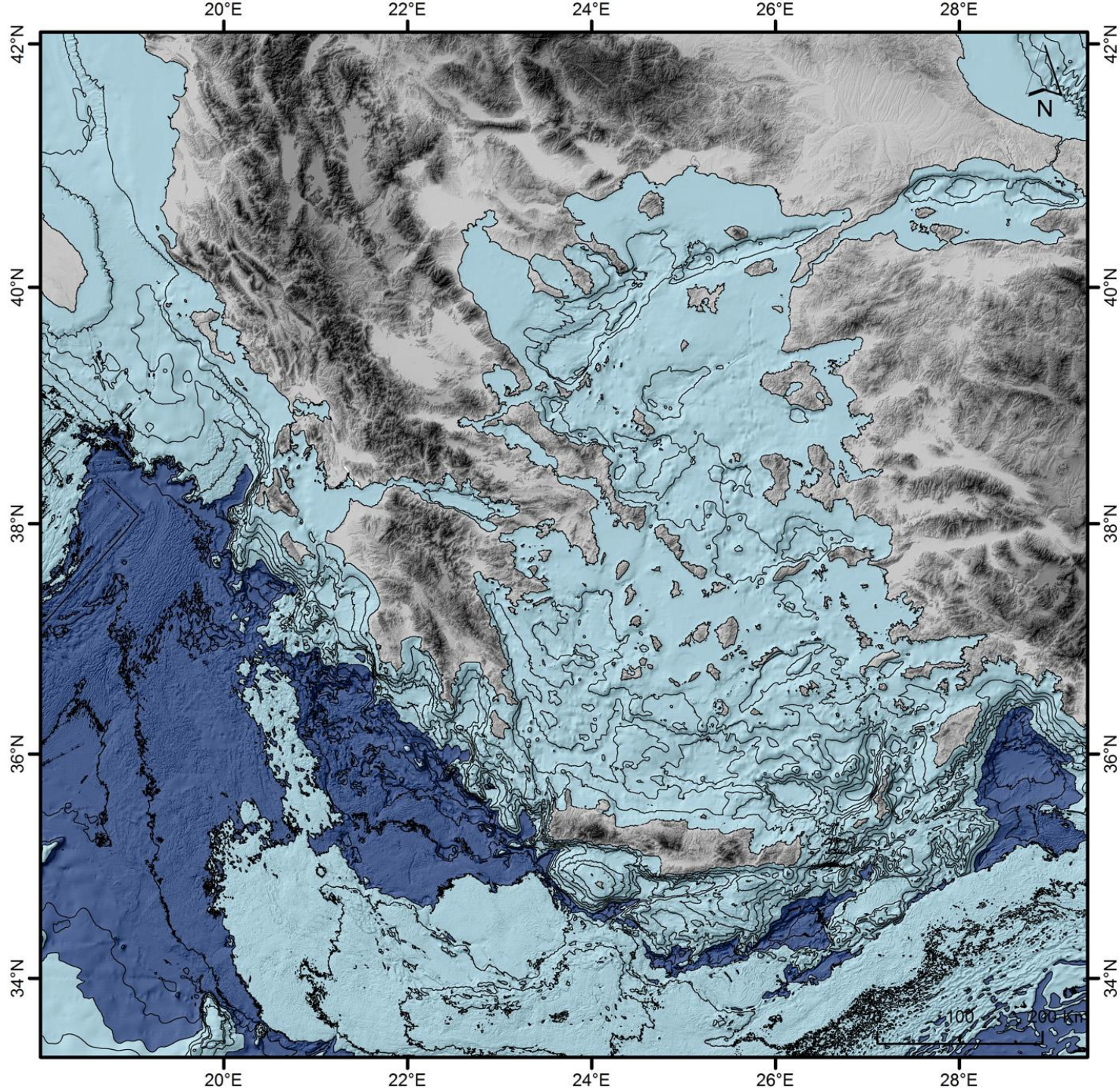




**> 2000 m  
depth**

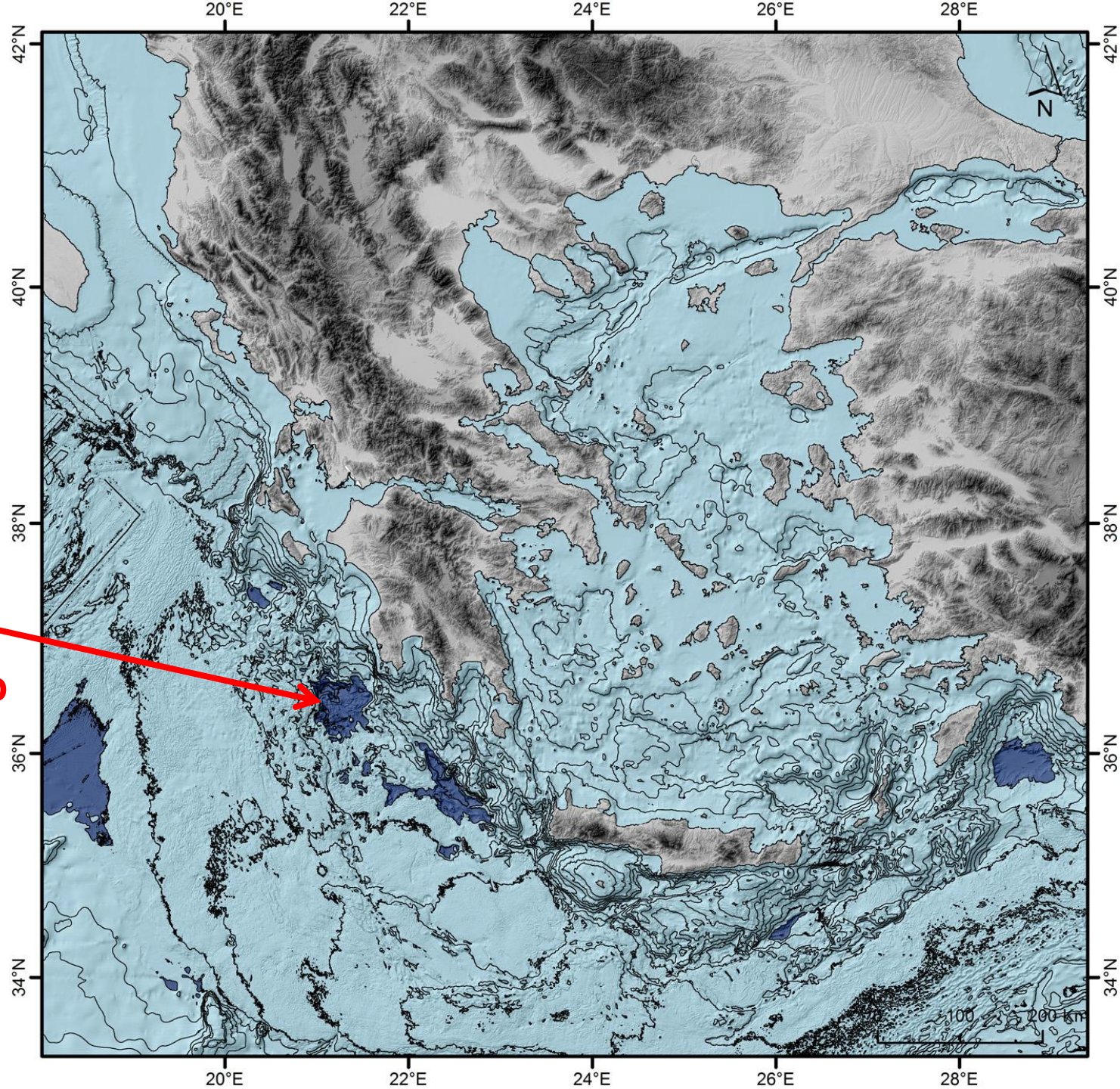


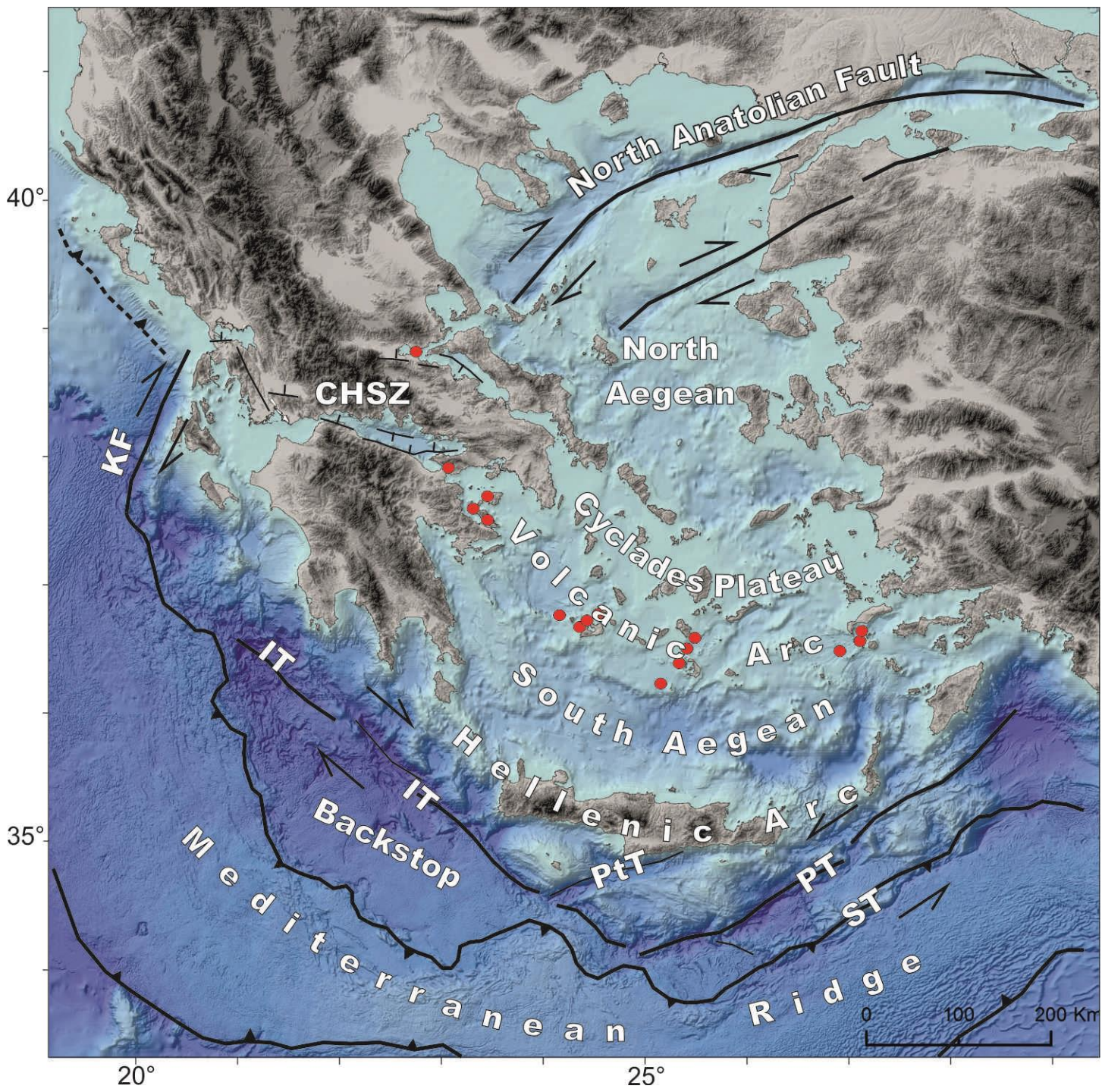
**> 3000 m  
depth**



**> 4000 m  
depth**

**$\pm 5130$  m  
Vavilon Deep  
Oinousses Deep  
Φρέαρ των  
Οινουσσών**





# Seismicity and fault-plane solutions

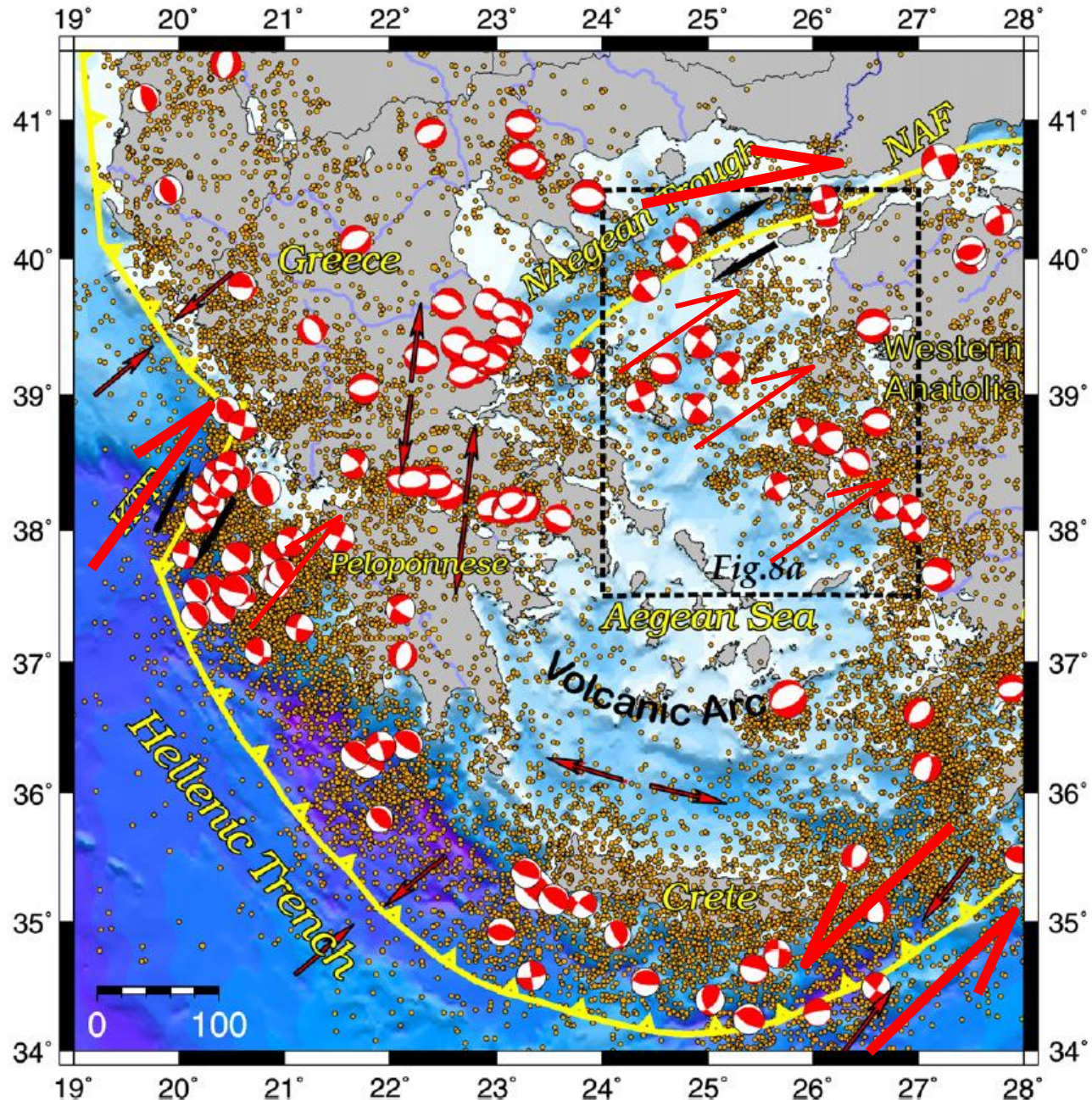
Along the Hellenic Trench:  
low angle thrust and steeper  
reverse faulting

Mainland Greece, the back-  
arc Aegean area and W.  
Anatolia: ~E–W normal  
faulting

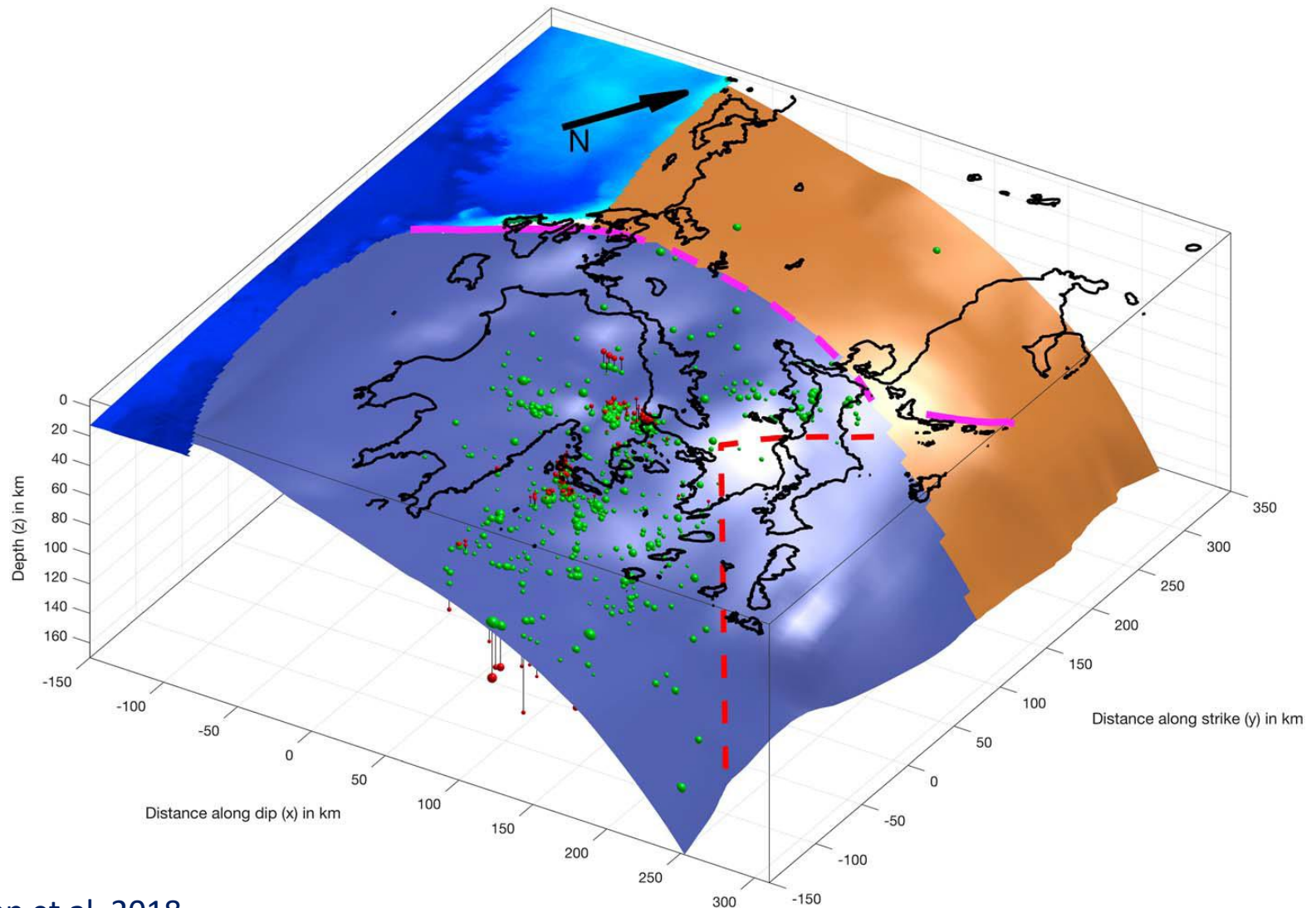
Hellenic Mountain Range:  
~N–S normal faulting

N. Aegean Sea, Ionian  
Islands and W. Peloponnese:  
strike–slip faulting.

Chatzipetros et al, 2013



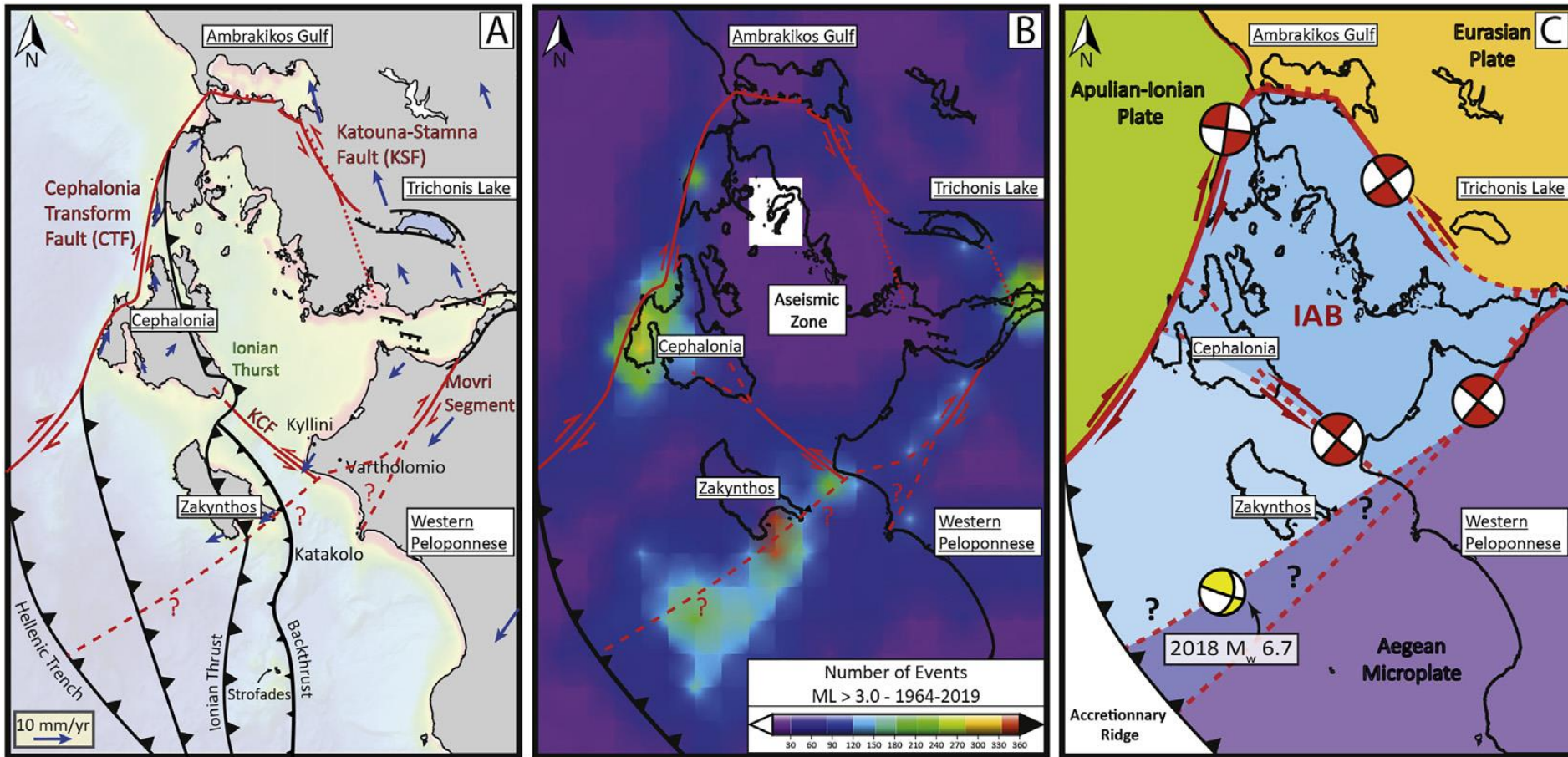
# Three-dimensional block model of the subduction



Halpaap et al. 2018

The subducting oceanic crust of the Ionian plate is dark blue, while the subducting continental crust of the Adriatic plate is in brown. The magenta solid lines mark large strike-slip faults, including the Kefalonia Transform Fault and the western tip of the North Anatolian Fault.

# Tectonic model of Central Ionian



Haddad et al. 2020:

**Panel A** points out the main fault systems characterizing the area. GPS velocities are plotted relative to a fixed Akarnania (west of the KSF) and are taken from Pérouse et al. (2017).

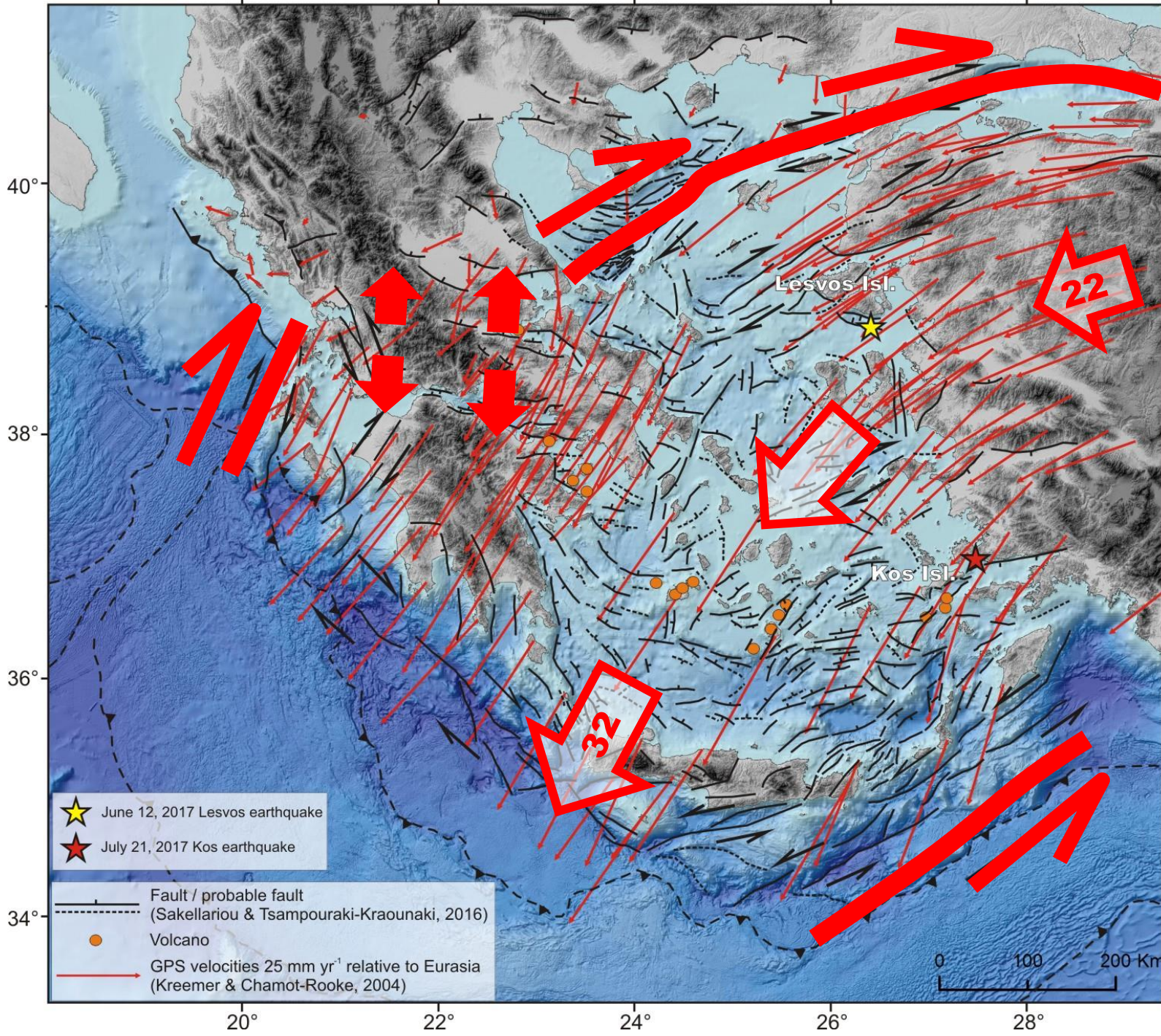
**Panel B** shows the density of events (calculated on a 0.1×0.1 degrees grid) recorded by the seismic network of the National Observatory of Athens within the studied area since 1964.

**Panel C** presents our model of the IAB built by combining seismic and literature data. The model points out the four seismically active strike-slip fault systems bounding the IAB.

# Offshore Faults & GPS vectors

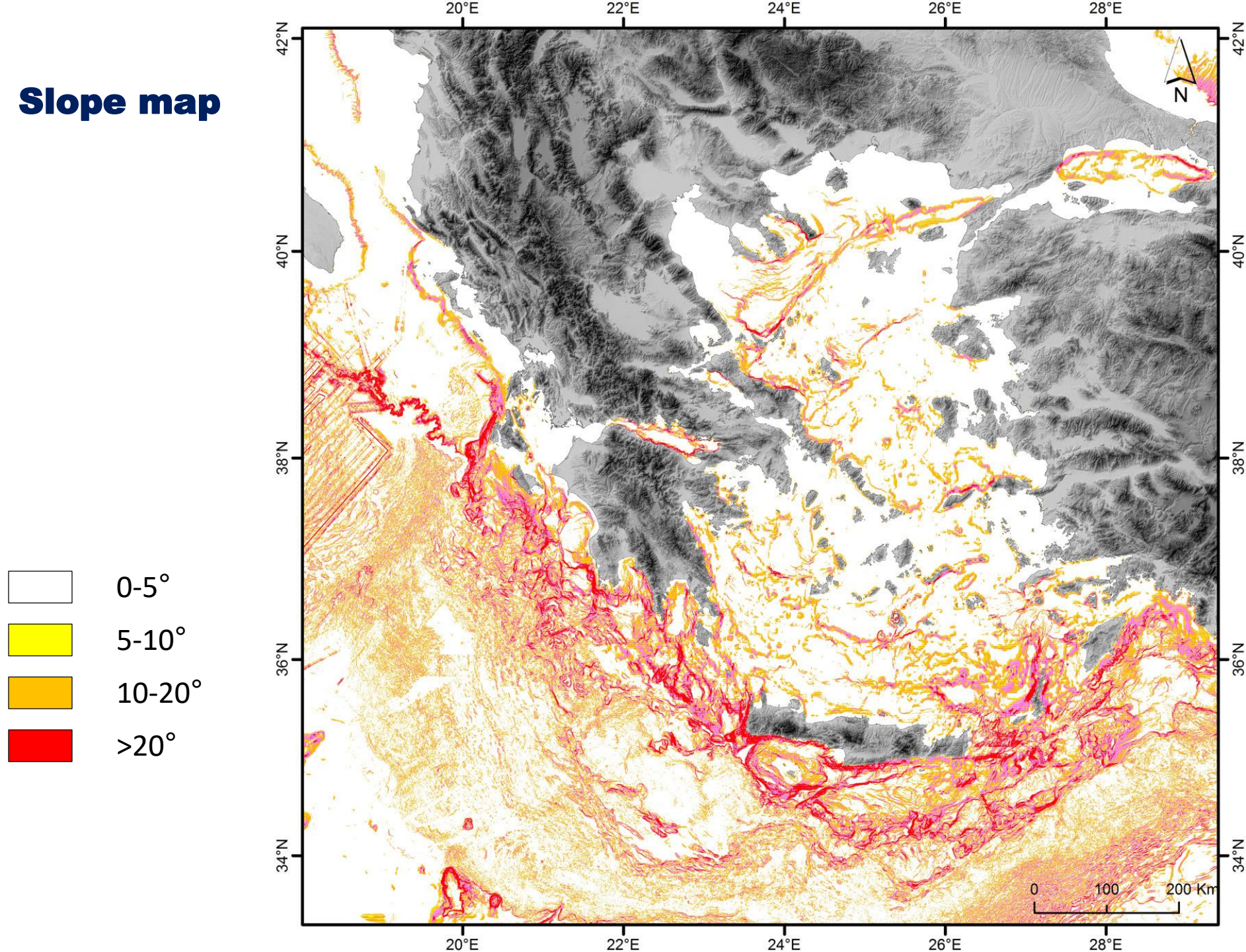
The deformation  
is confined  
between the NE  
(NAF-KF)  
and the Southern  
(Pliny-Strabo)  
tectonic  
boundaries

Sakellariou &  
Tsampouraki-  
Kraounaki, 2018





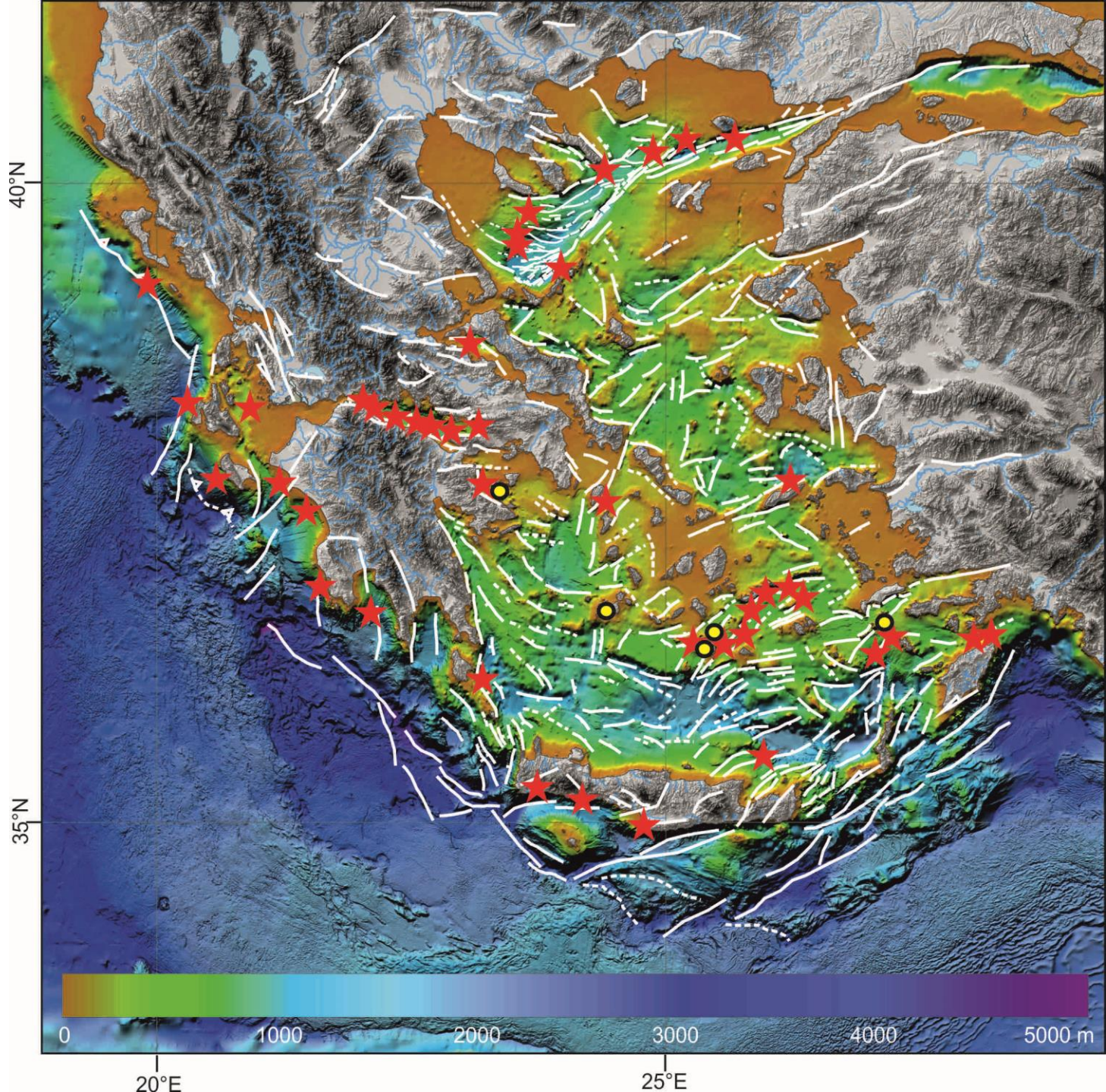
# Slope map



**Slope failures**

**Submarine  
landslides**

**Mass transport  
deposits**

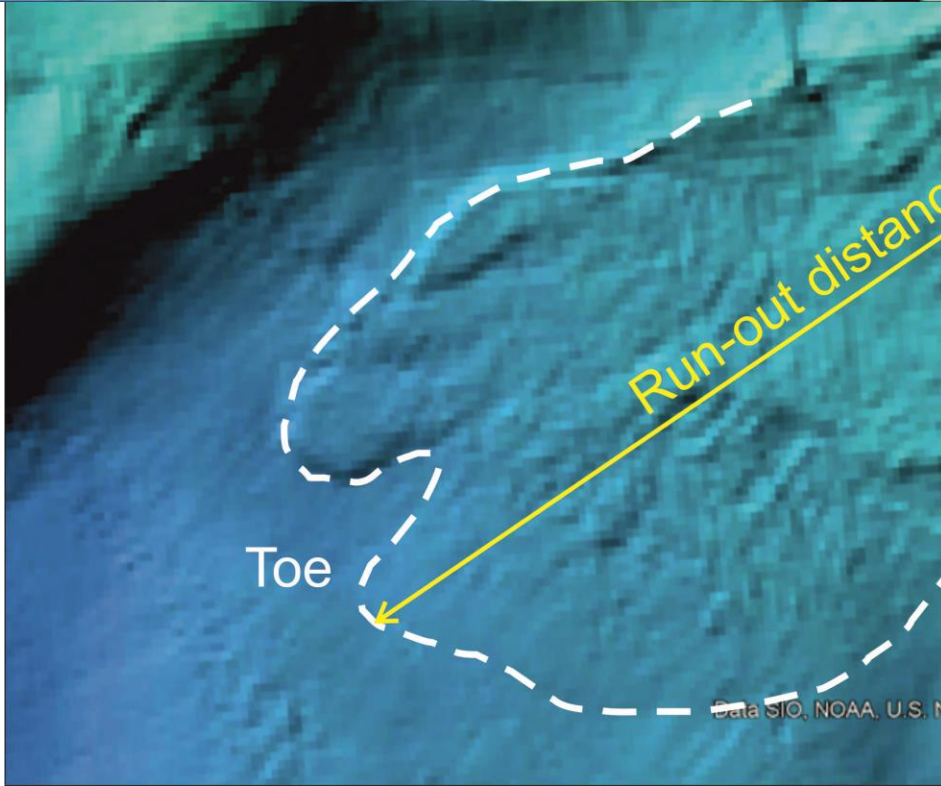
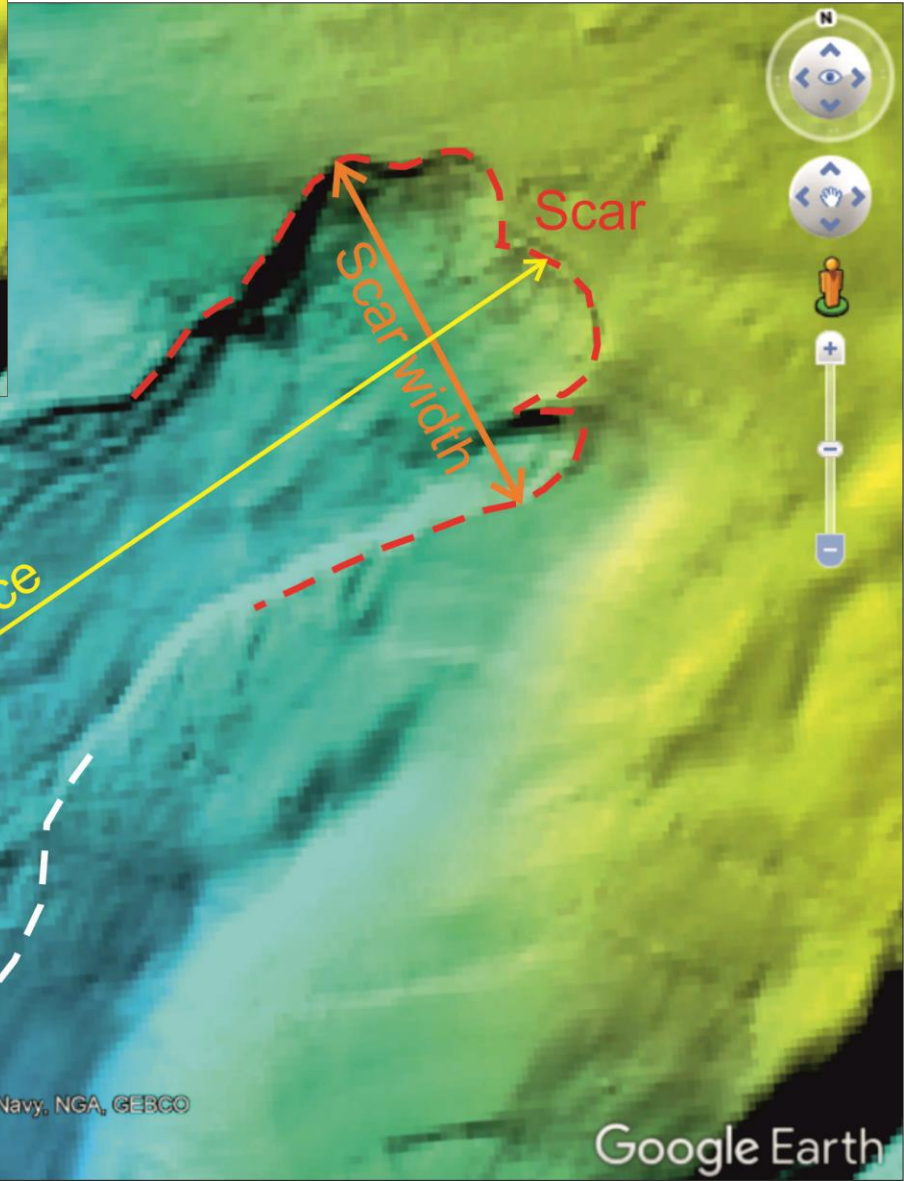
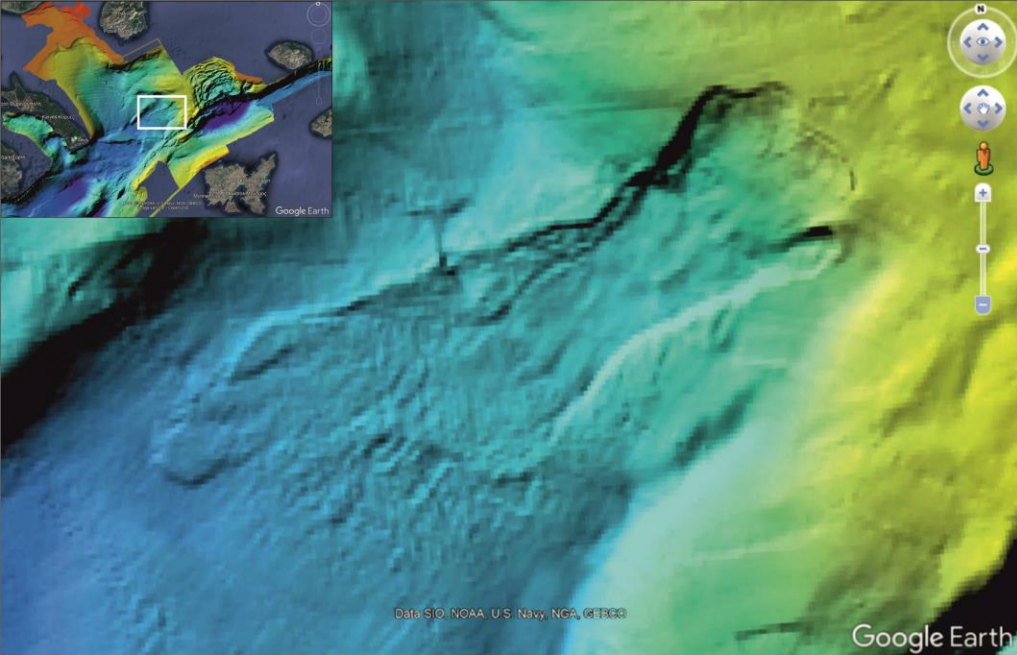


# Athos landslide

Scar Width: 5 km

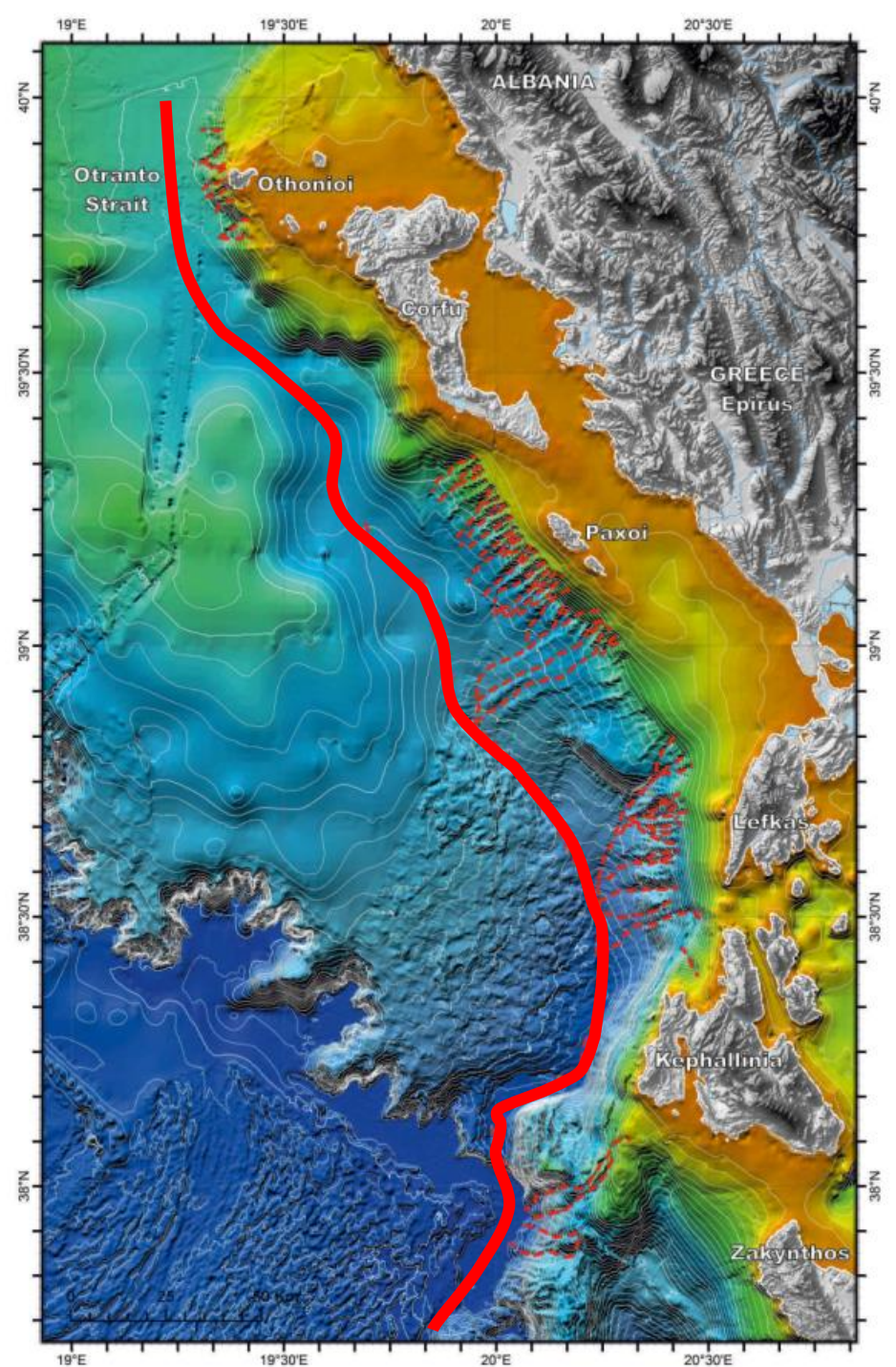
Run-out Distance: 24 km

Volume: 3.8 km<sup>3</sup>

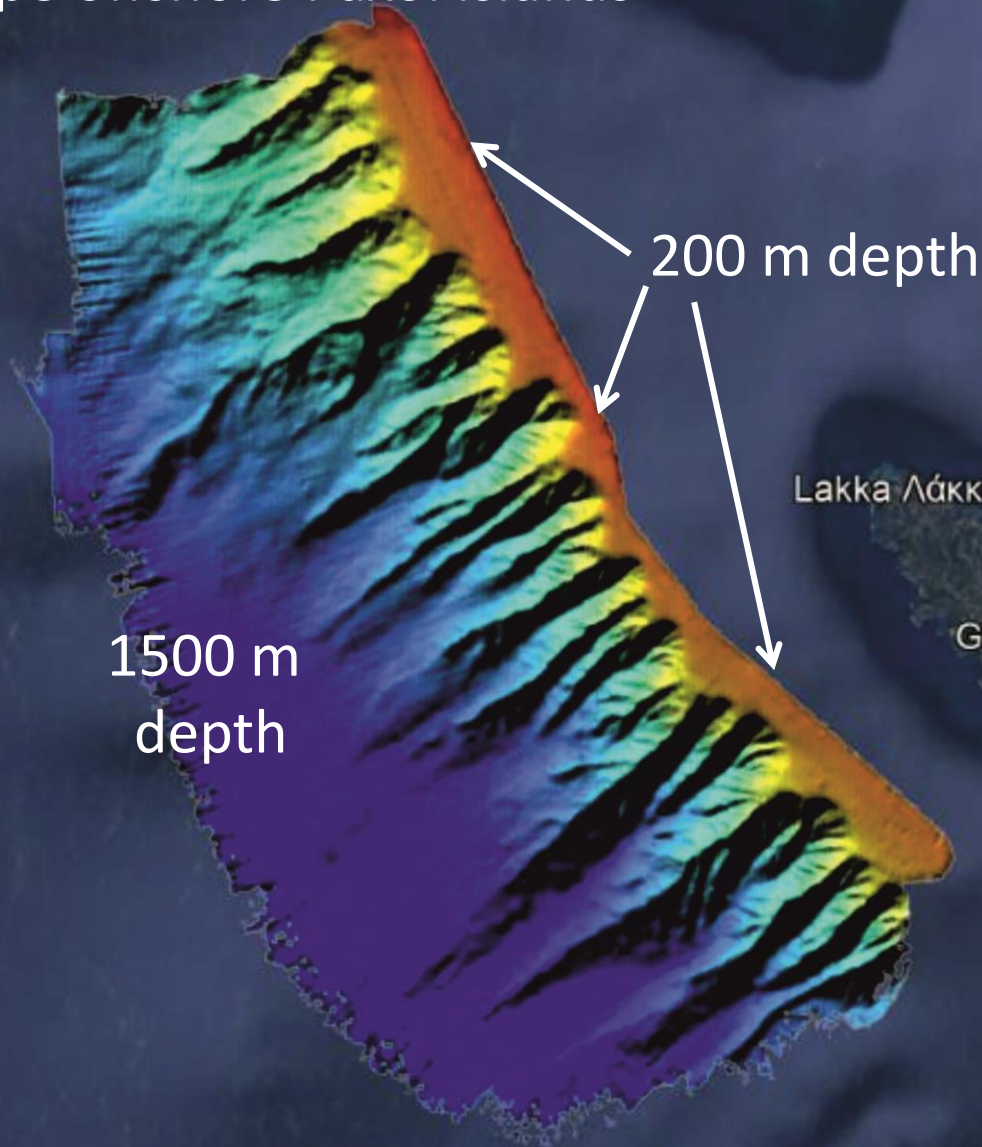


# Submarine canyon of Northern Ionian

The longest submarine canyon is located at the NW of Corfu and exceeds 150 km in length!!



# Submarine canyons & valleys on the slope offshore Paxoi Islands



Kavos Κάβος

Perdika Πέρδικα

Karavostasi Καραβοστάσι

200 m depth

1500 m  
depth

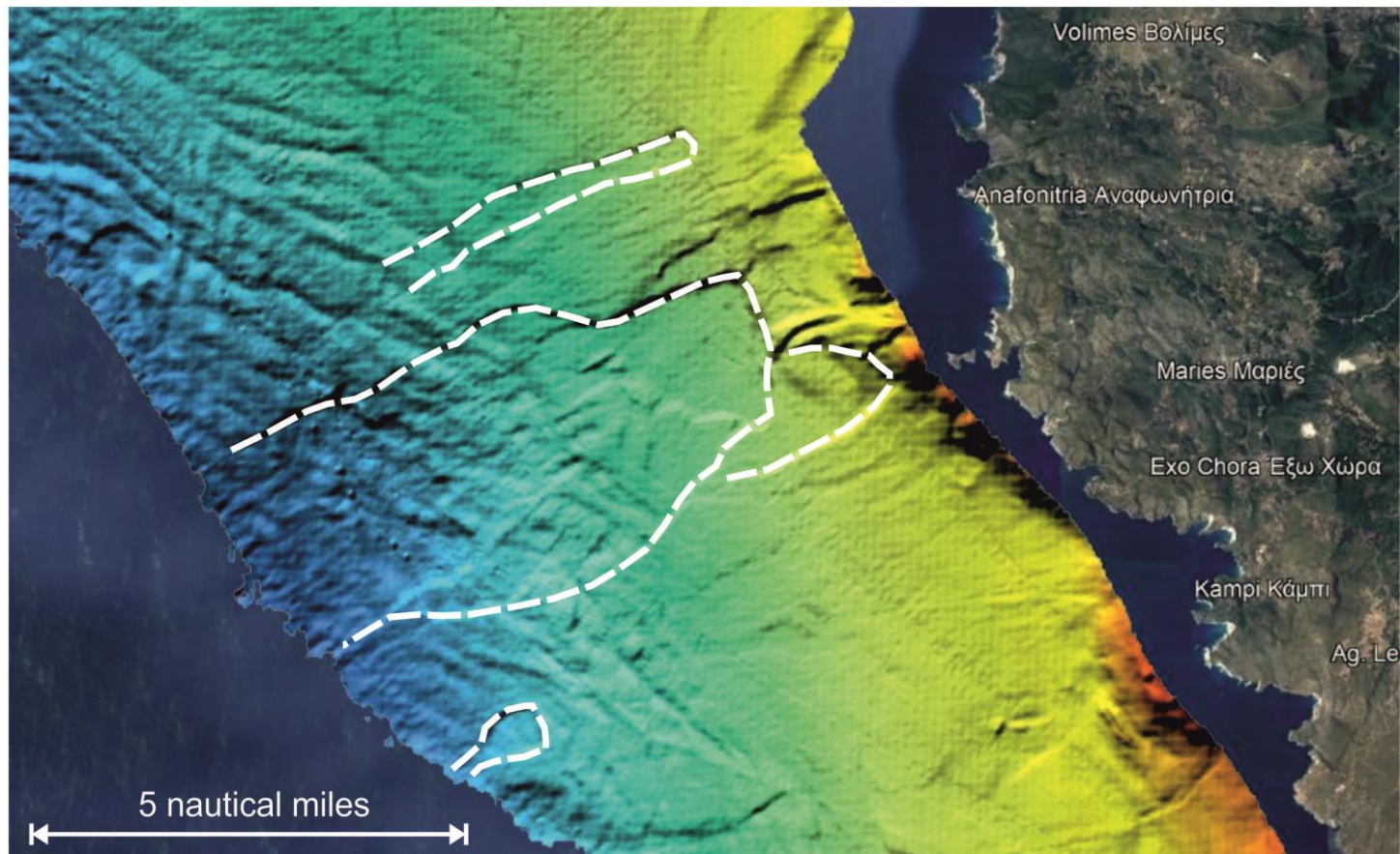
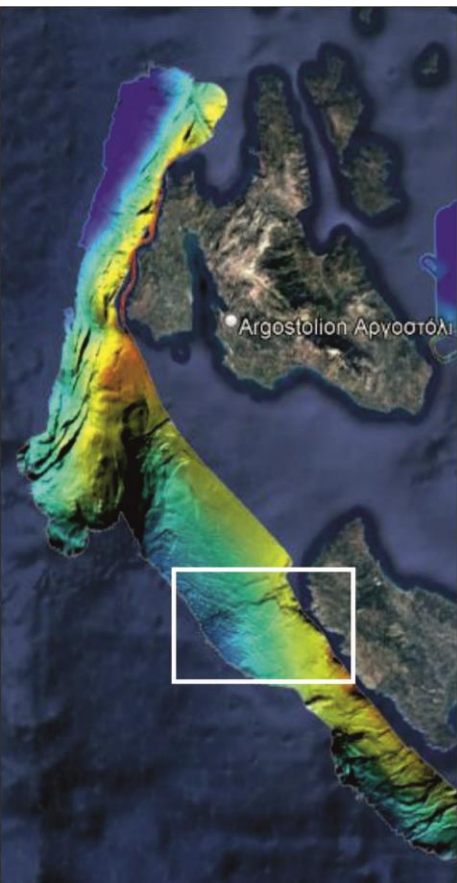
Lakka Λάκκα

Gaios Γάιος

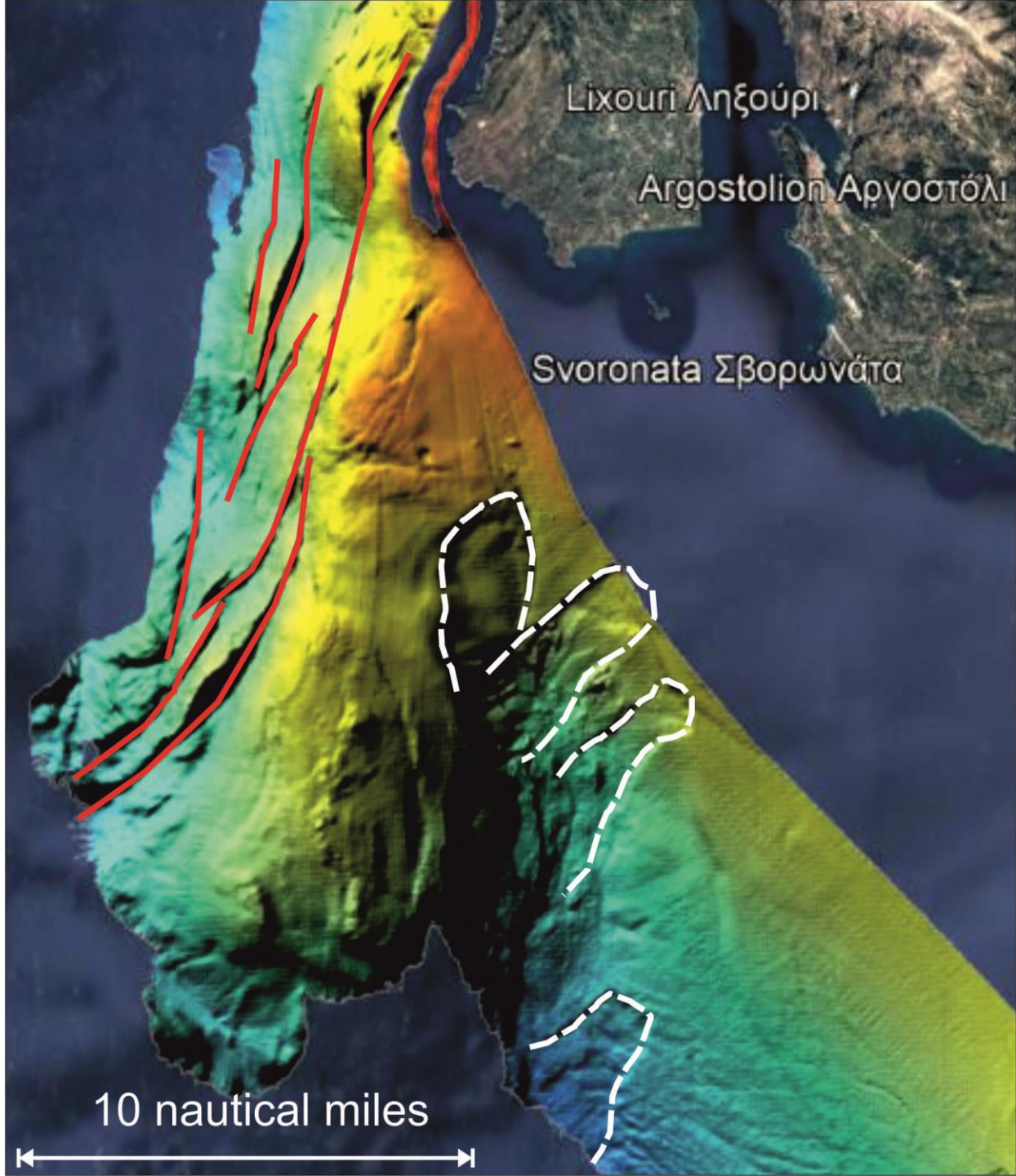
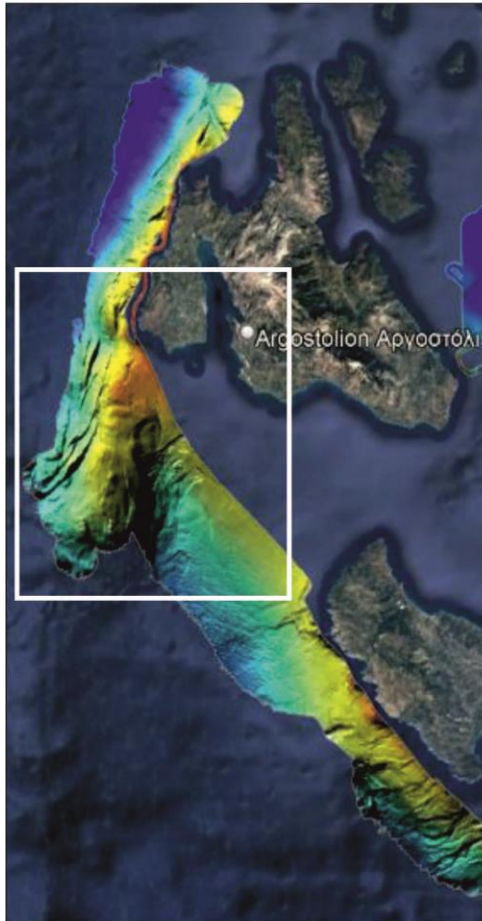
10 nautical miles



# Zakynthos landslides



# Submarine landslides and faults off SW Kephallinia

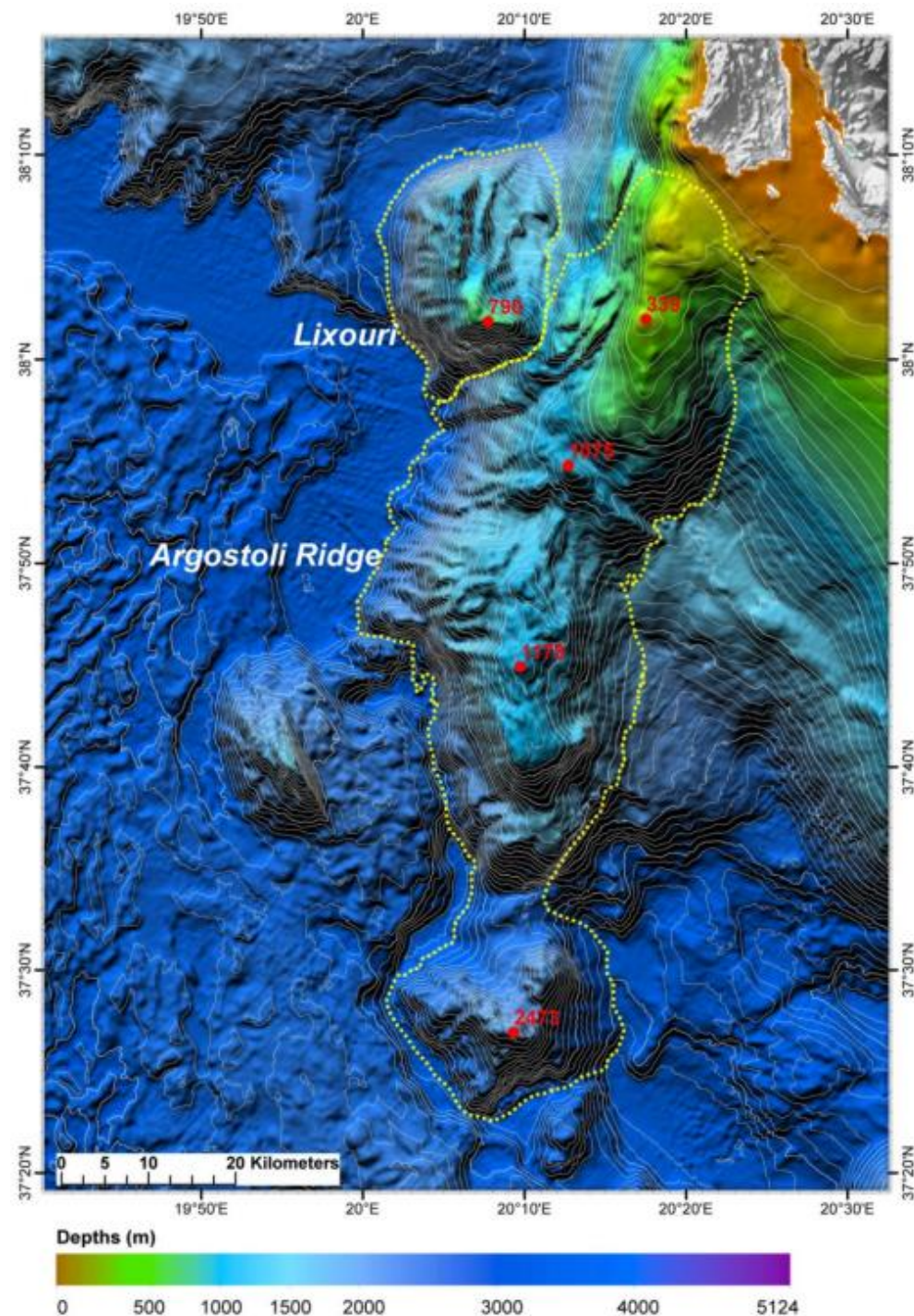


# Seamounts & Ridges of the Ionian Sea

## Argostoli Ridge

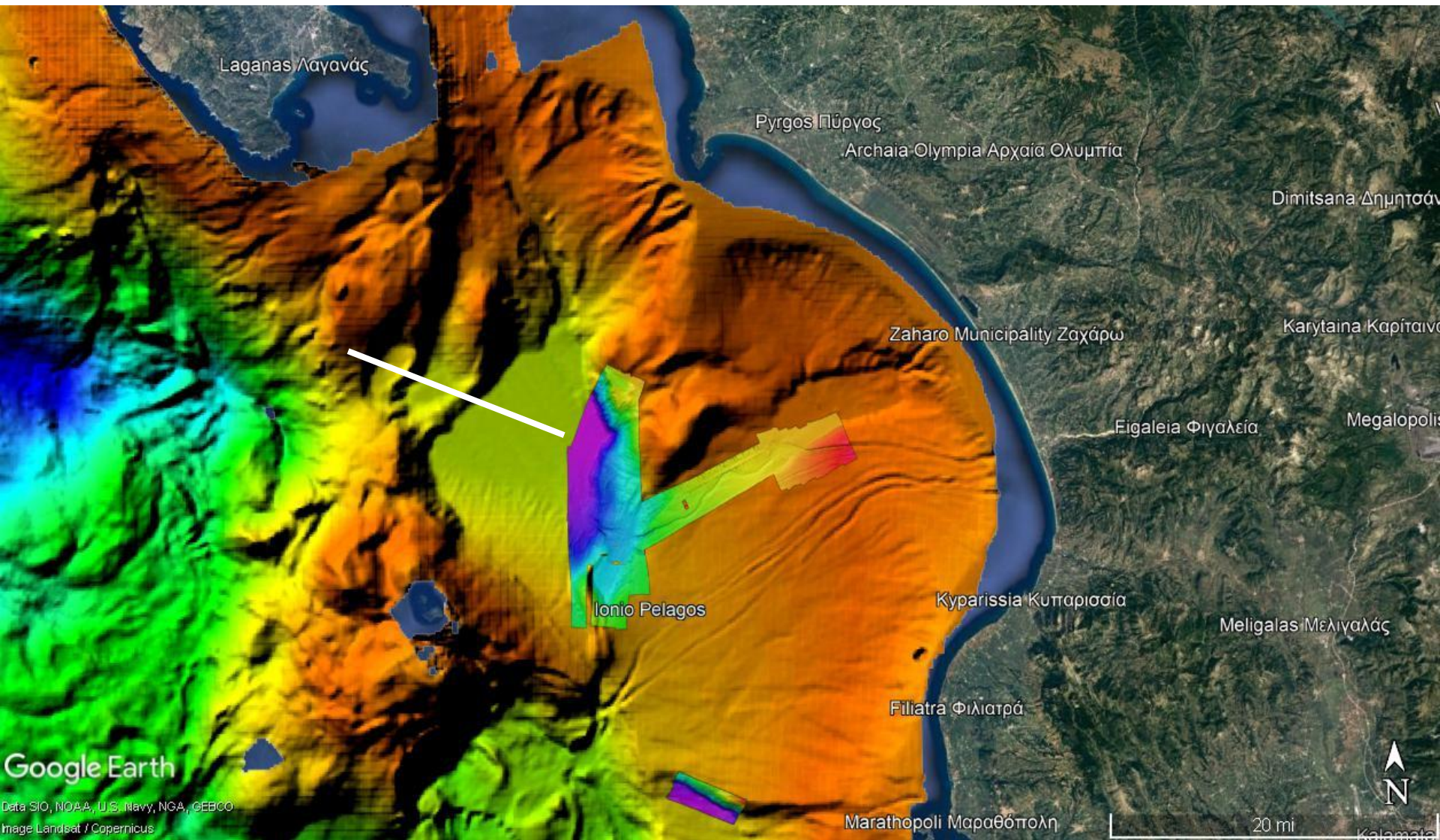
## Lixouri Seamount

Individual seamounts or ridges may display an elevation span of a few thousands of meters e.g. almost 4,000m at Argostoli Ridge, the most prominent rise in the Ionian Sea





# Zakynthos – Strofades Islands – Kyparissiakos Gulf



# Seismic Profile south of Zakynthos

WNW

ESE

1500

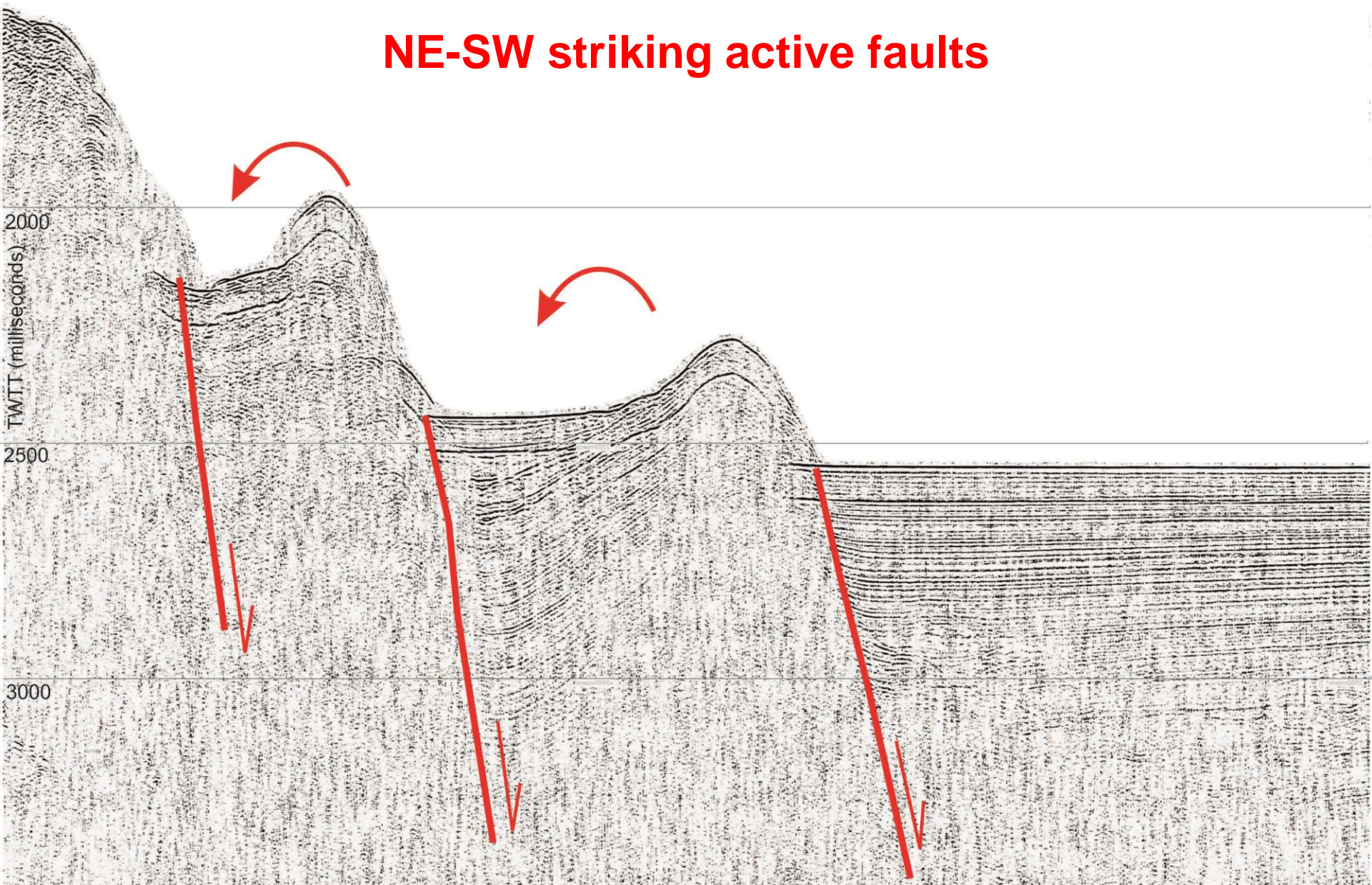
**NE-SW striking active faults**

2000

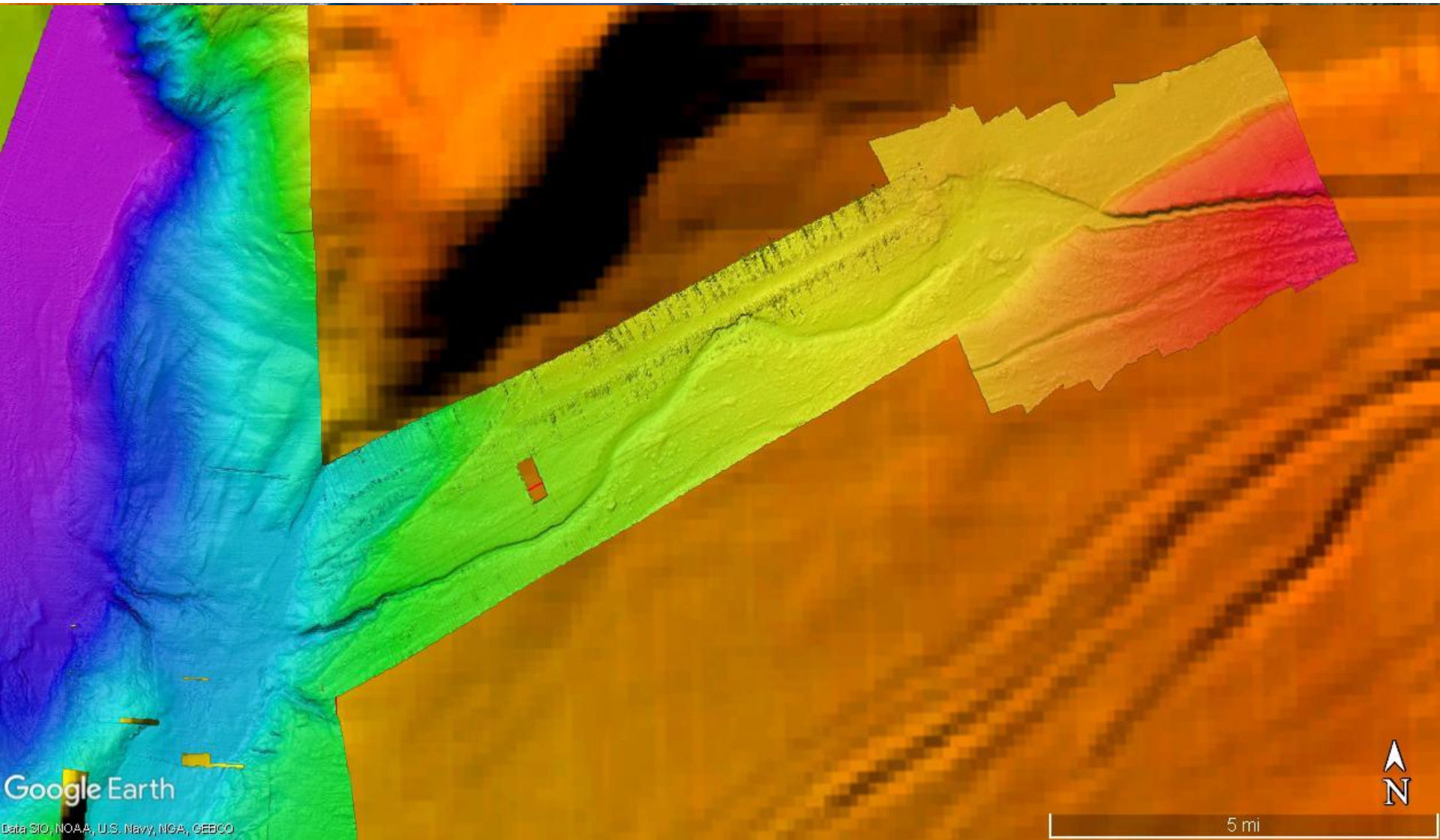
TWTT (milliseconds)

2500

3000



# Submarine canyons in Kyparissiakos Gulf

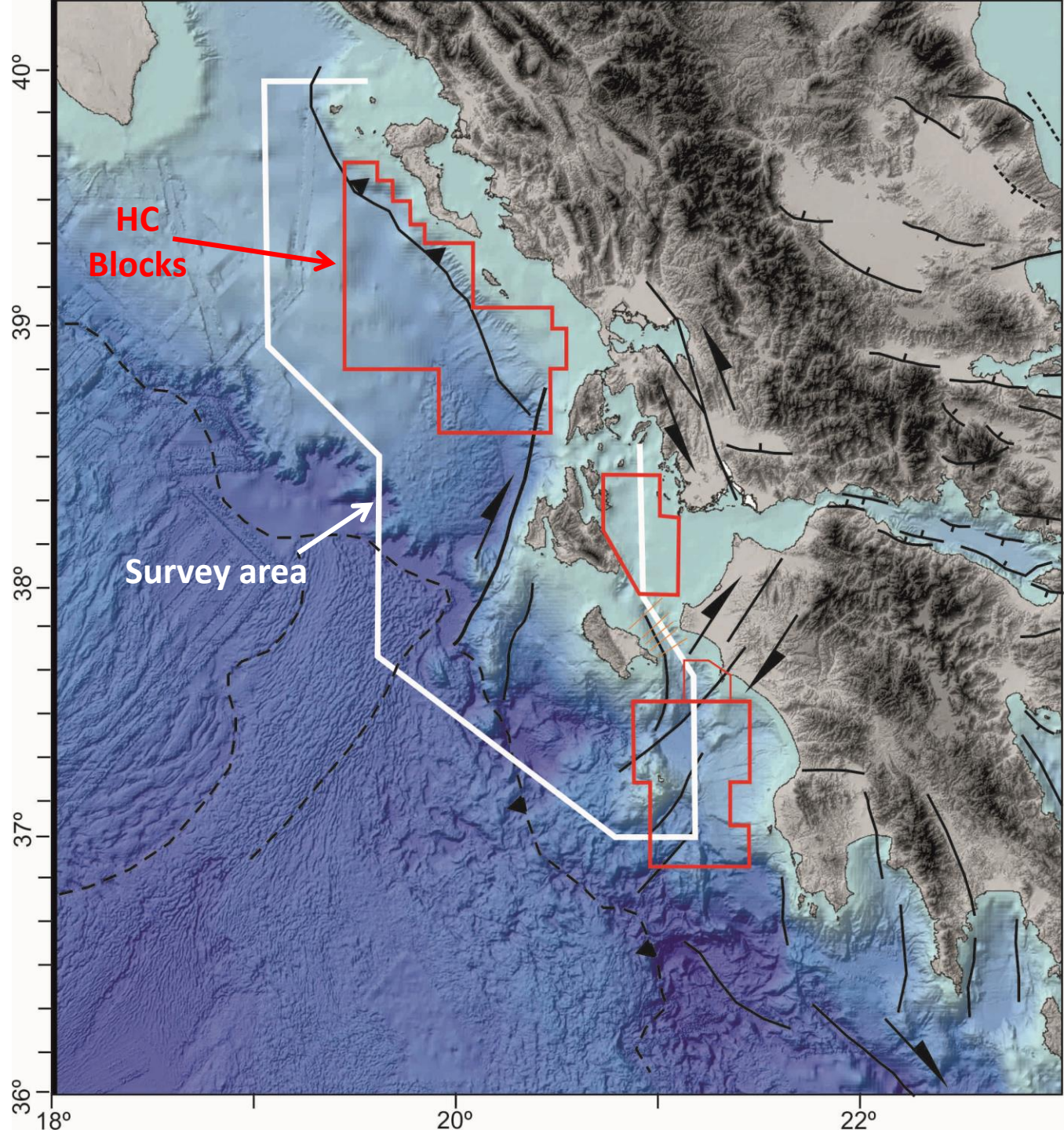


# MARE INCOGNITUM

A multidisciplinary approach to the marine geohazards threatening the Ionian Islands

R/V AEGAEON:  
10 cruises X 15 days =  
150 days (at least)

R/V ALKYON:  
6 cruises X 30 days = 180  
days (at least)

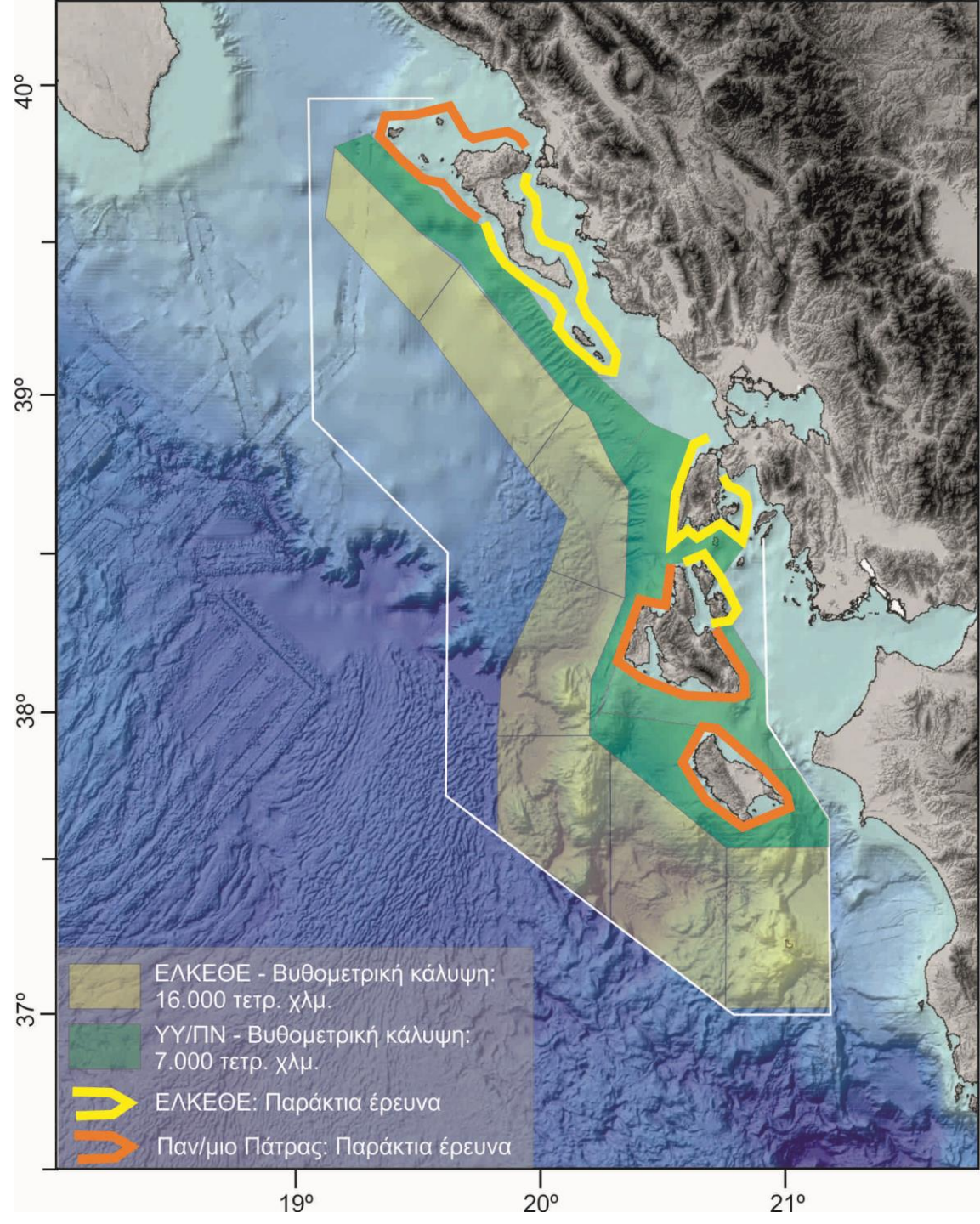


R/V ALKYON



R/V AEGAEON

- Swath Bathymetry**
- Geomorphology**
- Active Faults**
- Submarine Landslides**
- Coastal Zone**
- Habitat Mapping**



**Seismic survey (profiles)**

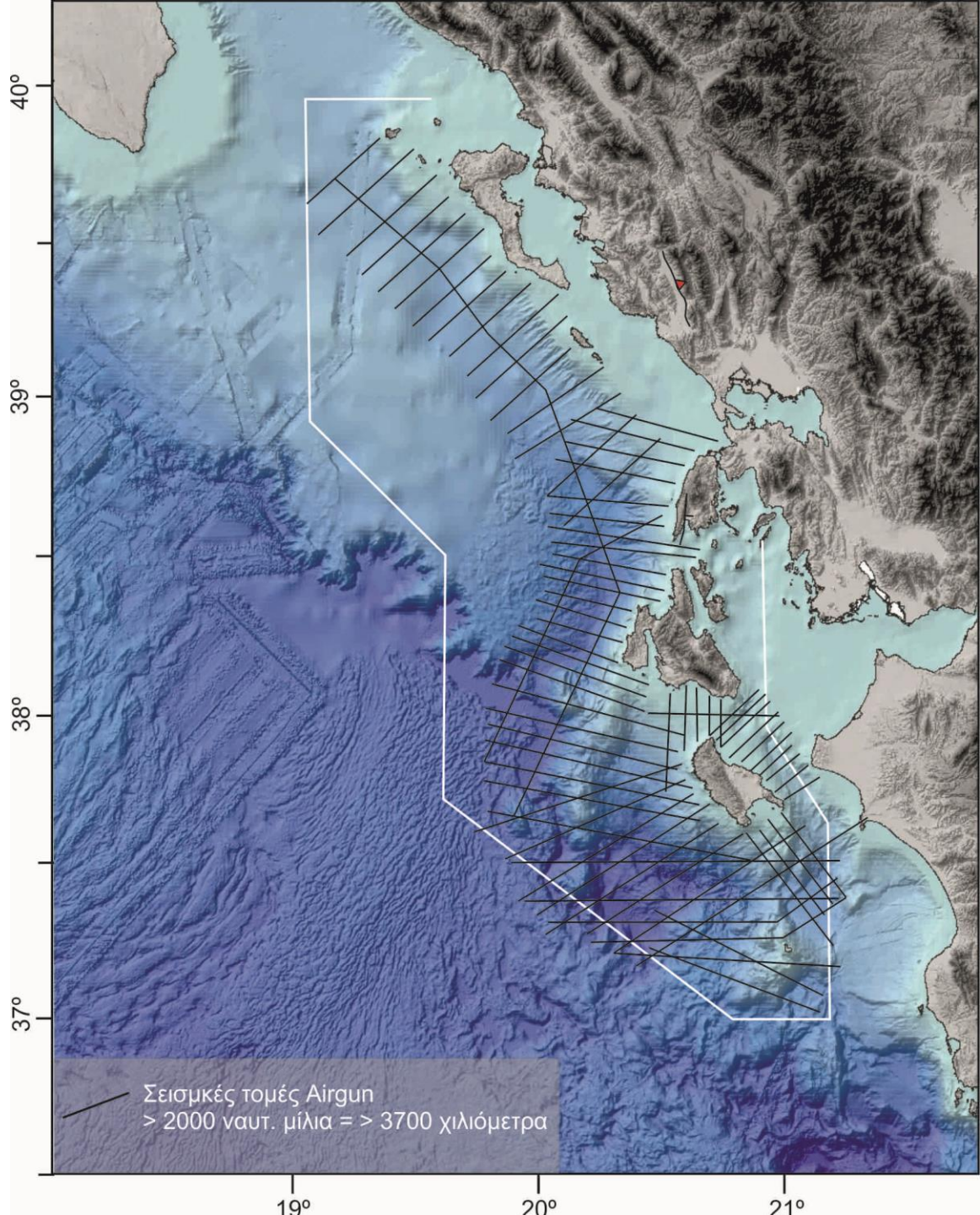
**Active Faults**

**Landslides**

**Landslide prone areas**

**Sedimentary Basins**

**Basin Evolution**



Σεισμικές τομές Airgun  
> 2000 ναυτ. μίλια = > 3700 χιλιόμετρα

**Ocean Bottom Seismographs**

**Land Seismographs**

**Geodetic Sensors (GNSS)**

**Tide Gauges**

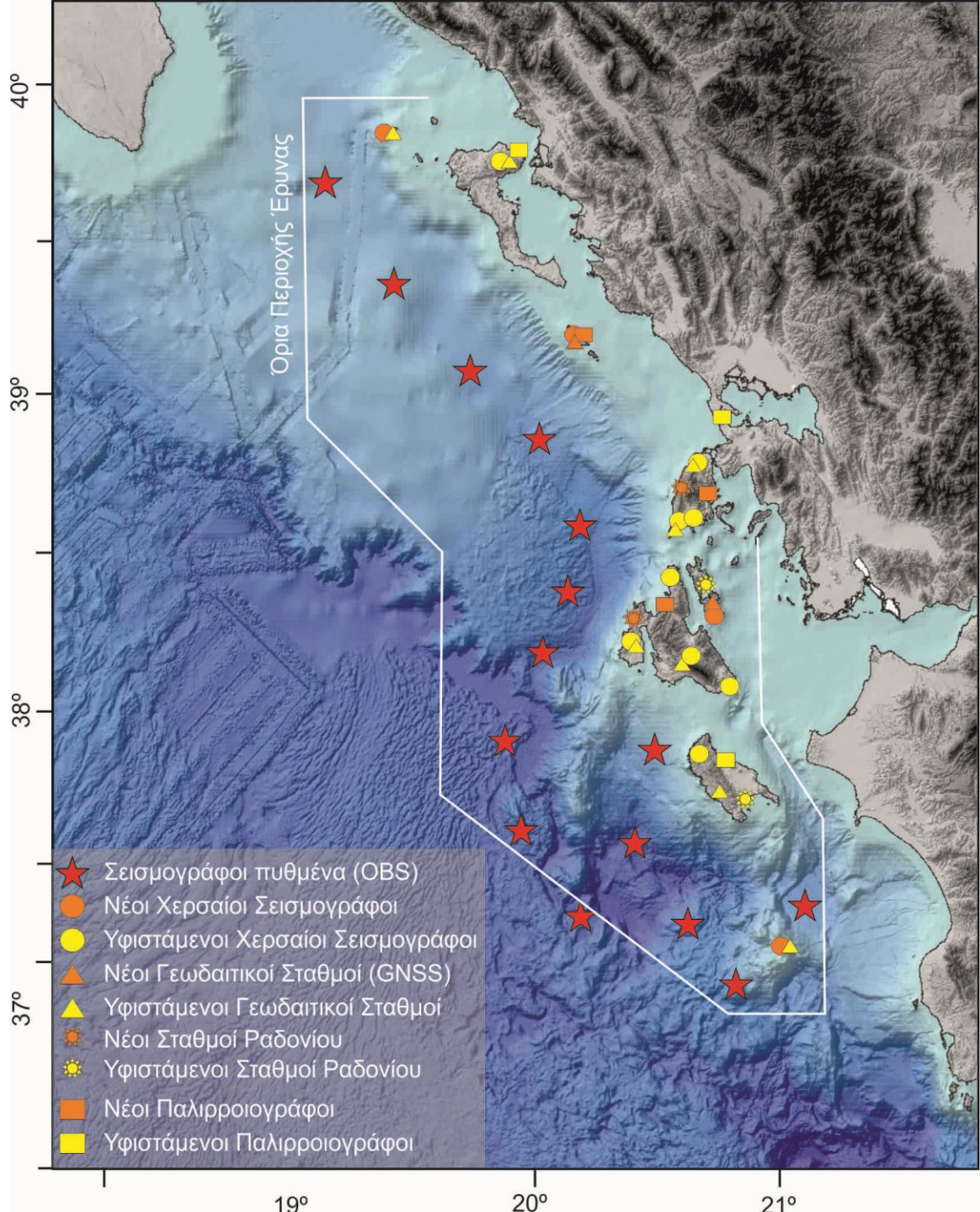
**Monitoring of Earthquakes**

**Fault kinematics**

**Seismic potential**

**Seismic hazard**

**Tsunami generation /  
propagation modeling**



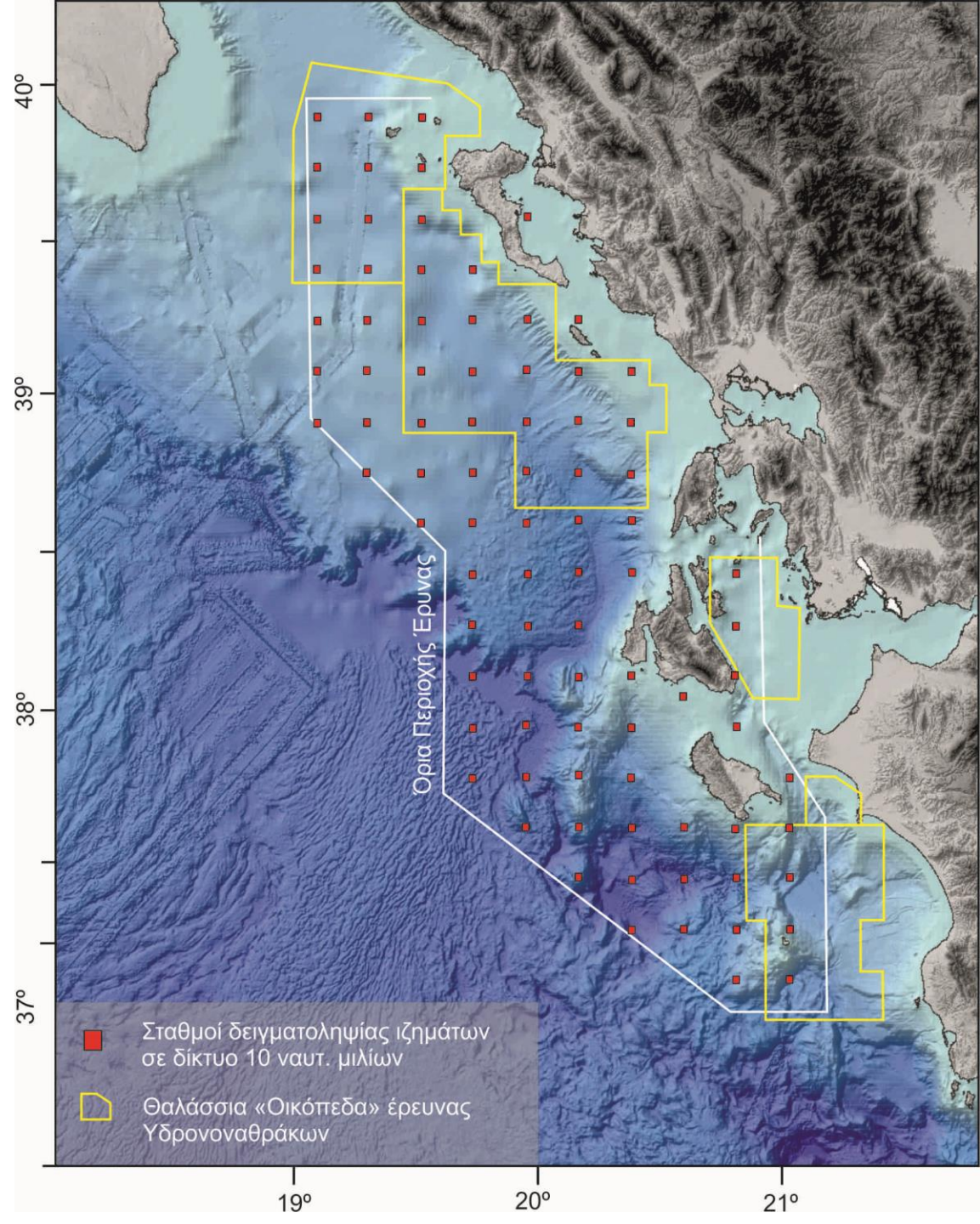


# Grid of Sampling Stations for:

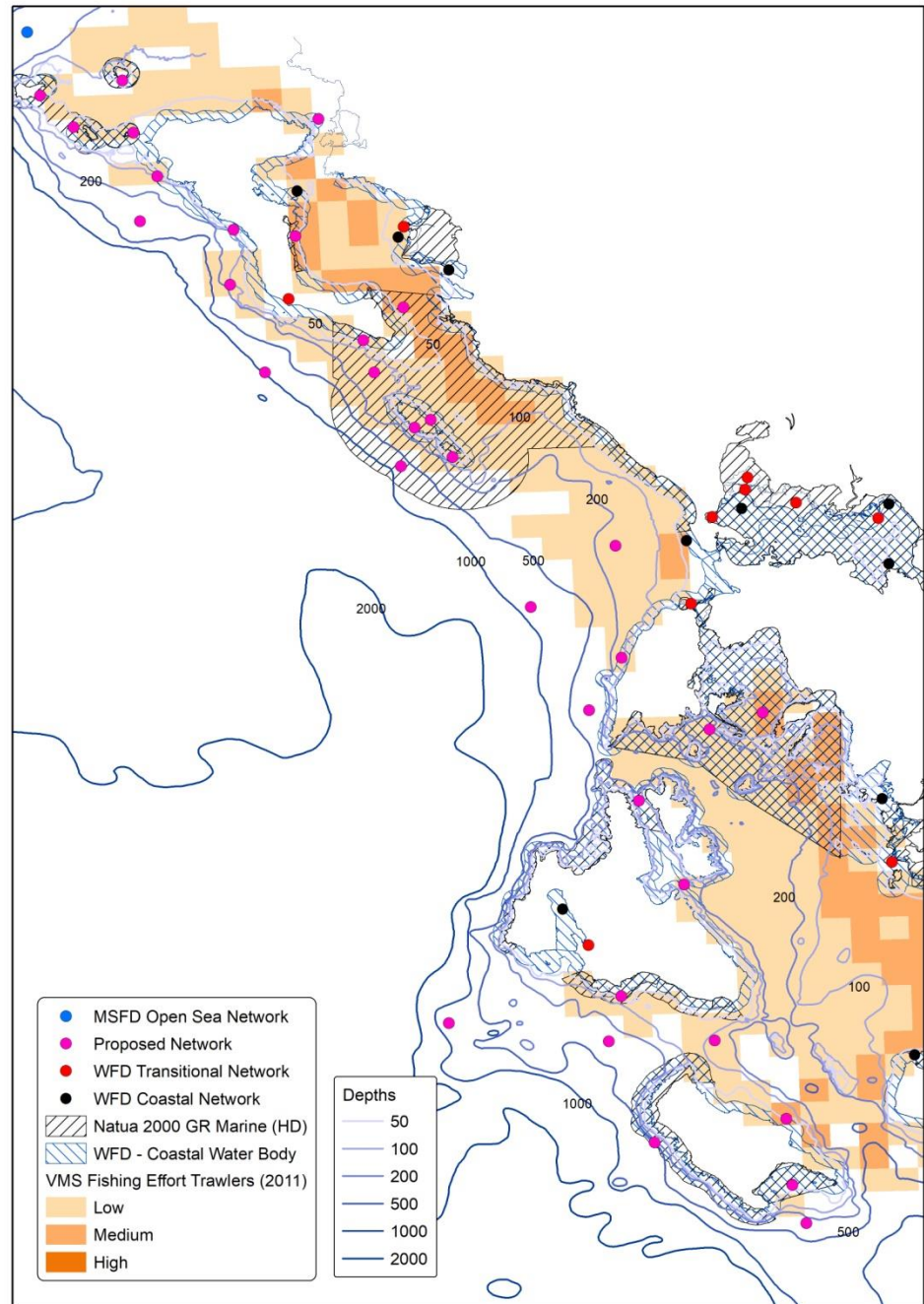
Sediments  
Benthic organisms  
Water

➤ 70 stations

Including estuaries of  
Corfu, Lefkas, Kephallinia

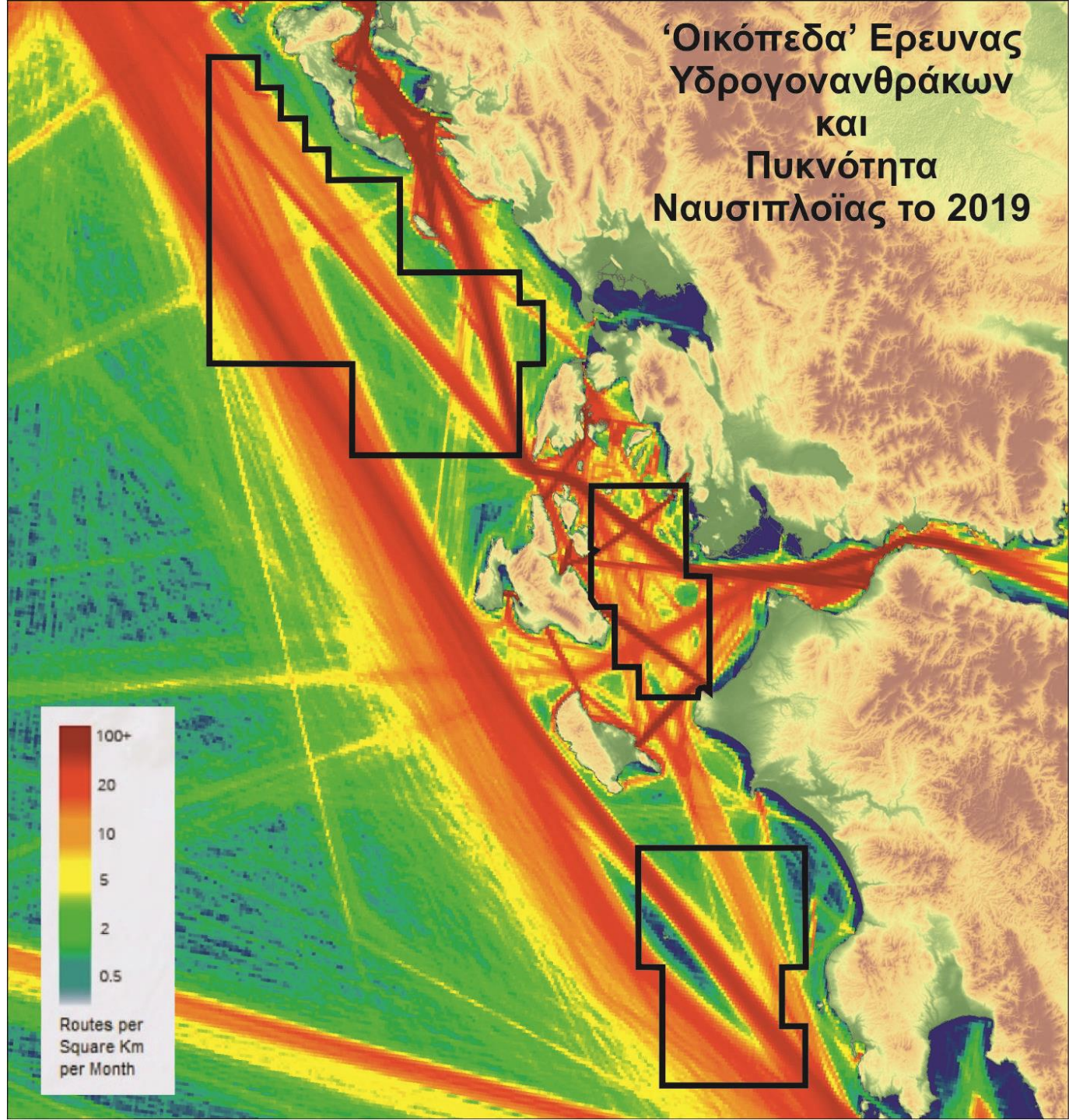


**Strategic plan  
for monitoring  
of benthic habitats,  
including estuaries of Corfu,  
Lefkas, Kephallinia**



# Oil spill modeling

‘Οικόπεδα’ Έρευνας  
Υδρογονανθράκων  
και  
Πυκνότητα  
Ναυσιπλοΐας το 2019



# **Final outcome for the Ionian Region Region**

**Operational System and digital tools for the assessment and management of vulnerability in real time**

**Υλοποίηση και ολοκλήρωση επιχειρησιακού συστήματος και εργαλείων διαχείρισης και εκτίμησης της επικινδυνότητας**

**Training and education of responsible organizations/services and of the public**

**Ενημέρωση και εκπαίδευση στελεχών εμπλεκόμενων φορέων και πληθυσμού**

# MARE INCOGNITUM Research Consortium



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**ΓΕΩΠΟΝΙΚΟ  
ΠΑΝΕΠΙΣΤΗΜΙΟ  
ΑΘΗΝΩΝ**

**Agricultural Univ.  
Athens**



**Hydrographic Service**



Strophades Isl.

**THANK YOU**