Institute of Oceanography

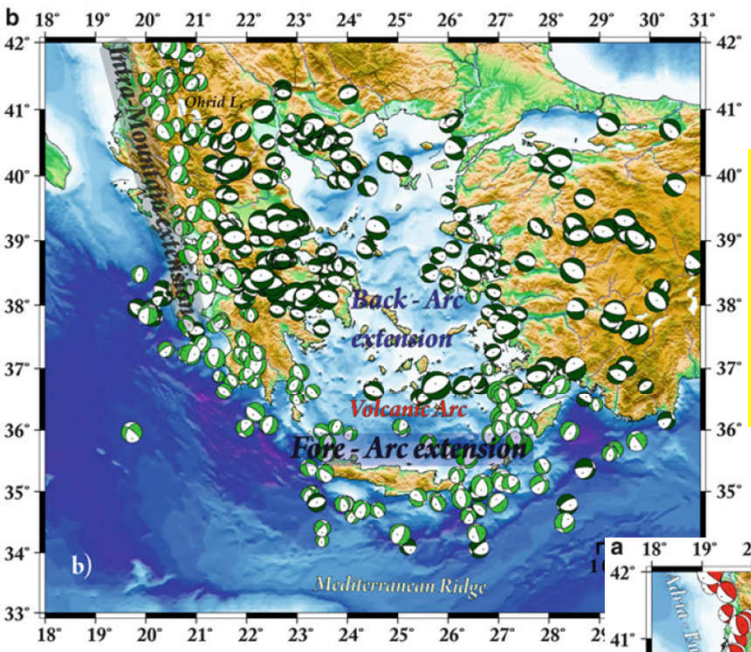
Χαρτογράφηση θαλάσσιων γεω-κινδύνων: Προοπτικές και περιορισμοί

Δ. Σακελλαρίου, Γ. Ρουσάκης & Τομέας Θαλάσσιας Γεωλογίας-Γεωφυσικής
Ινστ. Ωκεανογραφίας, ΕΛΛΗΝΙΚΟ ΚΕΝΤΡΟ ΘΑΛΑΣΙΩΝ ΕΡΕΥΝΩΝ

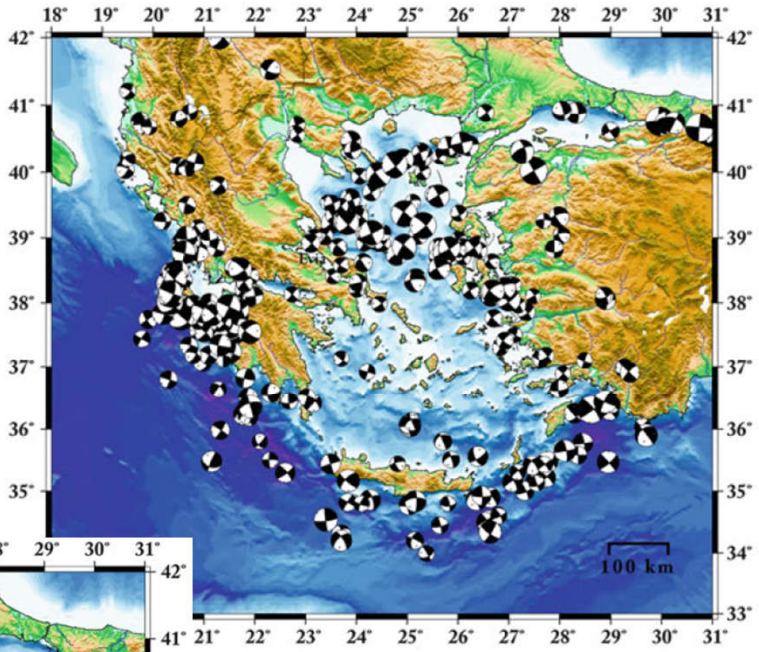
2ο Forum: Μείωση της Διακινδύνευσης από Καταστροφές
14-15/3/2019

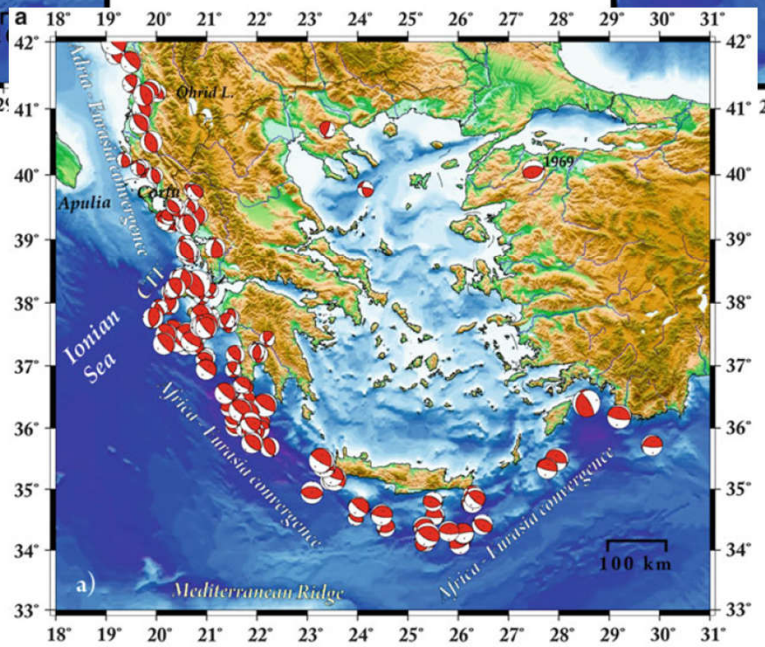
Η εικόνα έχει αντιγραφεί από παρουσίαση του N. Chamot-Rooke (ENS, Paris)

Χωρική διευθέτηση μηχανισμών γένεσης σεισμών στο Αιγαίο (Kiratzi, 2014)



Η πλειονότητα των σεισμών εκδηλώνεται στον υποθαλάσσιο χώρο



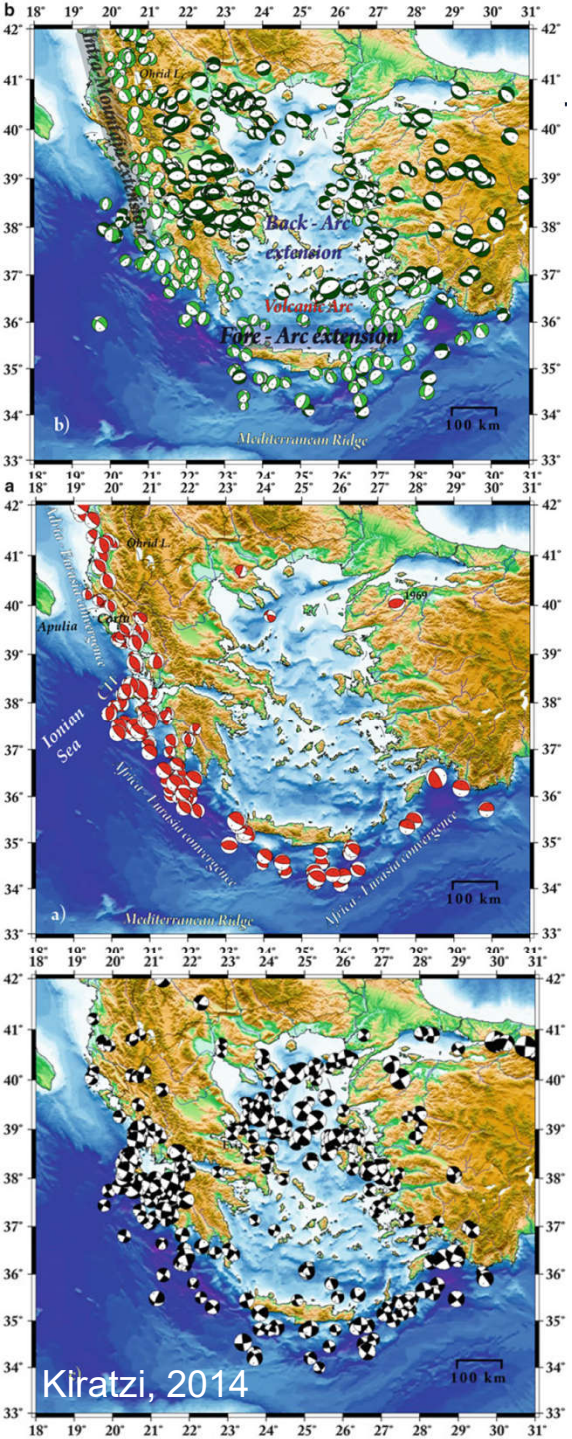


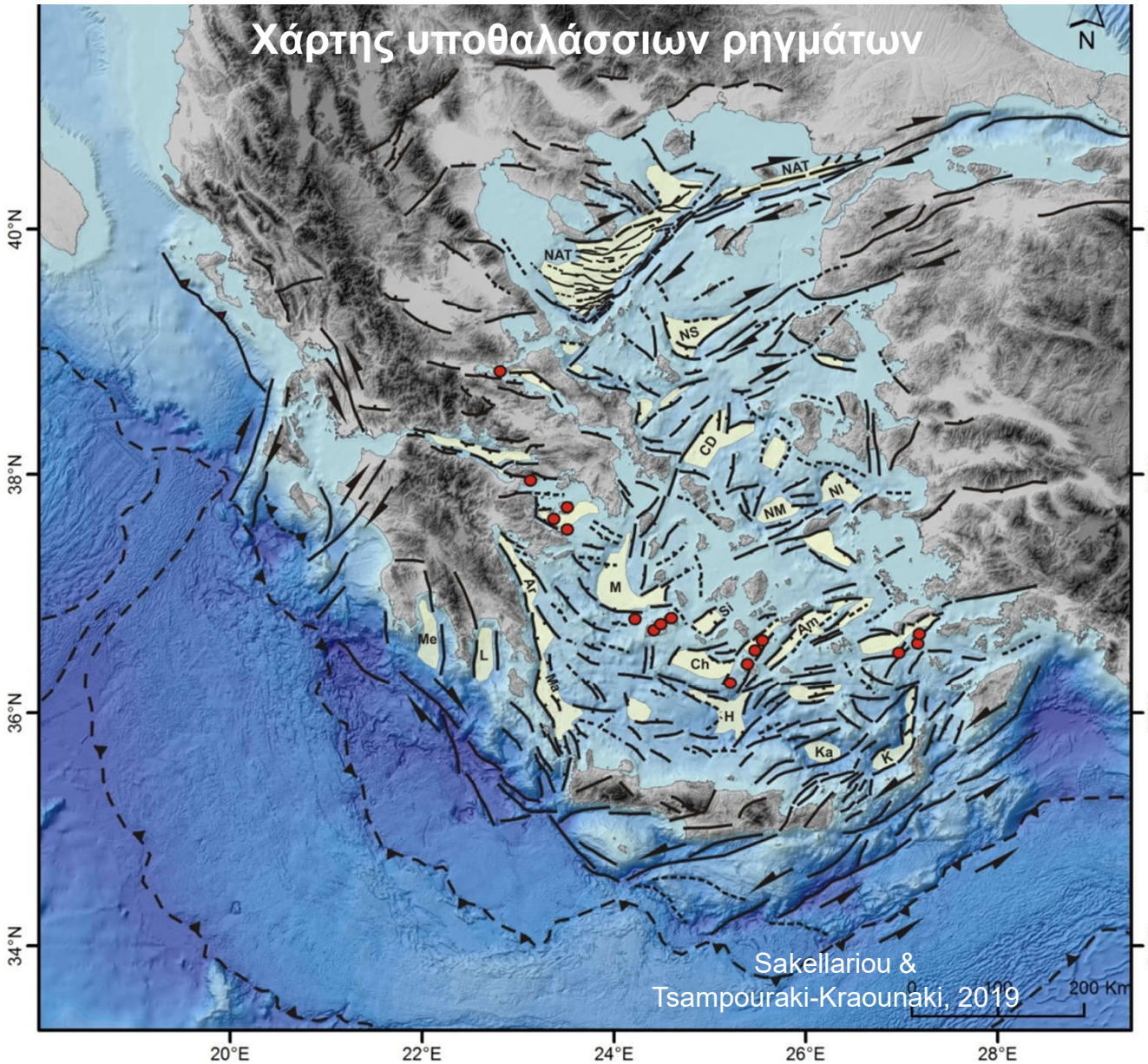
Εφελκυσμός – Κανονικά ρήγματα

Οριζόντια διάτμηση – Ρήγματα οριζόντιας ολίσθησης

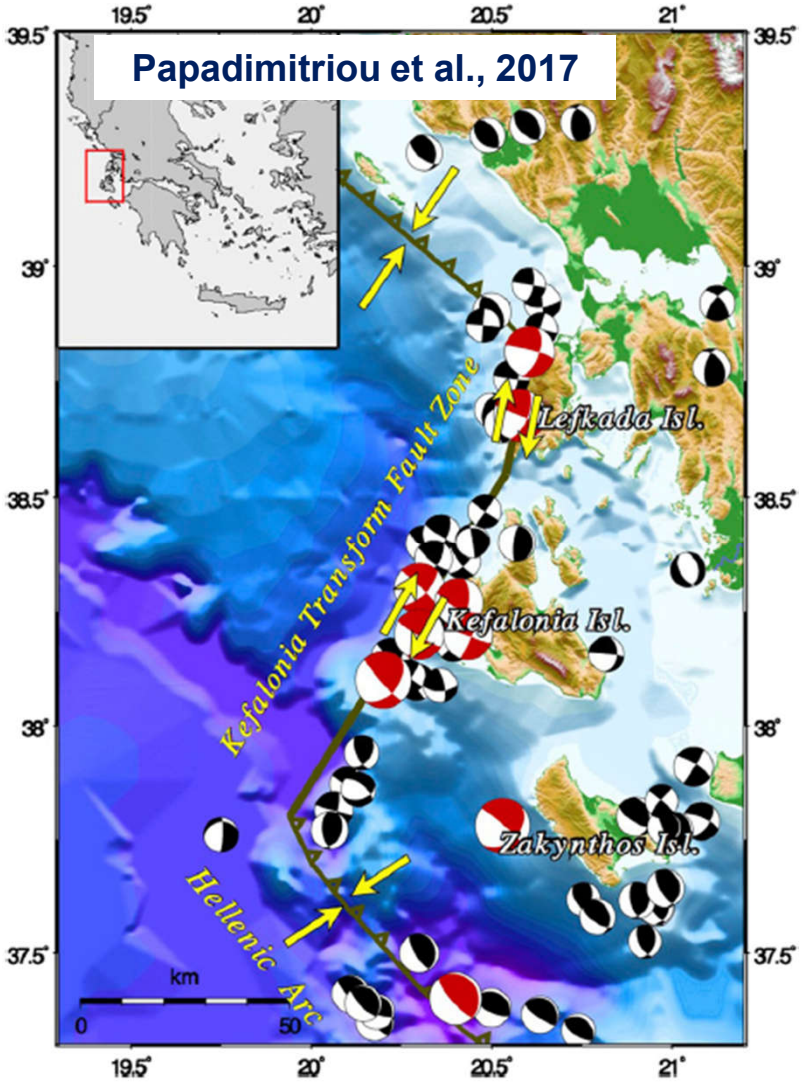
Συμπίεση – Ανάστροφα ρήγματα

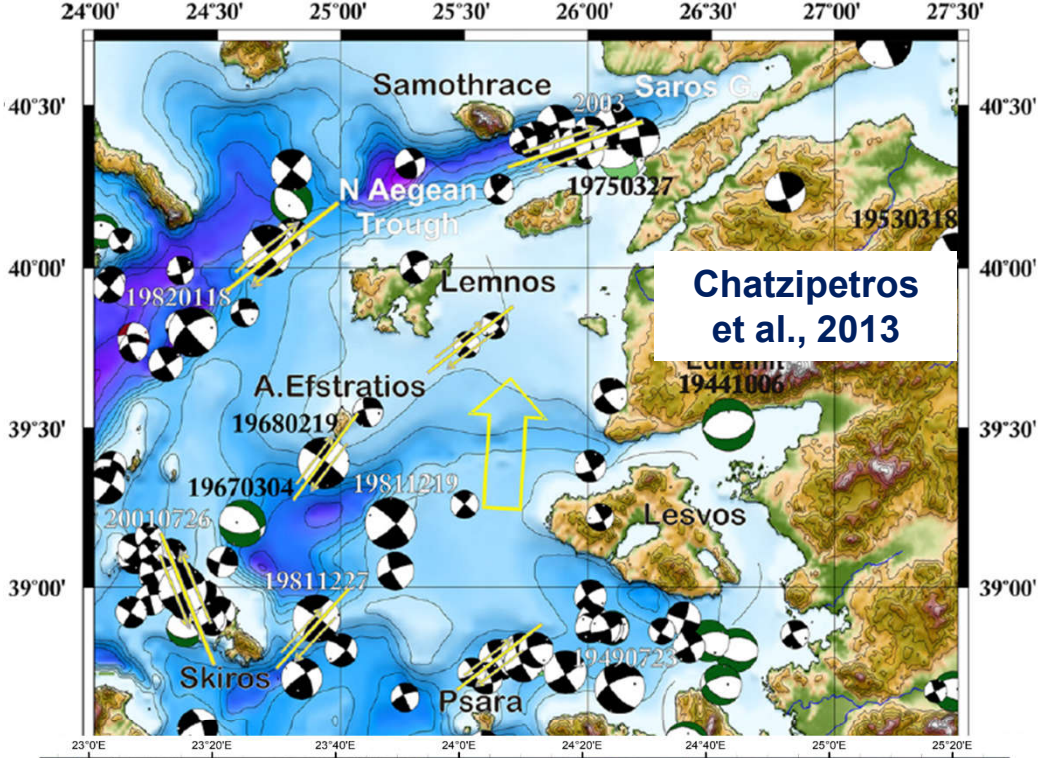
Συσχέτιση υποθαλάσσιων σεισμών και υποθαλάσσιων ρηγμάτων Πόσο εφικτή είναι?

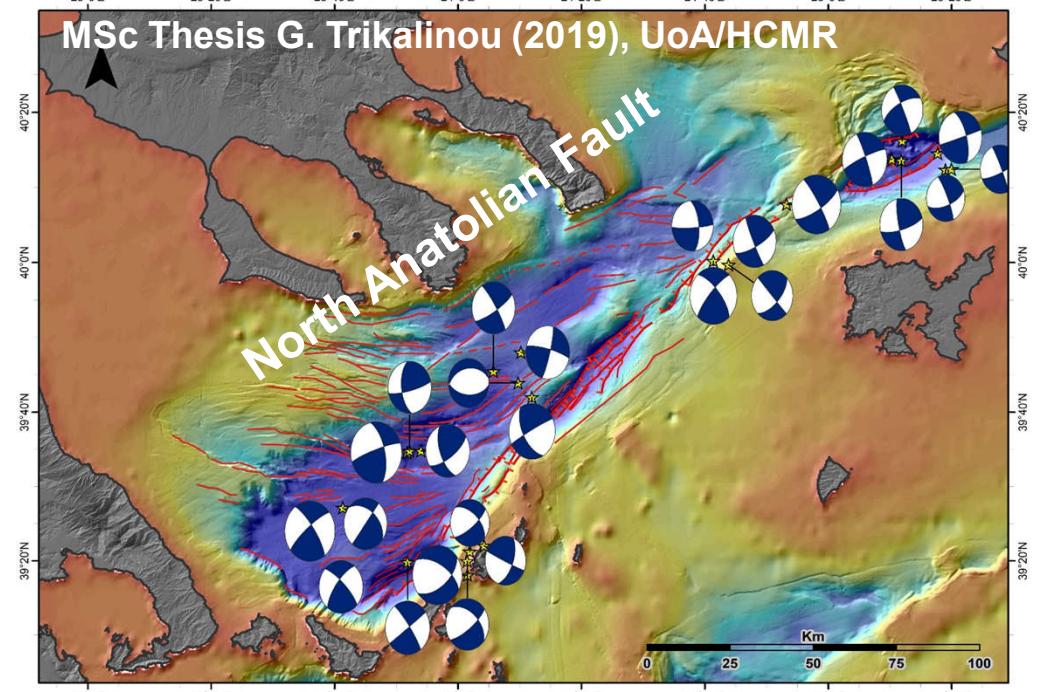




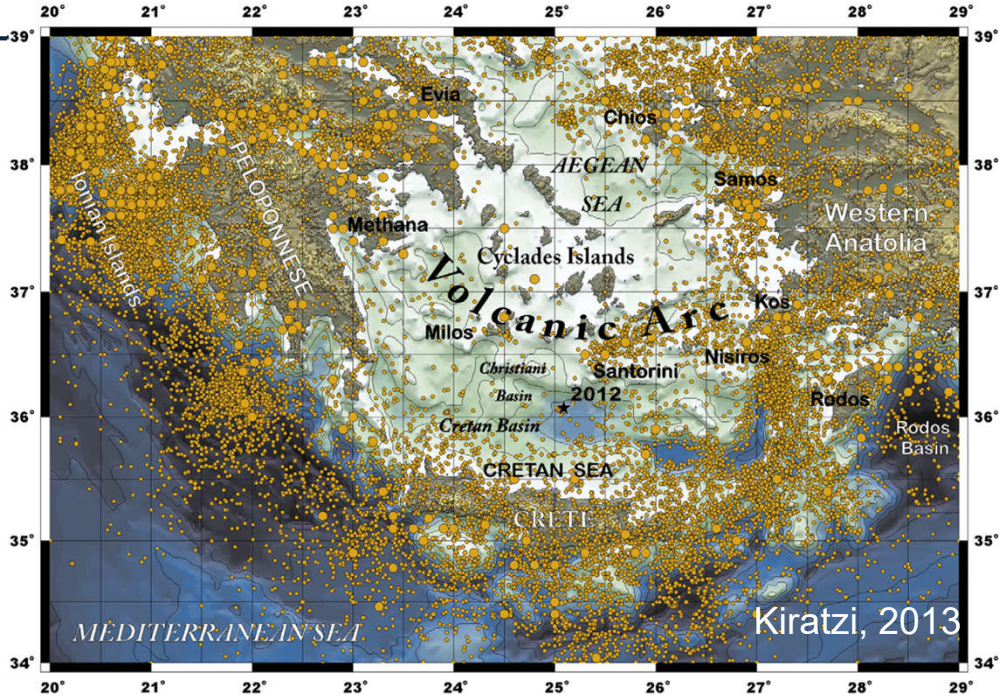
Σύνδεση υποθαλάσσιων σεισμών με υποθαλάσσια ρήγματα. Πόσο εφικτή είναι?

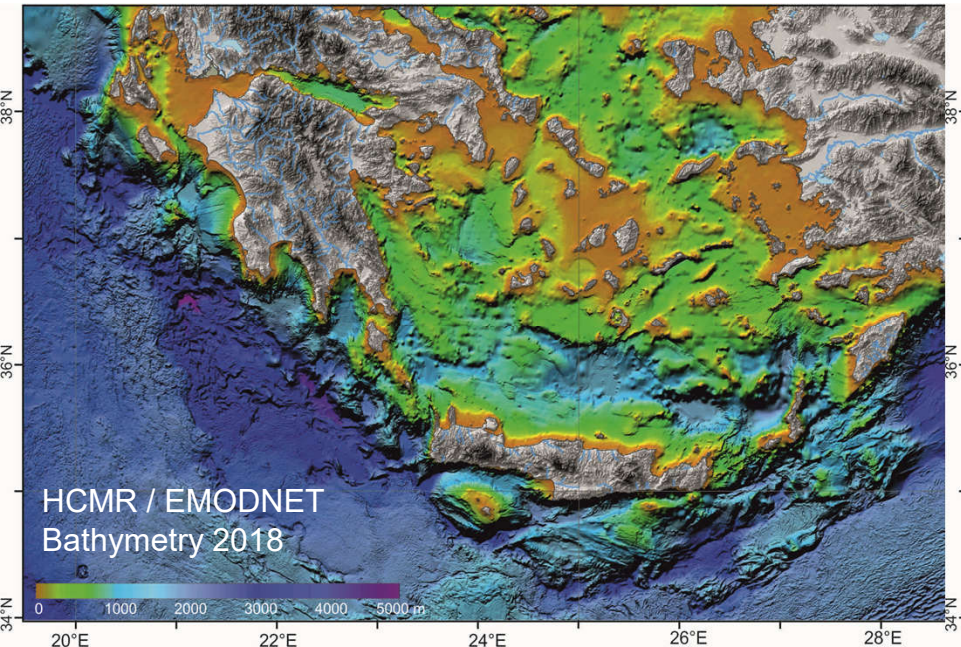


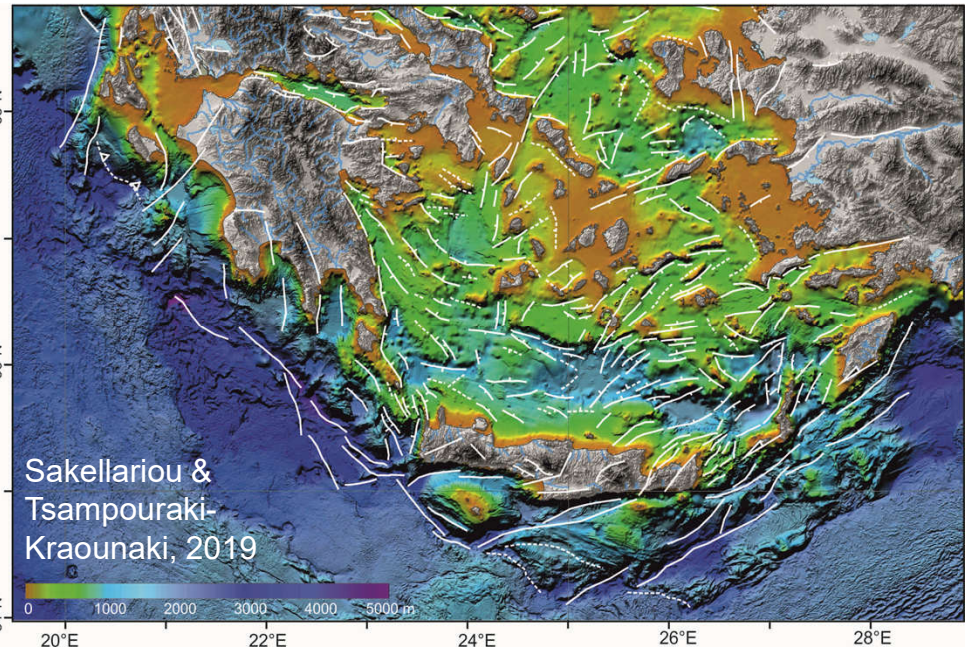




Σύνδεση υποθαλάσσιων σεισμών με υποθαλάσσια ρήγματα. Πόσο εφικτή είναι?





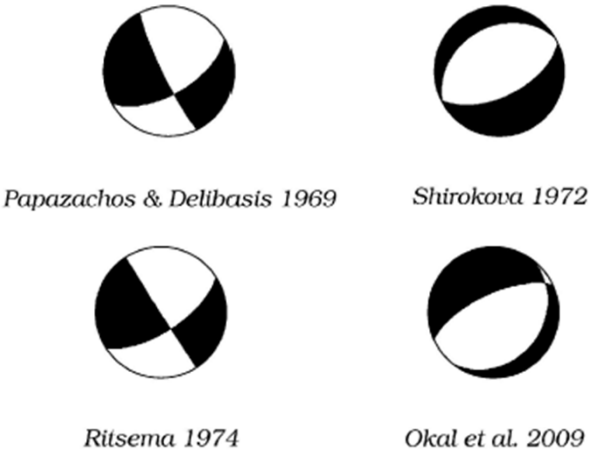


Δίδυμοι Σεισμοί Αμοργού, 9 Ιουλίου 1956 Ms: 7.4 & 7.2

Επίκεντρο?

Ποιό/ποιά ρήγματα κινήθηκαν?
Το «περίφημο» Ρήγμα της Αμοργού?

Μηχανισμός γένεσης?



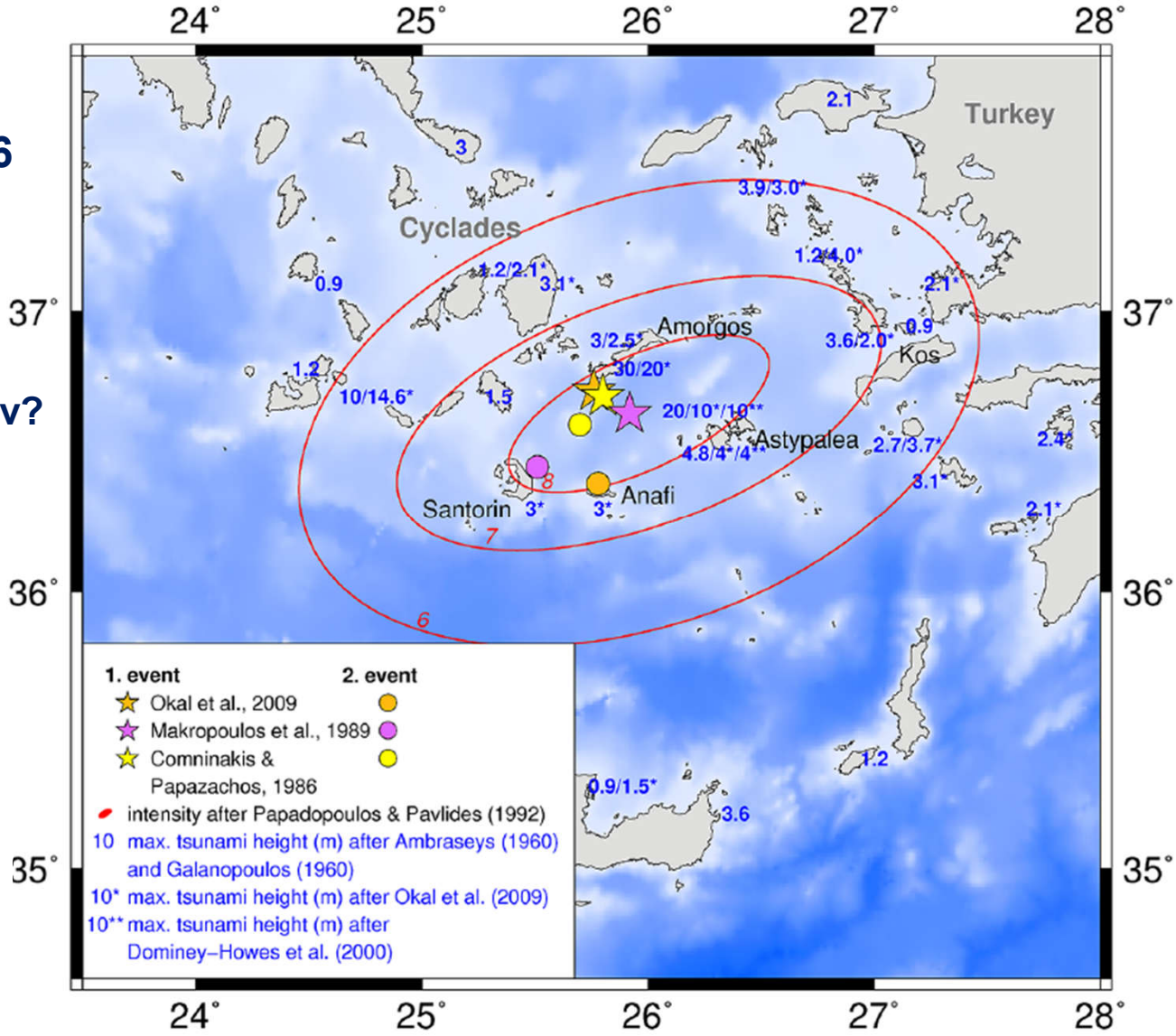
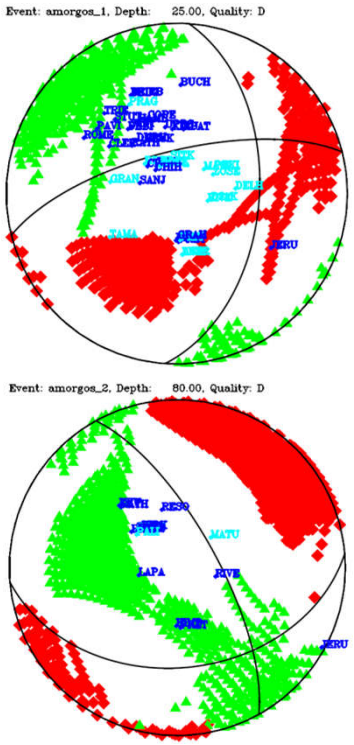


Figure 2. Map of locations of the two earthquakes on 9 July 1956 at 03:11 and 03.24 UTC investigated in this study (Bruestle et al., 2014).

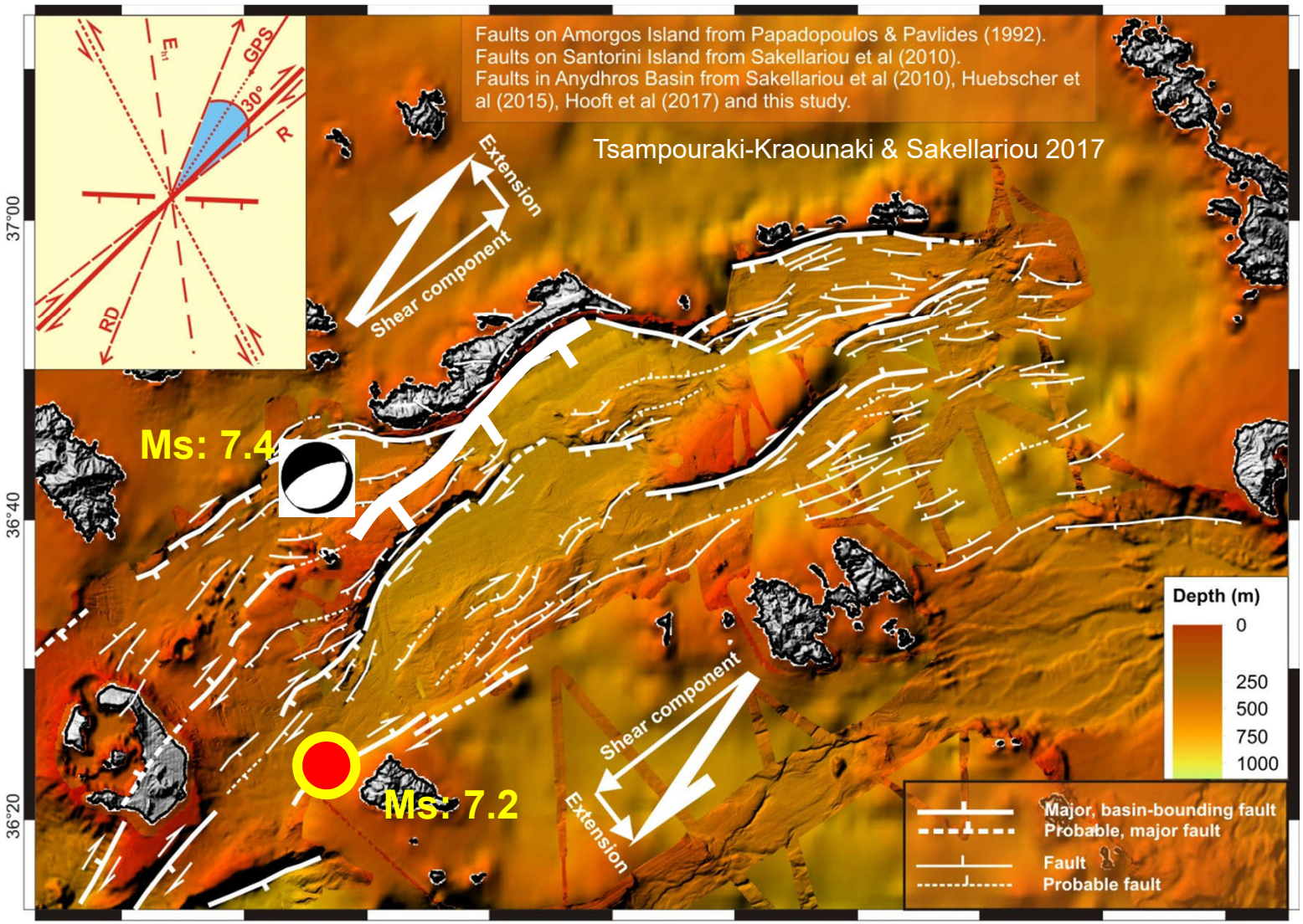
Επίκεντρα και μηχανισμοί γένεσης των Δίδυμων Σεισμών της Αμοργού
Σχέση με «Ρήγμα Αμοργού»

Bruestle et al., 2014:

1st event: Dextral SE dipping normal fault

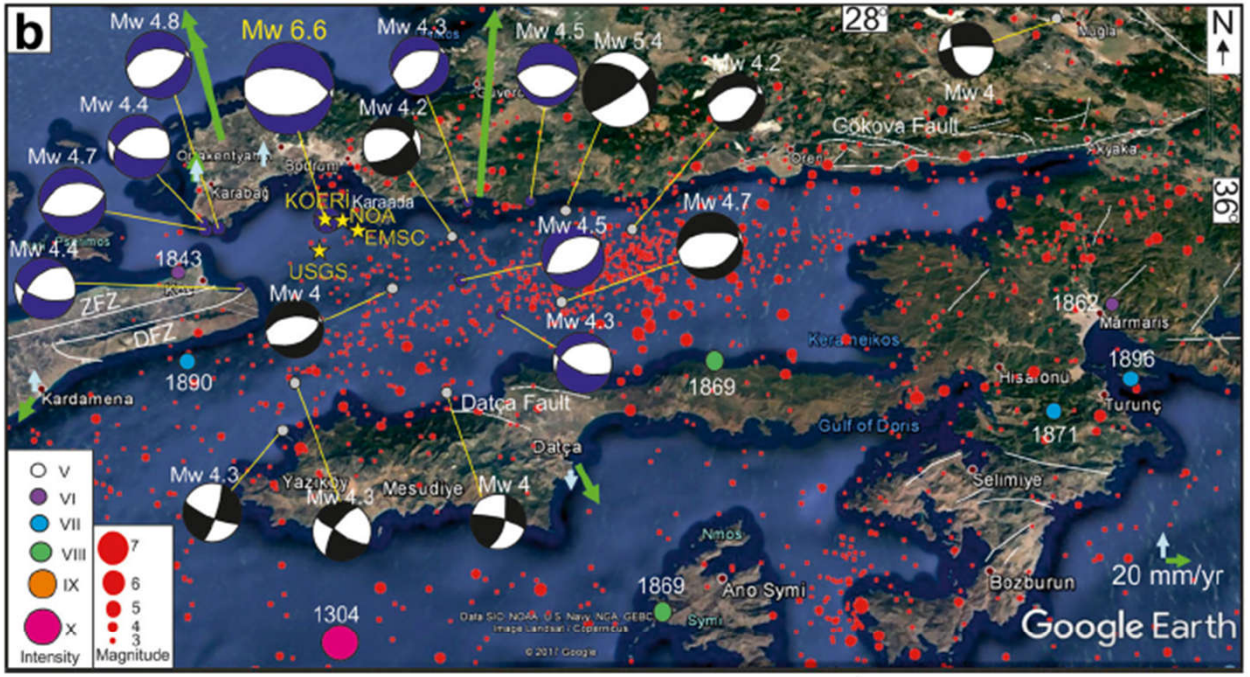


2nd event: Thrust fault (Benioff zone)

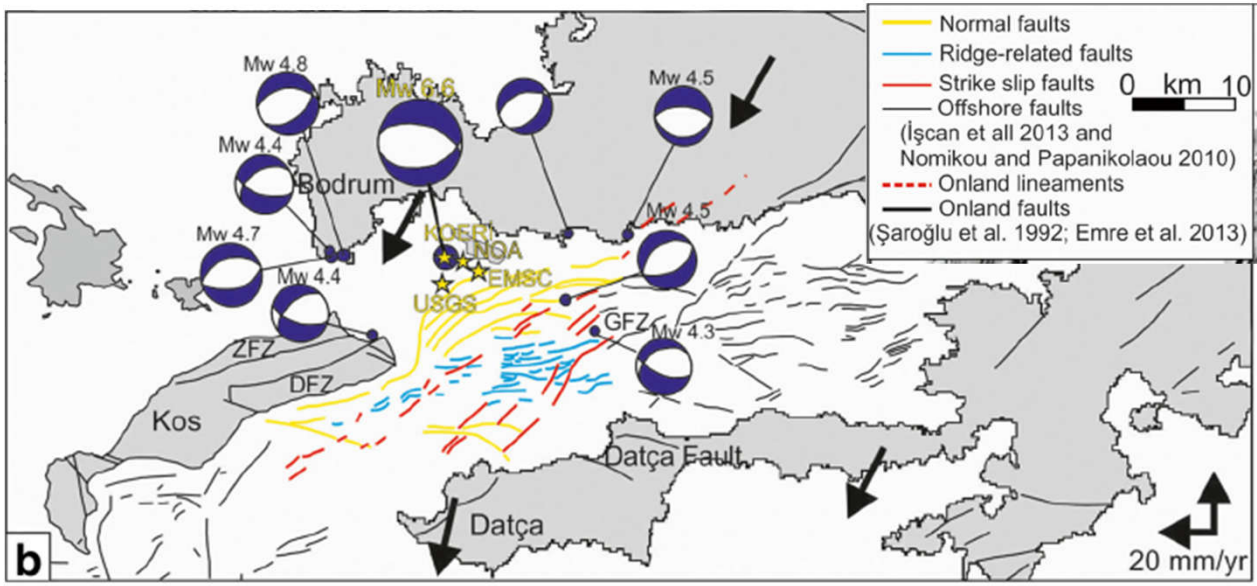


ΣεισμόςBodrum-Κω Mw6.6, 20/7/2017

Ocakoglu et al. (2017): This offshore study reveals that the normal and strike-slip faults are well correlated with the focal mechanism solutions of the recent earthquake and general seismicity of the Gökova Gulf.



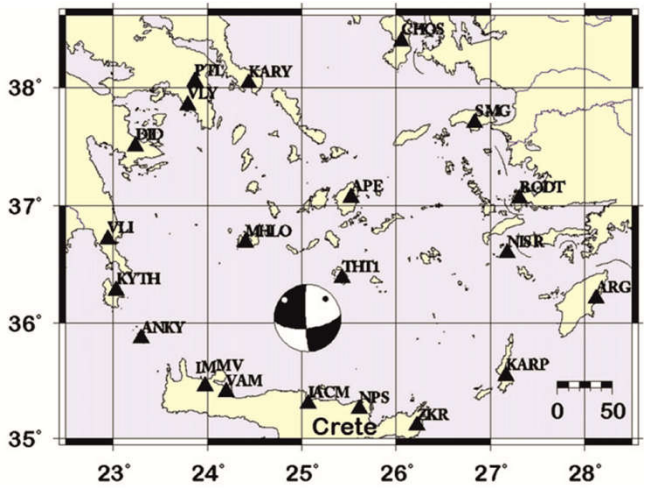
Historical earthquakes and focal mechanism solutions of the July 20, 2017 Mw6.6 Bodrum-Kos EQ and its aftershocks (KOERI 2017) with purple focal spheres;
Earthquake focal mechanisms (Mw≥4.0) (black focal spheres) by Shah (2015).
Epicenter distribution of Mw>3 EQ before the main shock reported by ISC for 1973–2017. GPS slip vectors in horizontal map view (light green) from Saltogianni et al. (2017)



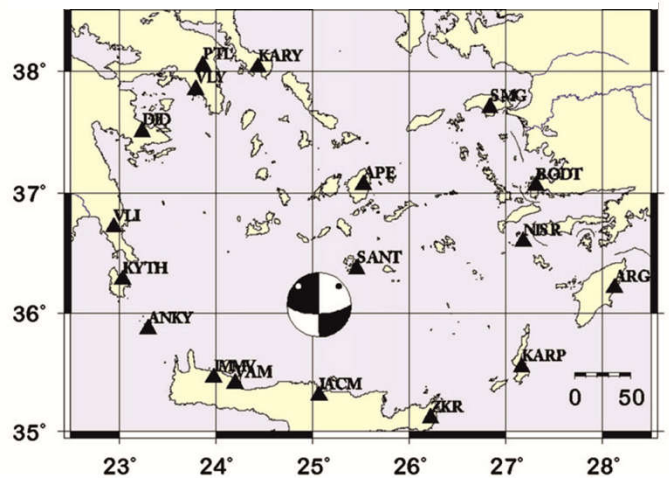
Focal mechanism solutions of the 20 July 2017 Mw6.6 Bodrum-Kos earthquake and its aftershocks reported by KOERI (2017). The GPS velocity vectors are from McClusky et al. (2000).

The January 2012 moderate-size (Mw5.3) sequence in Cretan Basin

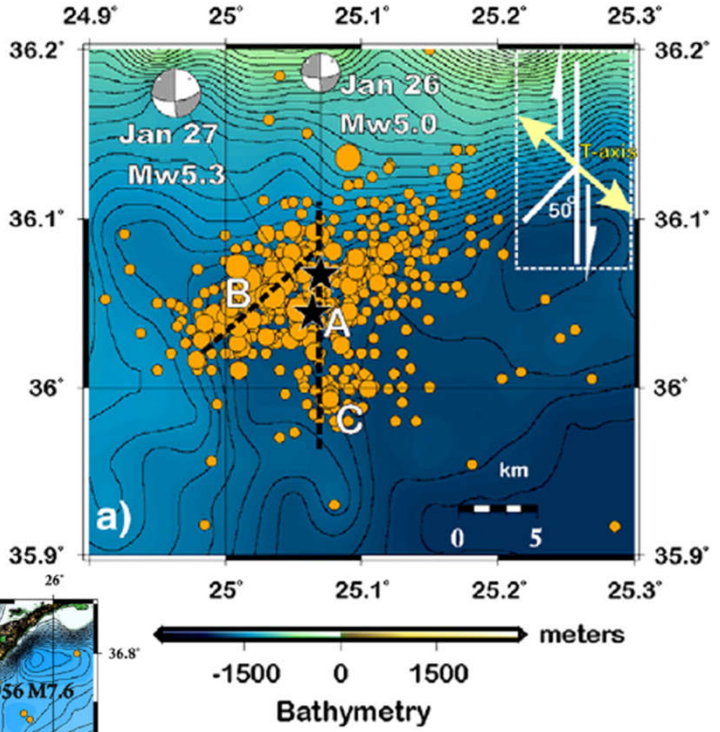
January 26, 2012, 01:33 Mw5.3

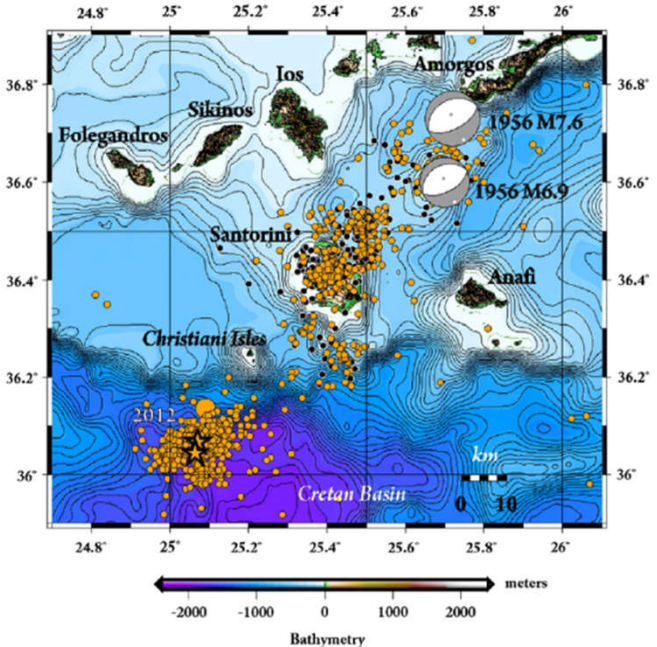


January 26, 2012, 04:24 Mw5.0

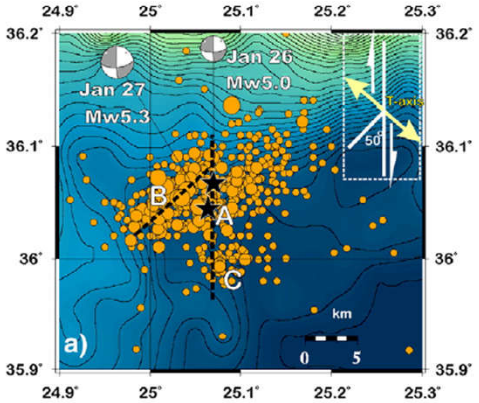


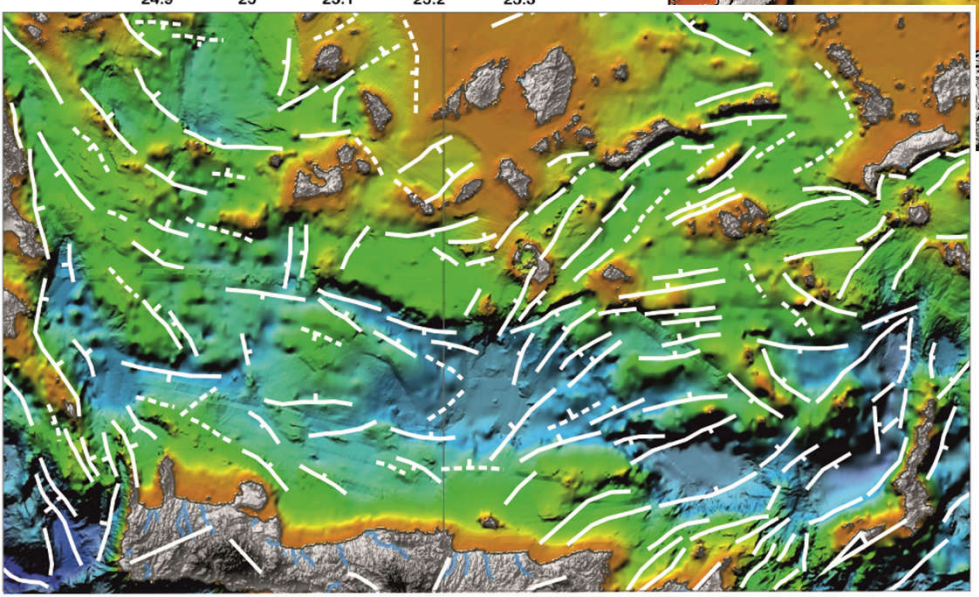
(Kiratzi, 2013)

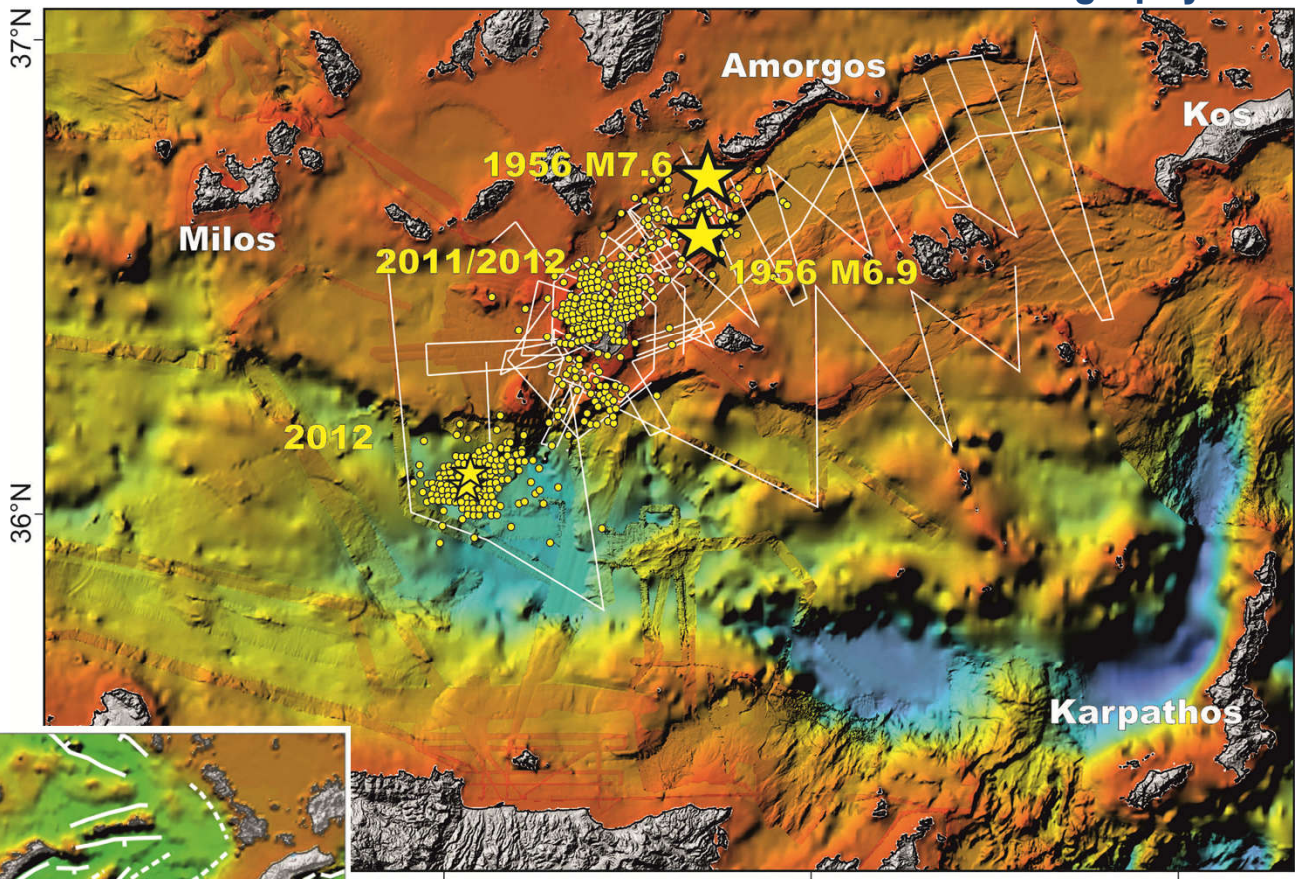




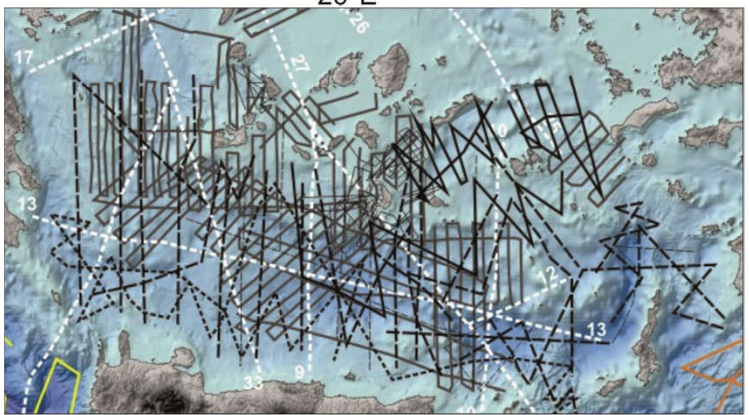
The January 2012 moderate-size (Mw5.3) sequence in Cretan Basin







26°E



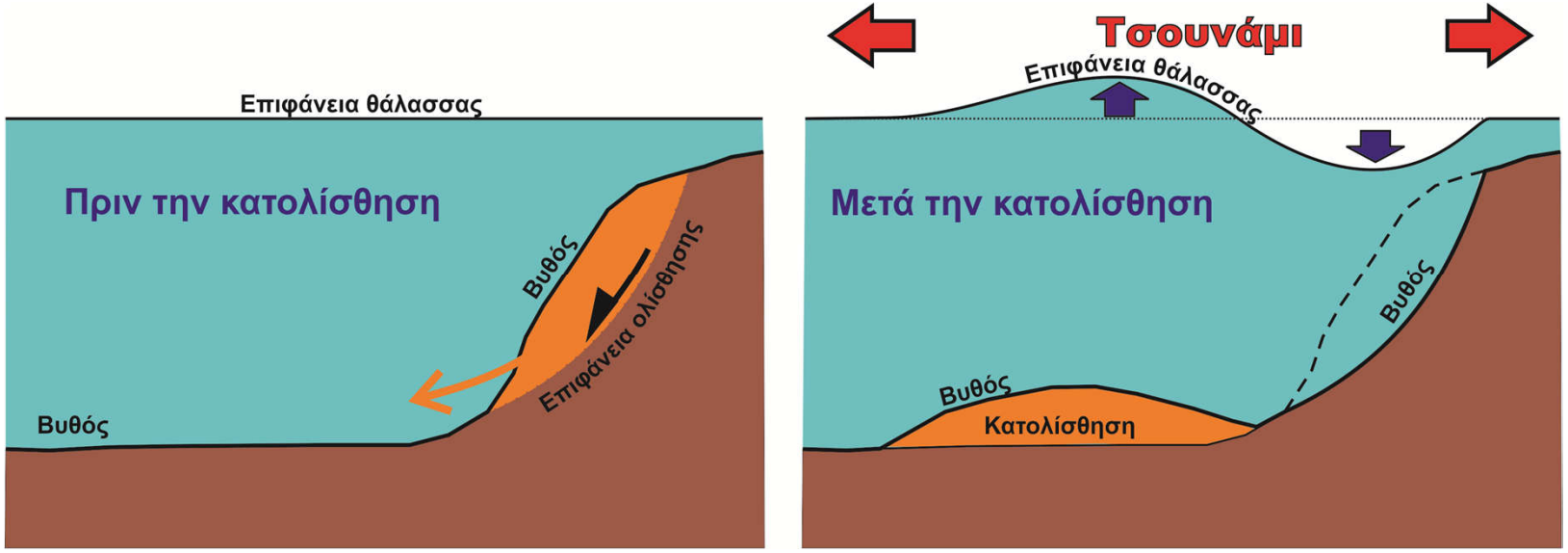
Υποθαλάσσιες Κατολισθήσεις

Για να εκδηλωθεί μια υποθαλάσσια κατολίσθηση χρειάζονται τρεις βασικές παράμετροι:

1) Κατάλληλη μορφολογία του βυθού

2) Υλικό μικρής συνοχής για να μπορεί να κατολισθήσει

3) Οι κατάλληλες συνθήκες για να πυροδοτήσουν την κατολίσθηση
(συν-σεισμικές, ασεισμικές κατολισθήσεις)

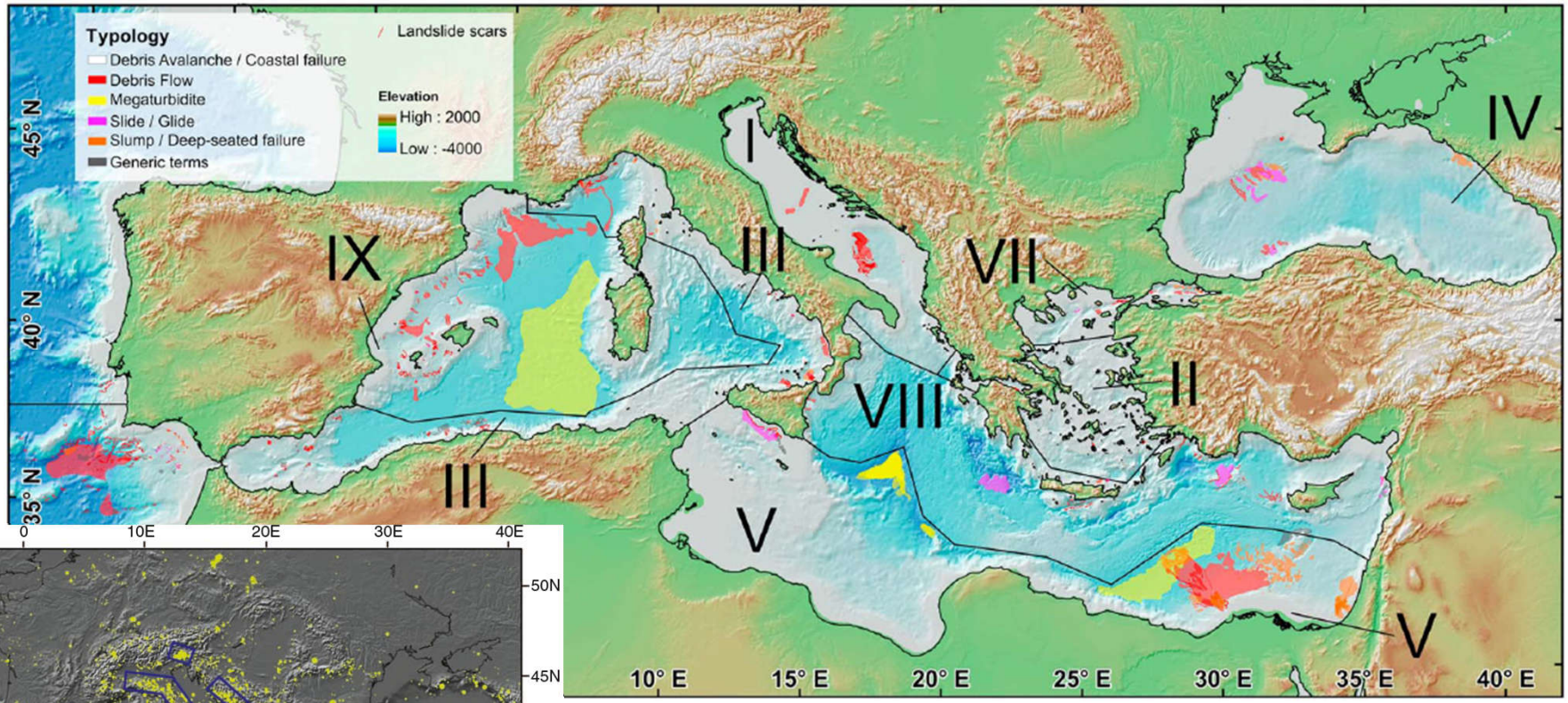


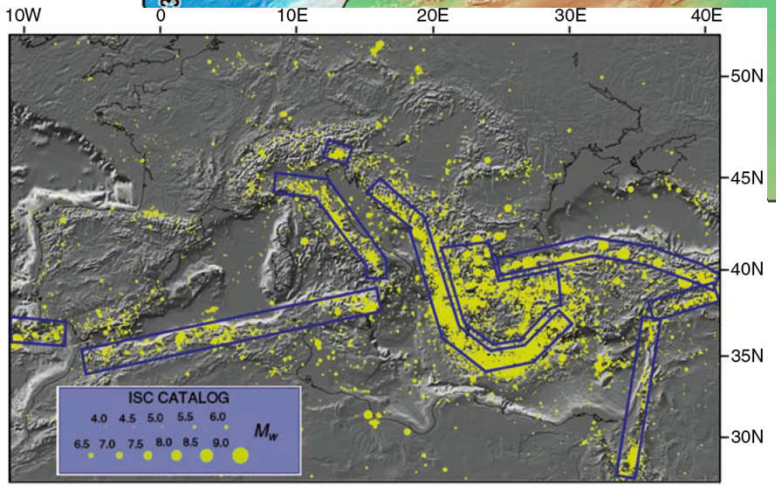
Υποθαλάσσιες Κατολισθήσεις στη Μεσόγειο

Major deltaic wedges have a higher density of large submarine landslides.

Tectonically active margins are characterized by relatively small failures !!!

(Urgeles & Camerlenghi, 2013)

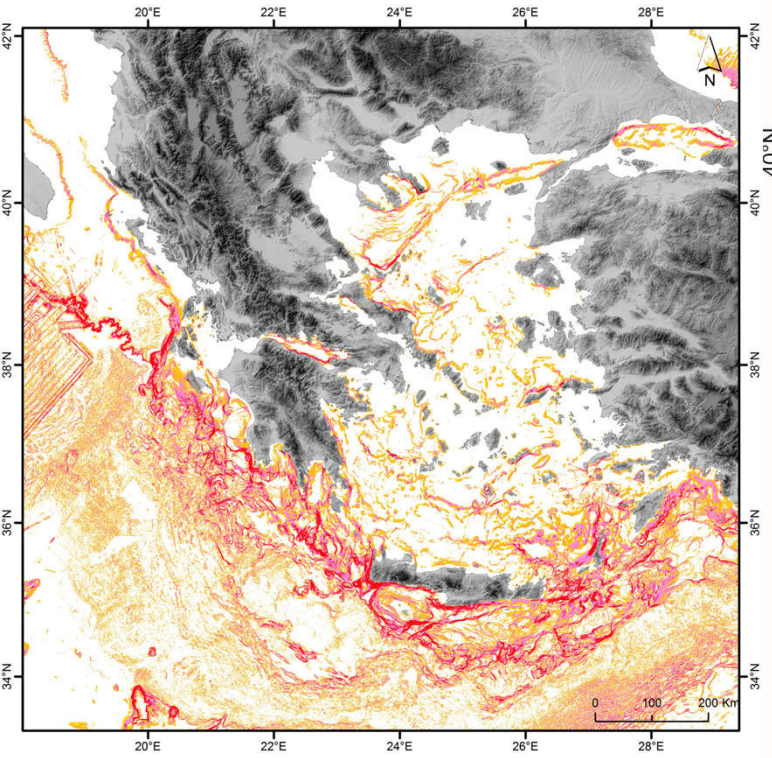




Landslide distribution in the Mediterranean Sea
(Urgeles & Camerlenghi, 2013)

Instrumentally recorded seismicity shallower than 50 km (Vannucci et al., 2004)

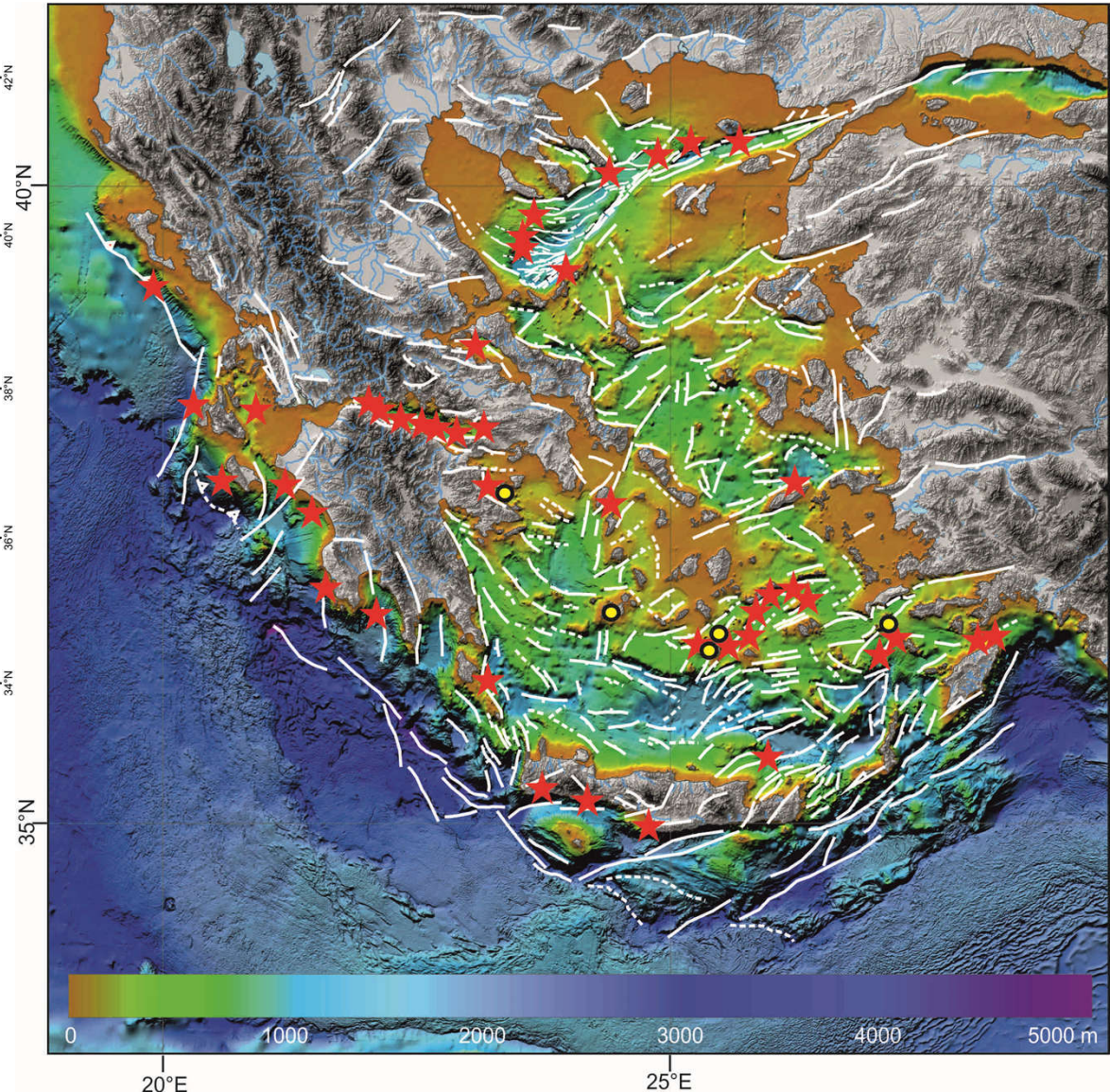
Μορφολογική Ανάλυση Υποθαλάσσιου Ανάγλυφου



Κλίση

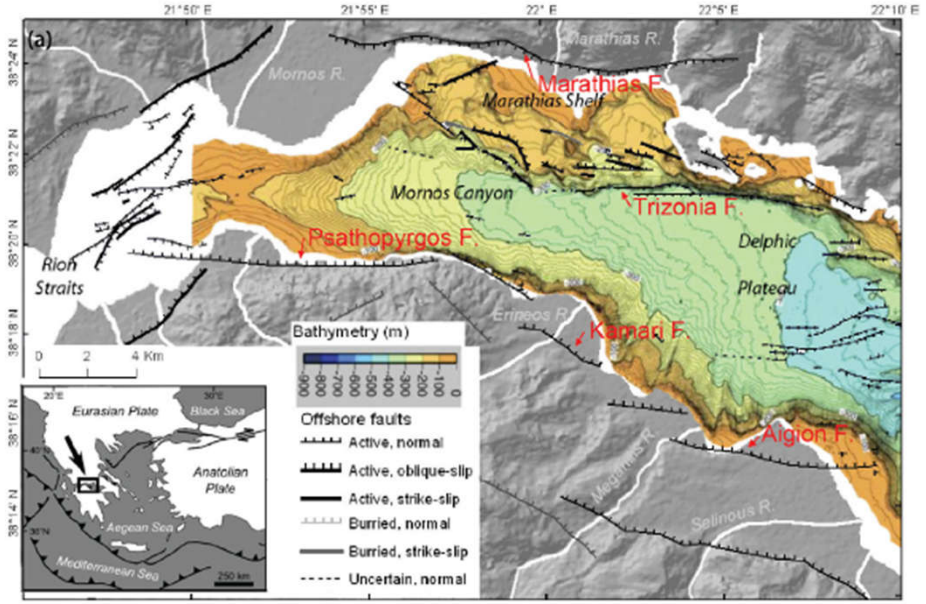
λευκό: 0-5% - Πορτοκαλί: 5-10%

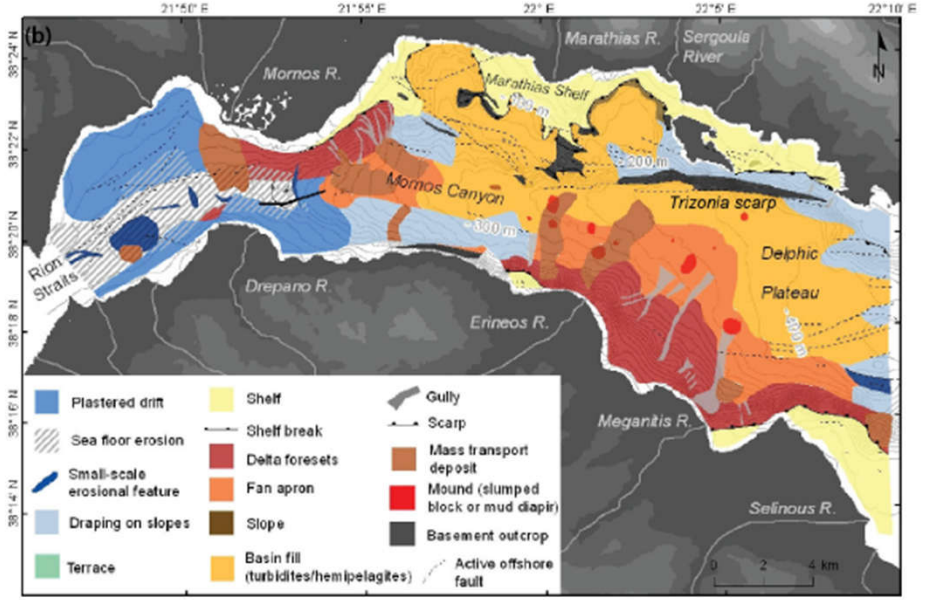
Ροζ: 10-20% - Κόκκινο: >20%

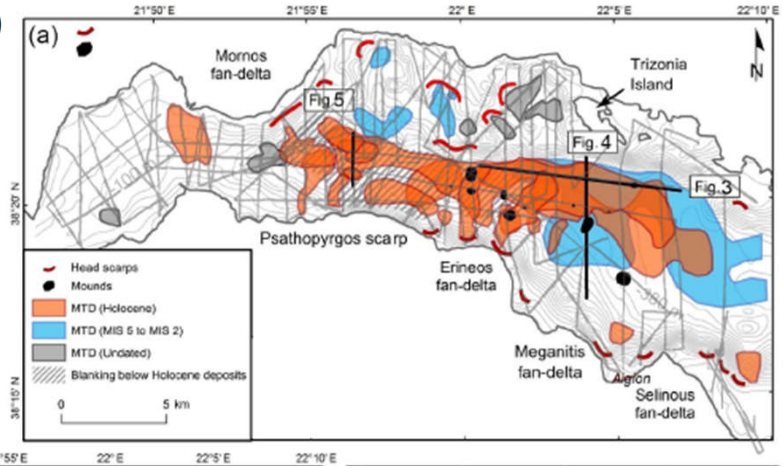


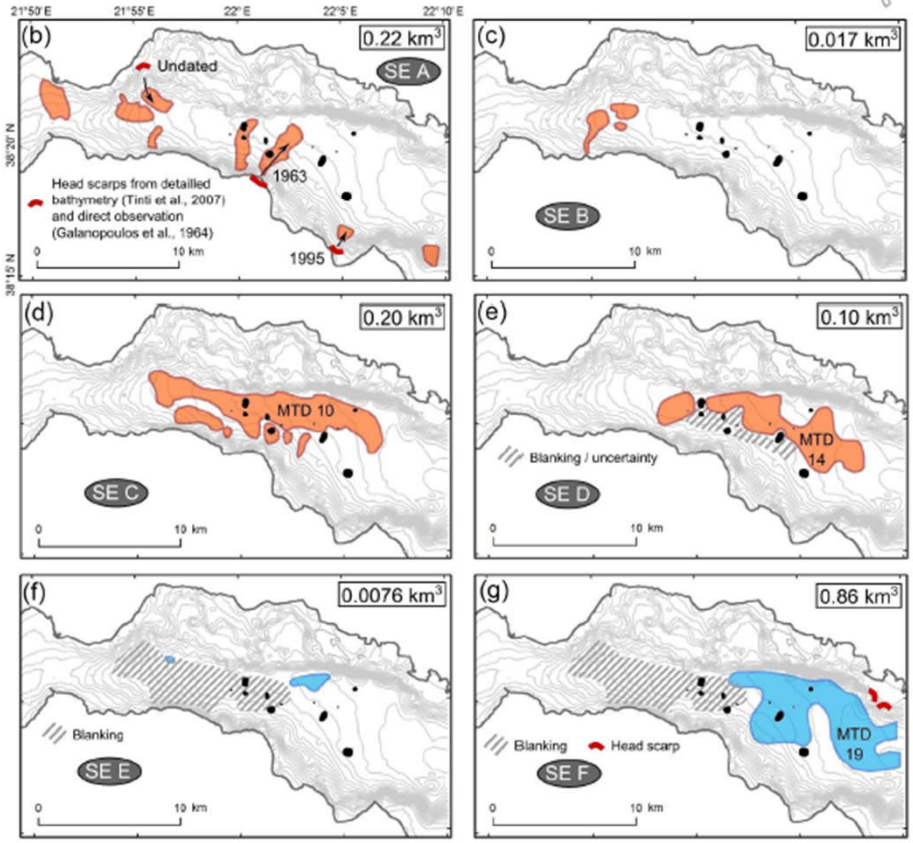
Χαρτογράφηση Υποθαλάσσιων Κατολισθήσεων

Δυτικός Κορινθιακός (Beckers et al., 2018)









Χαρτογράφηση Υποθαλάσσιων Κατολισθήσεων

Δυτικός Κορινθιακός (Beckers et al., 2018)

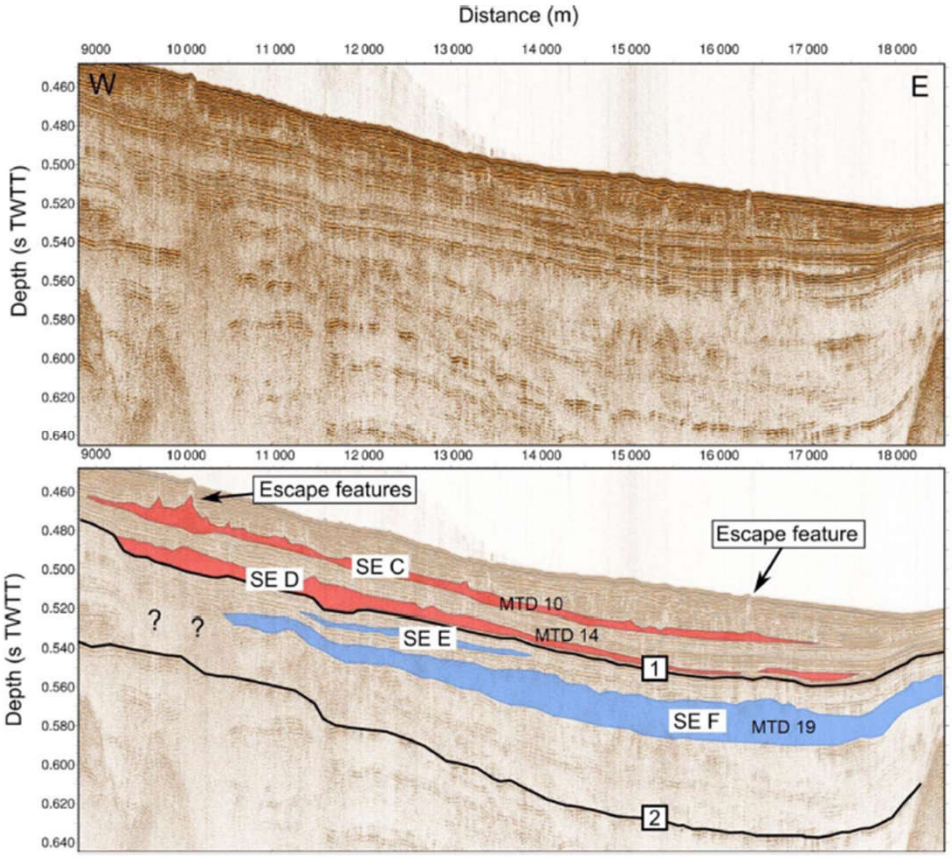


Figure 3. E–W sparker seismic profile showing the mass transport deposits imaged in the Delphic Plateau basin. Horizon (1) indicates the beginning of the last post-glacial transgression, at 10.5–12.5 ka, and horizon (2) is the marine isotopic stage 6 to 5 transgression, which occurred at ca. 130 ka (Cotterill, 2006; Beckers et al., 2015, 2016).

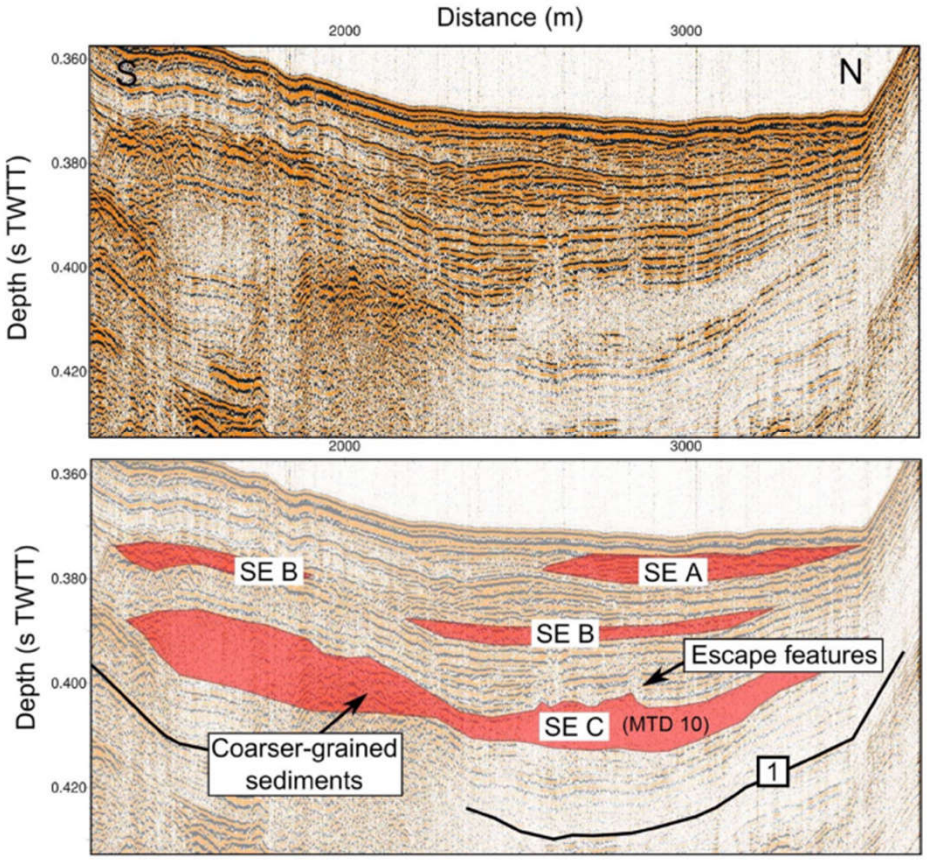
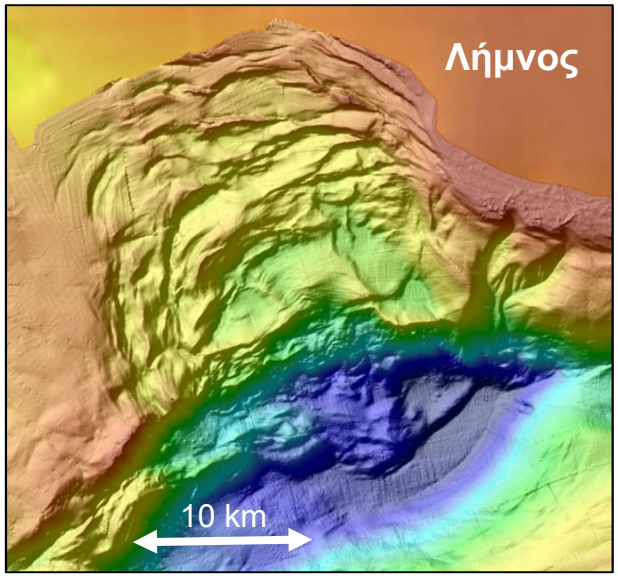
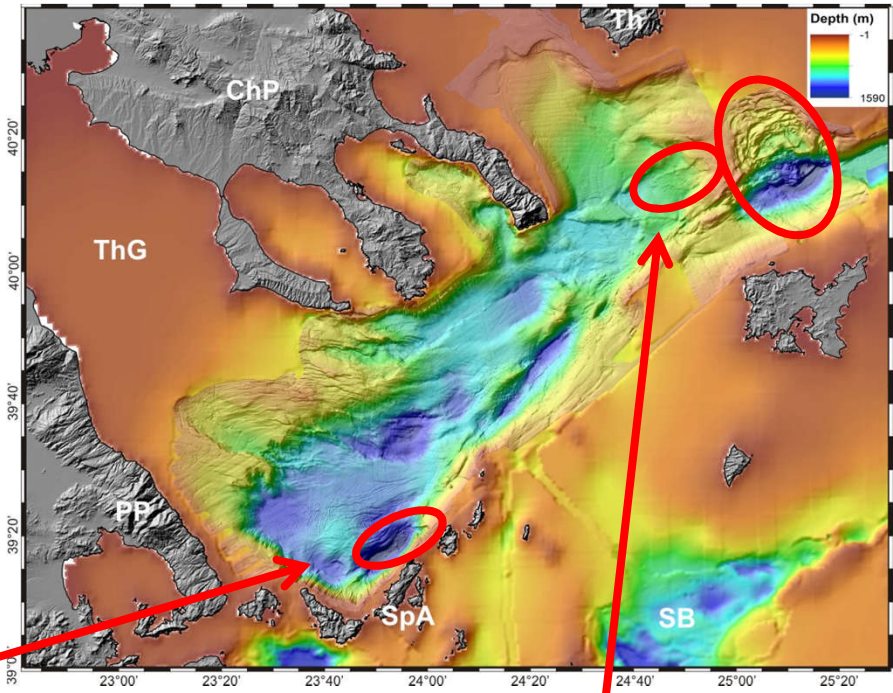


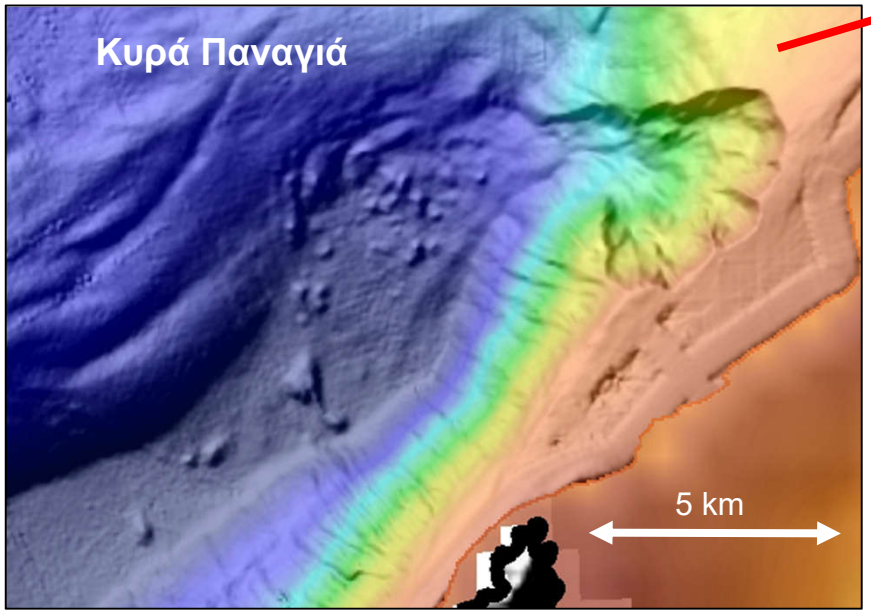
Figure 5. Examples of mass transport deposits in Mornos Canyon basin.

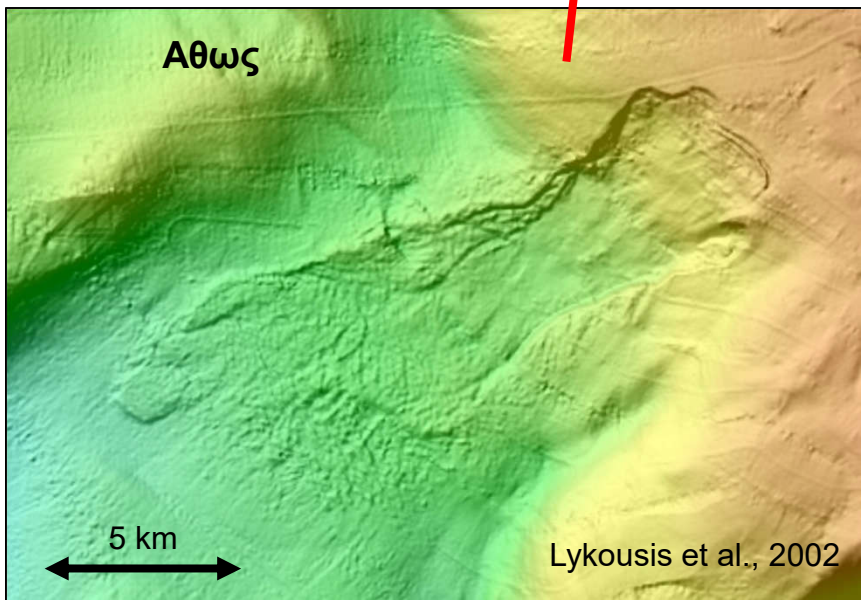
Υποθαλάσσιες κατολισθήσεις στην Τάφρο Β. Αιγαίου

Χαρτογράφηση με multibeam



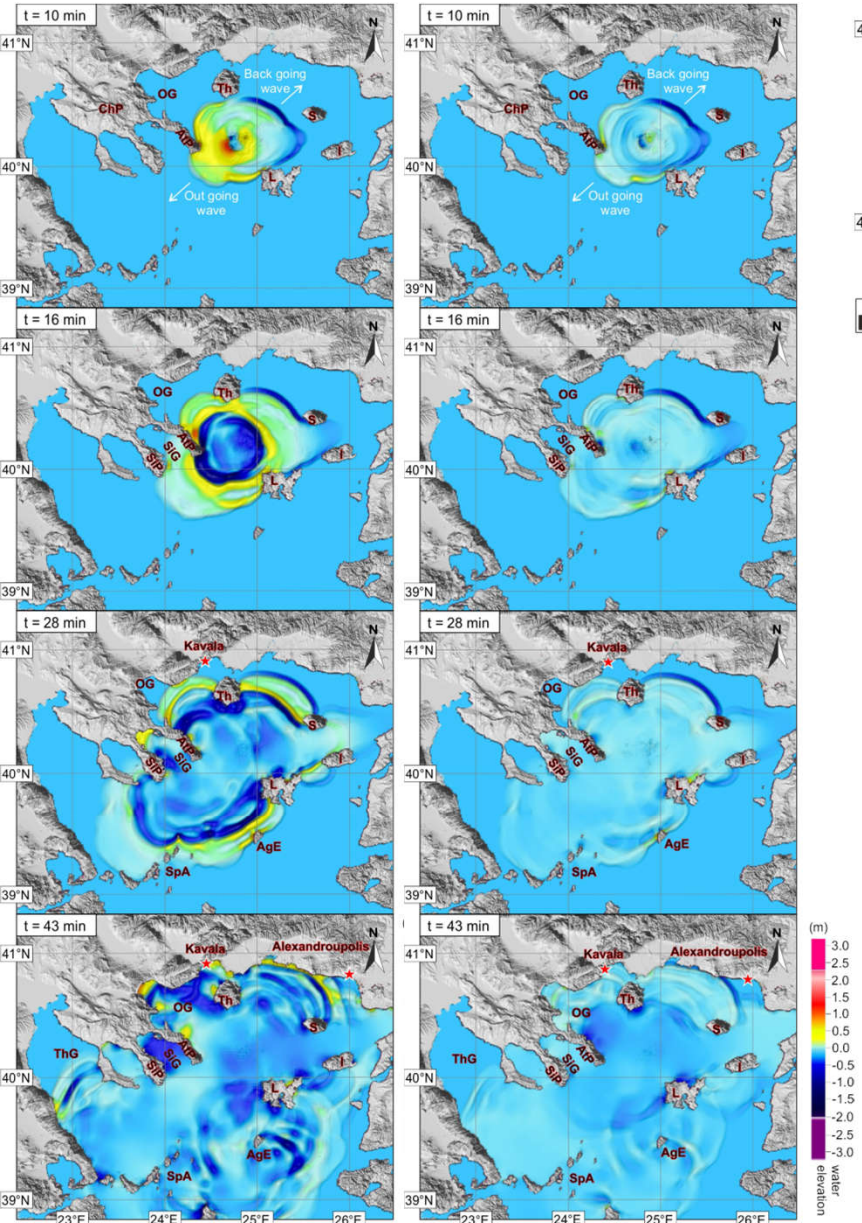


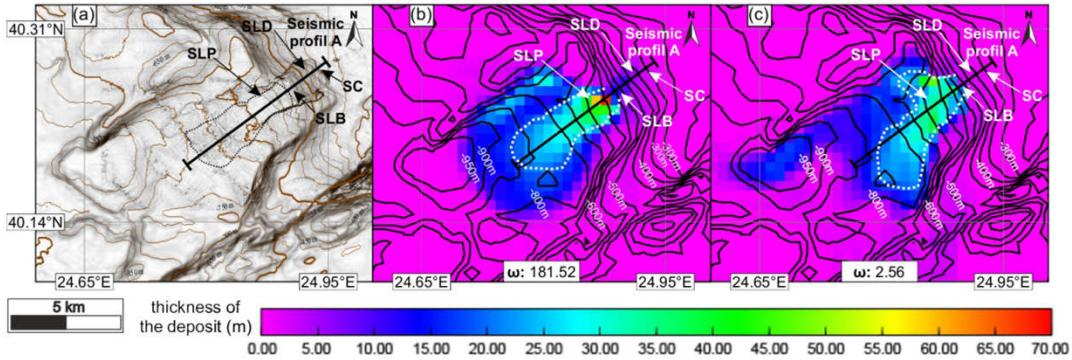


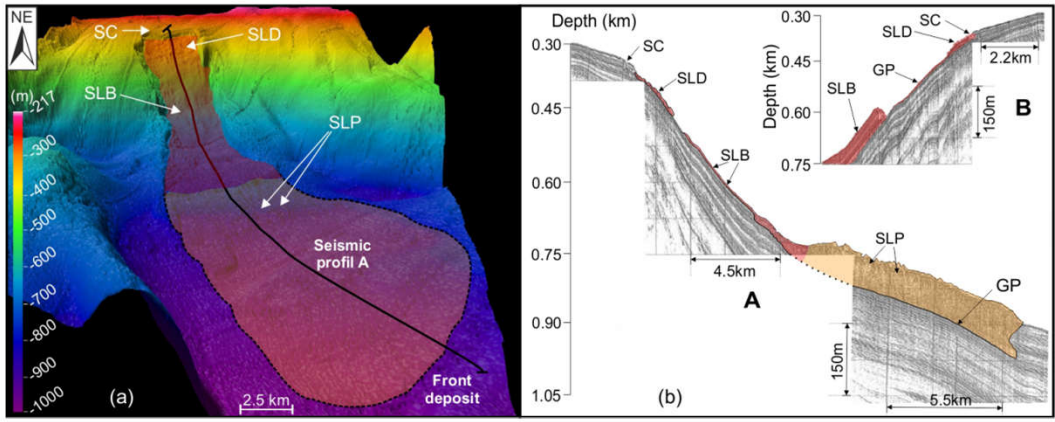


Lykousis et al., 2002

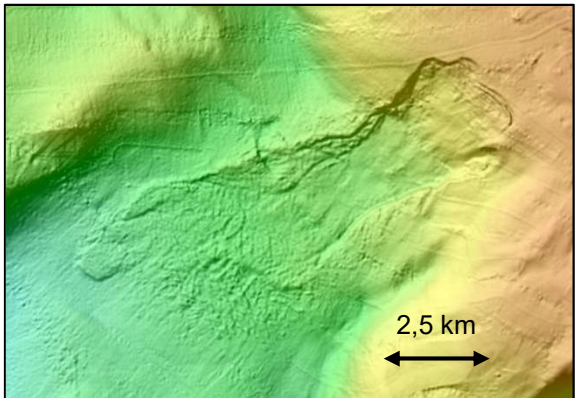
Προσομοιώσεις διάδοσης τσουνάμι



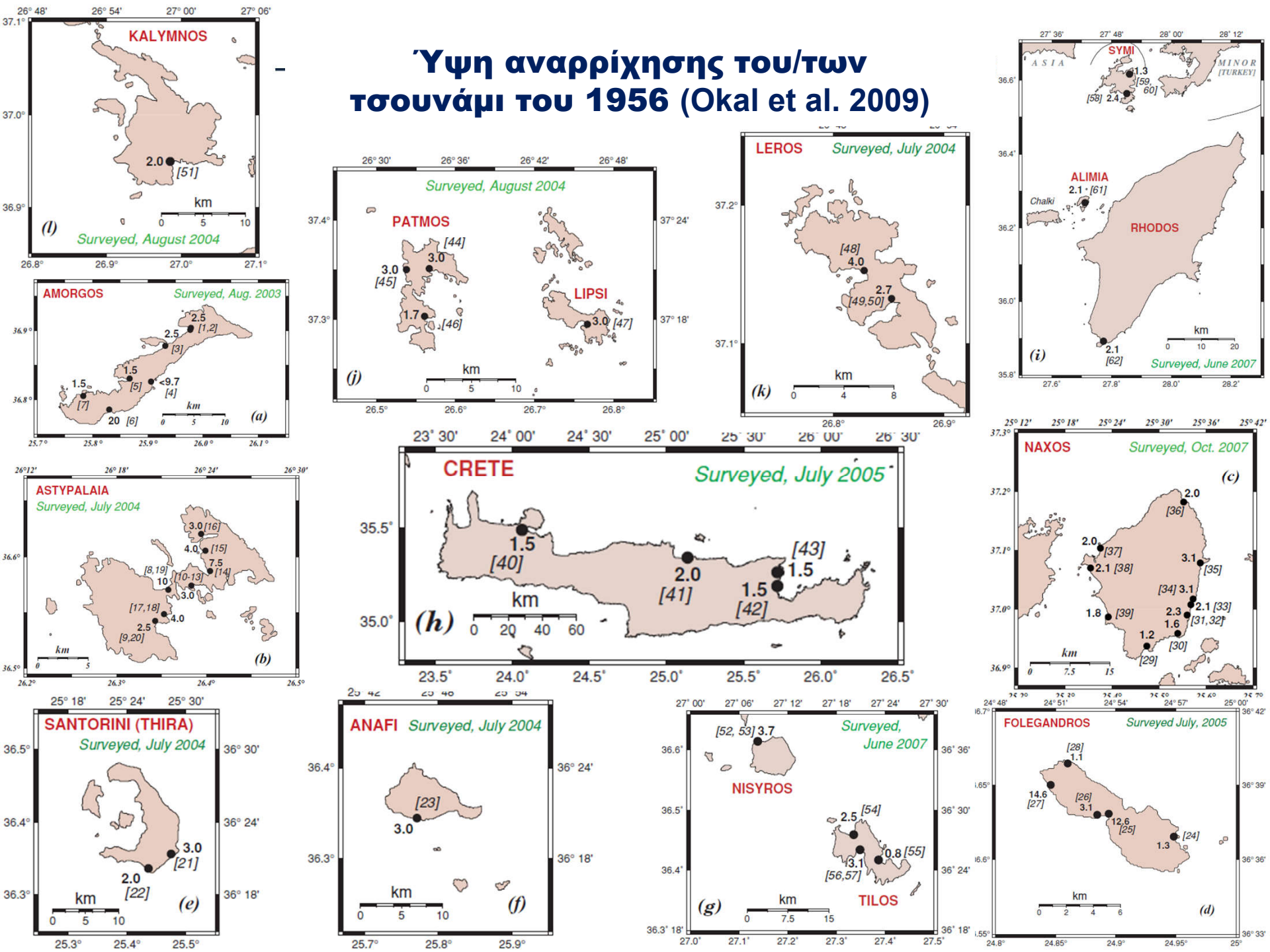


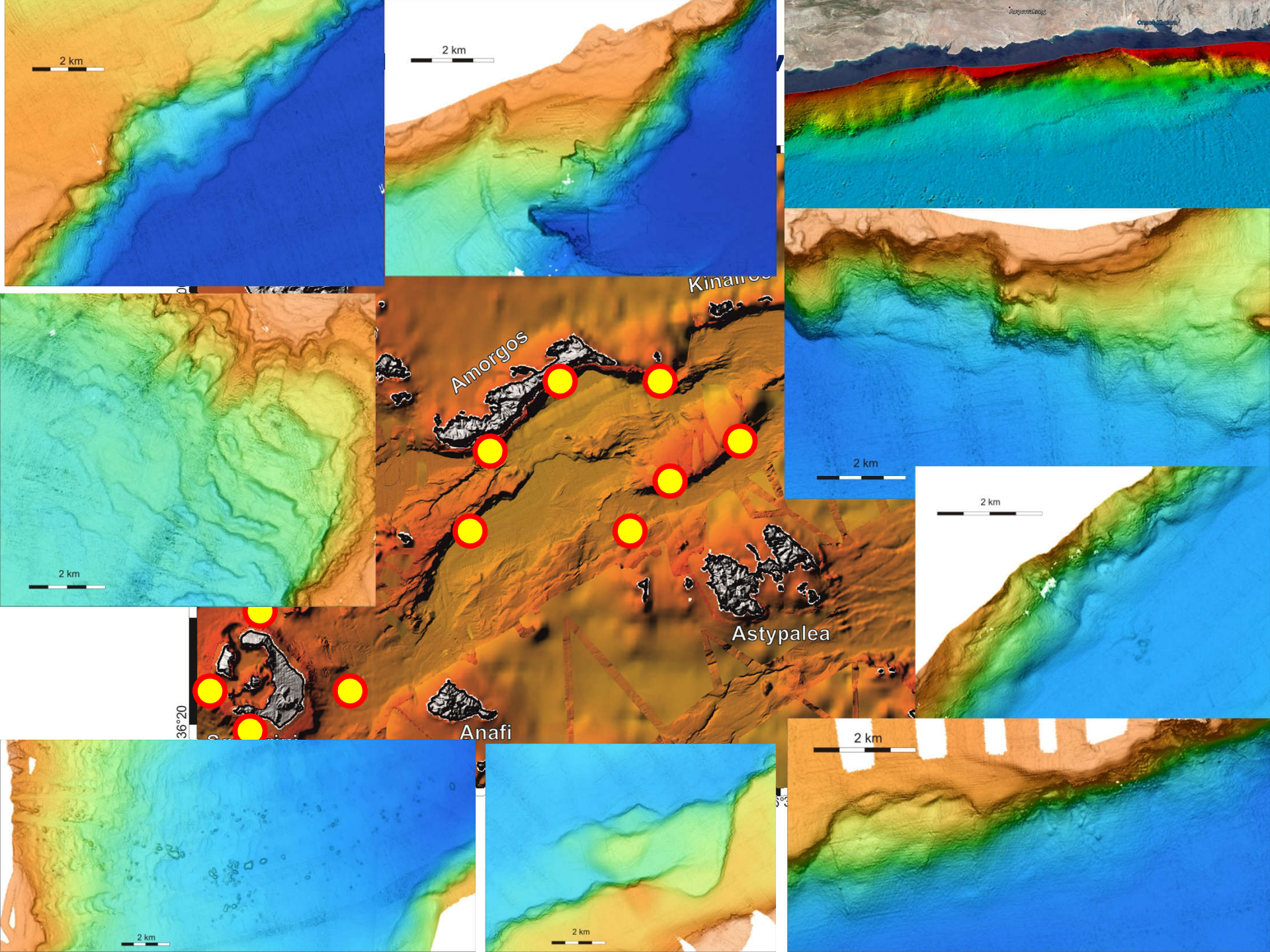


Lykousis et al, 2002
Janin et al, 2019



Ύψη αναρρίχησης του/των τσουνάμι του 1956 (Okal et al. 2009)

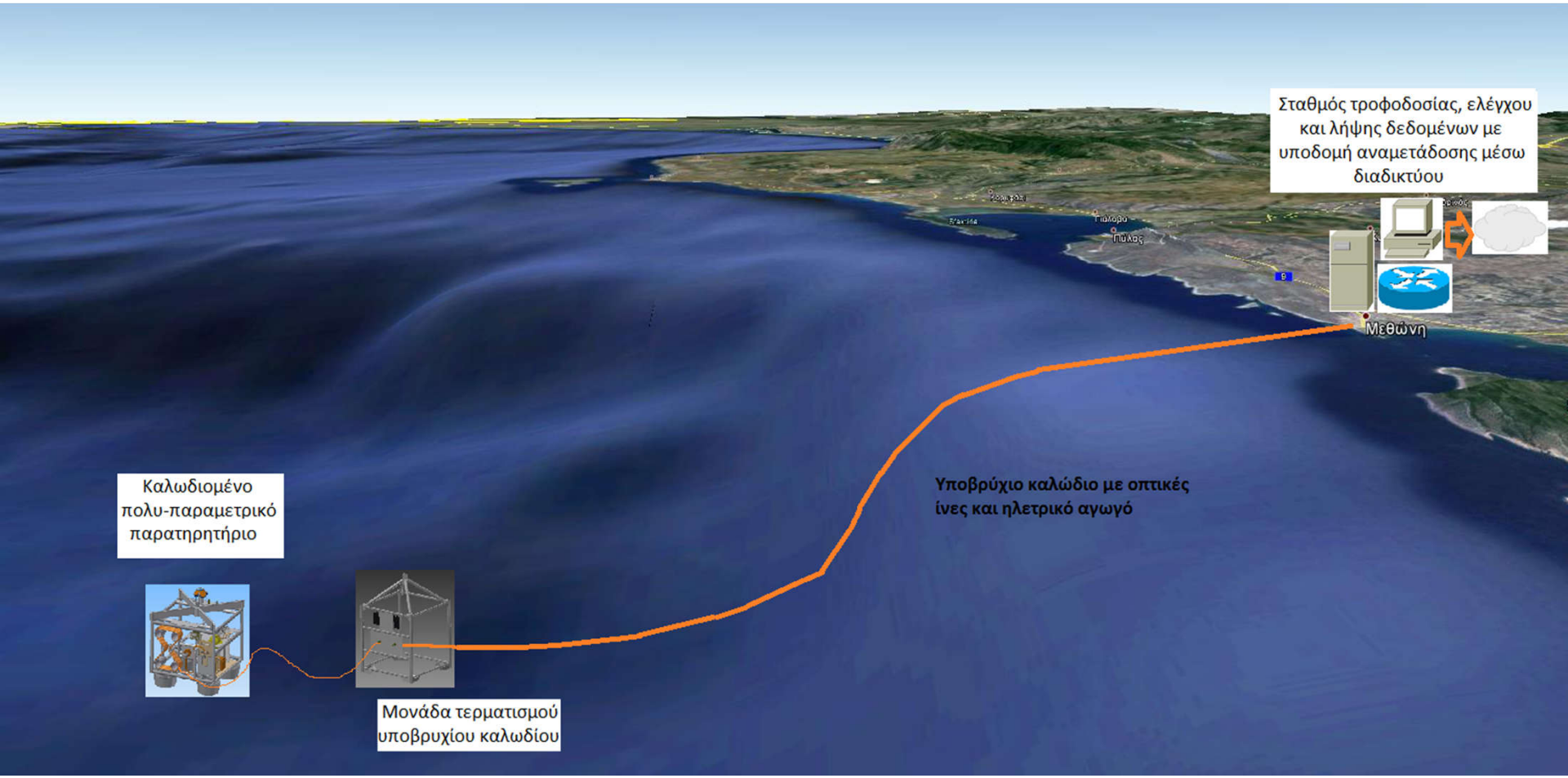



2 km
2 km
2 km
2 km
2 km
2 km
2 km
2 km
Amorgos
Astypalea
Anafi
36°20

Institute of Oceanography

EMSO - European Multidisciplinary Seafloor Observatory

EMSO-HELLENIC
Πολύ-παραμετρική πλατφόρμα βυθού, δυτικά της Μεθώνης σε 1520 μ. βάθος



EMSO-HELLENIC

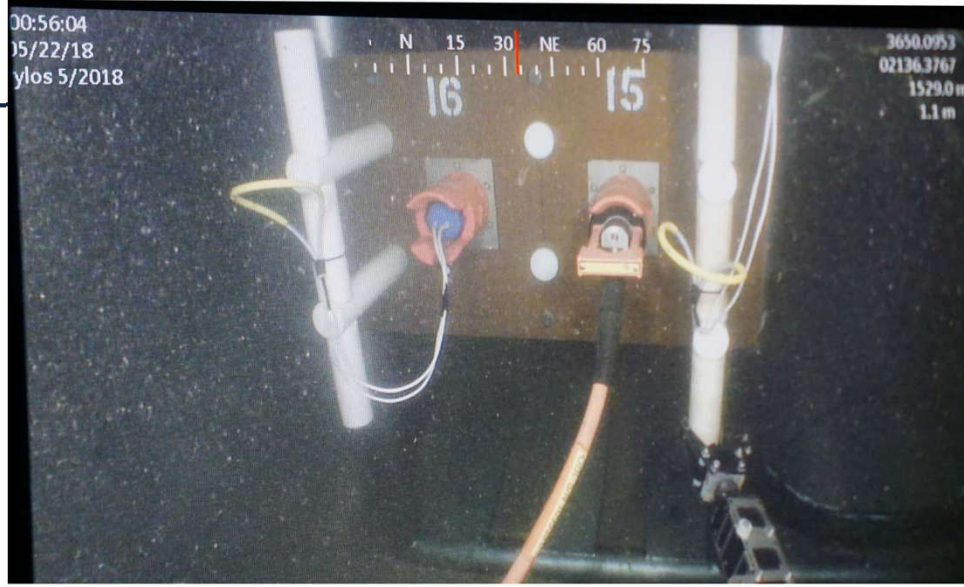
Σύνδεση με την Μεθώνη με καλώδιο οπτικών ινών μήκους15χλμ.

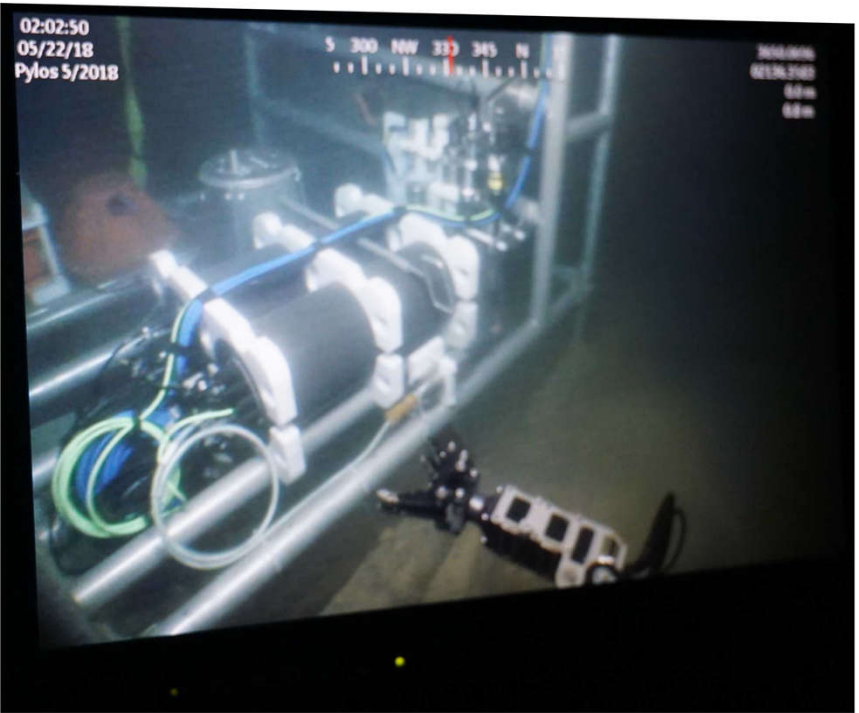
Μετάδοση δεδομένων σε πραγματικό χρόνο. Περιβαλλοντικοί Αισθητήρες (θερμοκρασία, αλατότητας, θολερότητα, διαλ. O2, θρεπτικά, CO2, CH4, βιο-ήχους.

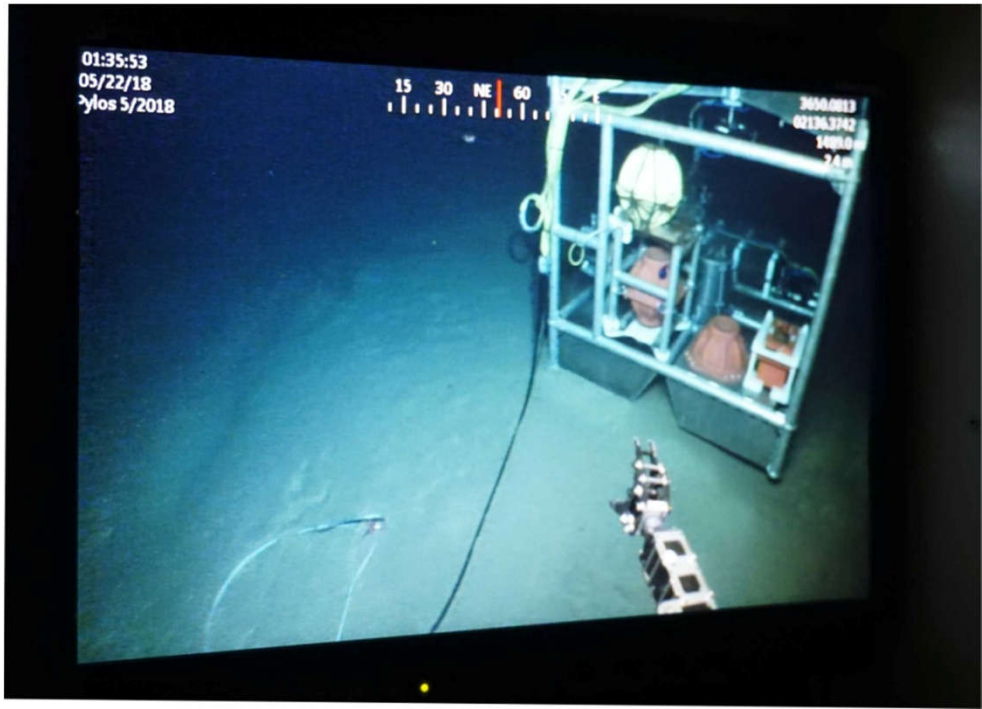
Κάμερες για παρατηρήσεις βυθού

Σεισμογράφος

Αισθητήρας πίεσης (τσουνάμι)

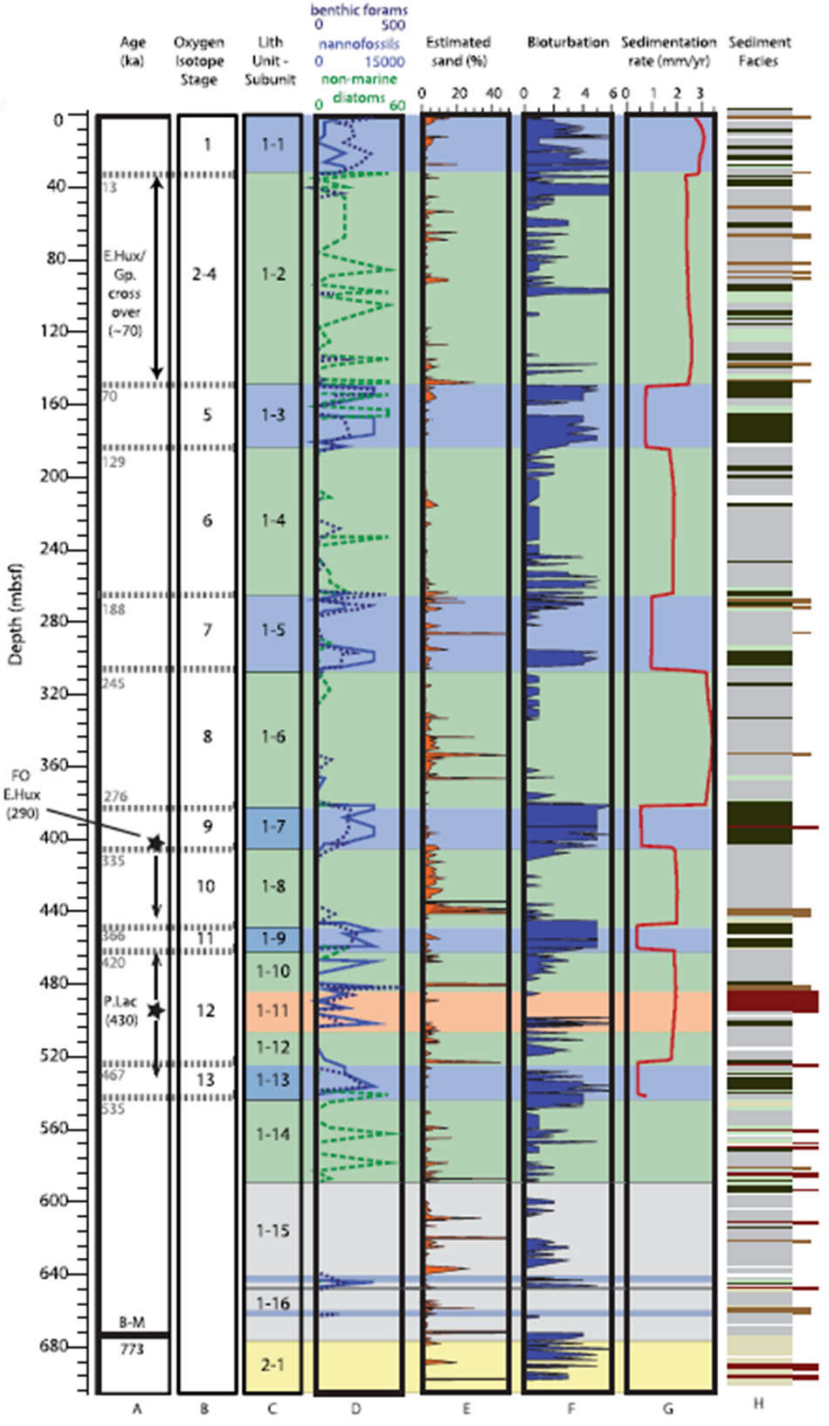




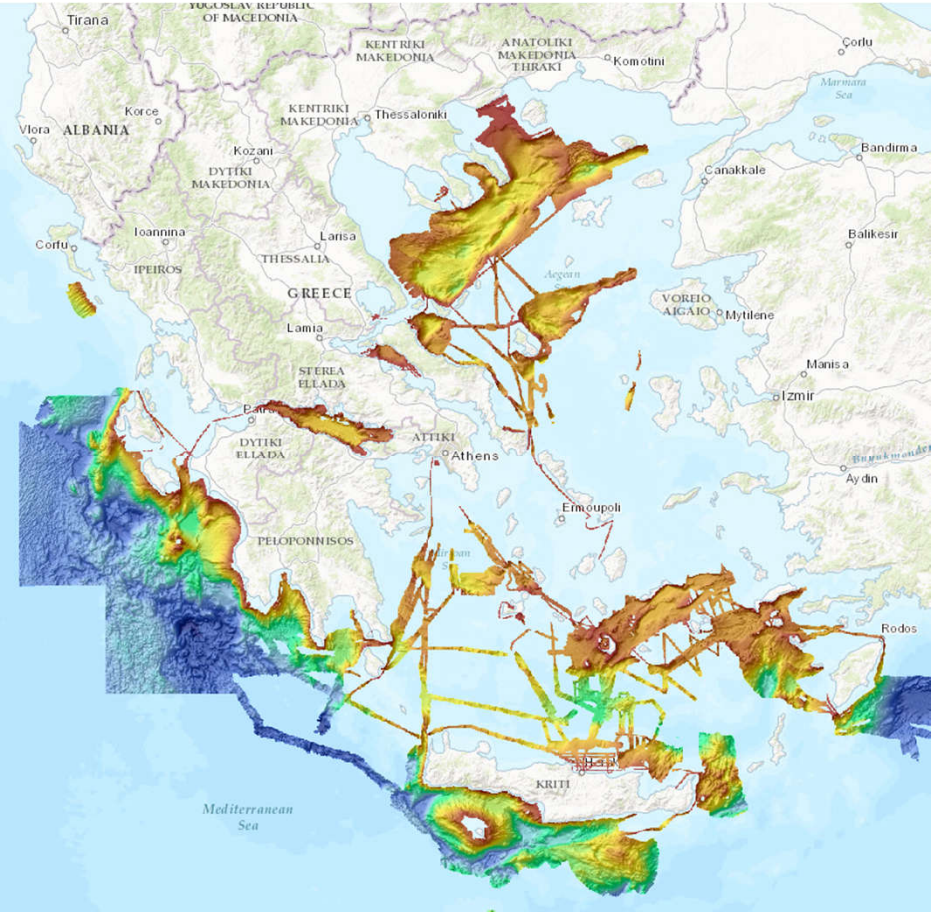


IODP/ECORD Expedition 381
Corinth Drilling

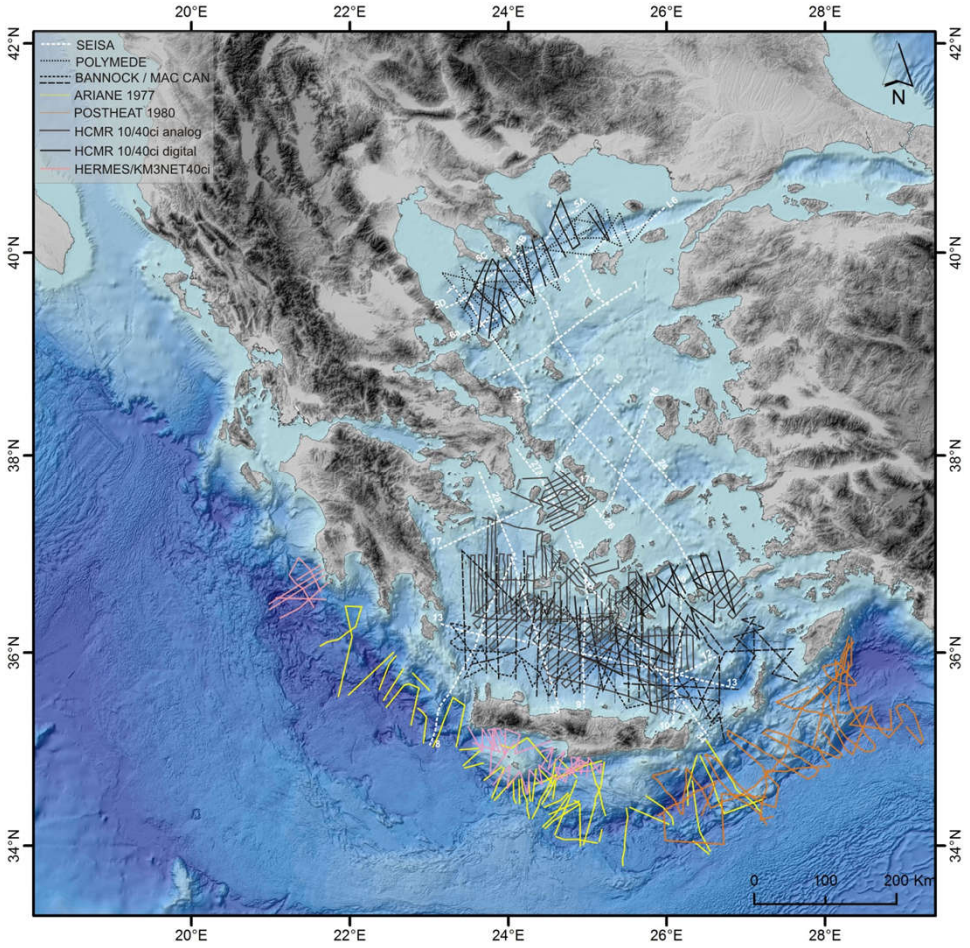
- **Natural Hazards** – What are the implications for earthquake activity in a developing rift?
- **Structural Evolution** – How does the rift actually evolve and grow and on what timescale? How did the activity on faults change with time?
- **Surface Processes** – How does the landscape respond to tectonic and climatic changes?
- **Paleoclimate reconstruction** – What was the climate and the environment of the rift basin in the last 1 to 2 million years?



Στόχος: Εθνικό Πρόγραμμα Χαρτογράφησης του Πυθμένα των Ελληνικών Θαλασσών



Μικρή κάλυψη σε λεπτομερή βυθομετρία



Μικρή κάλυψη σε σεισμικές τομές