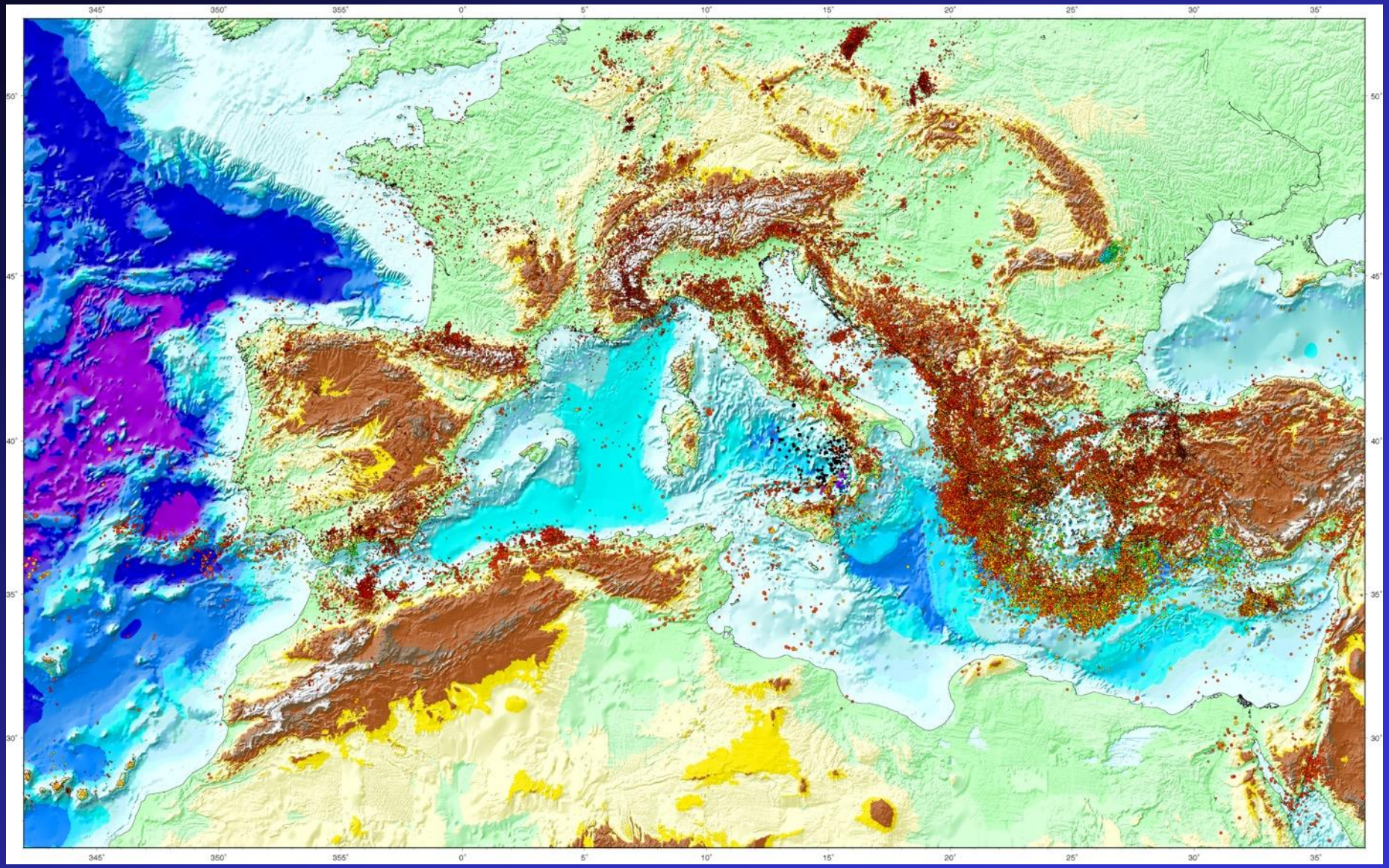
Seismic zones and sources in the NEAM region – Their tsunamigenic potential

UNESCO tsunami Meeting, Paris, 18-20 March 2025

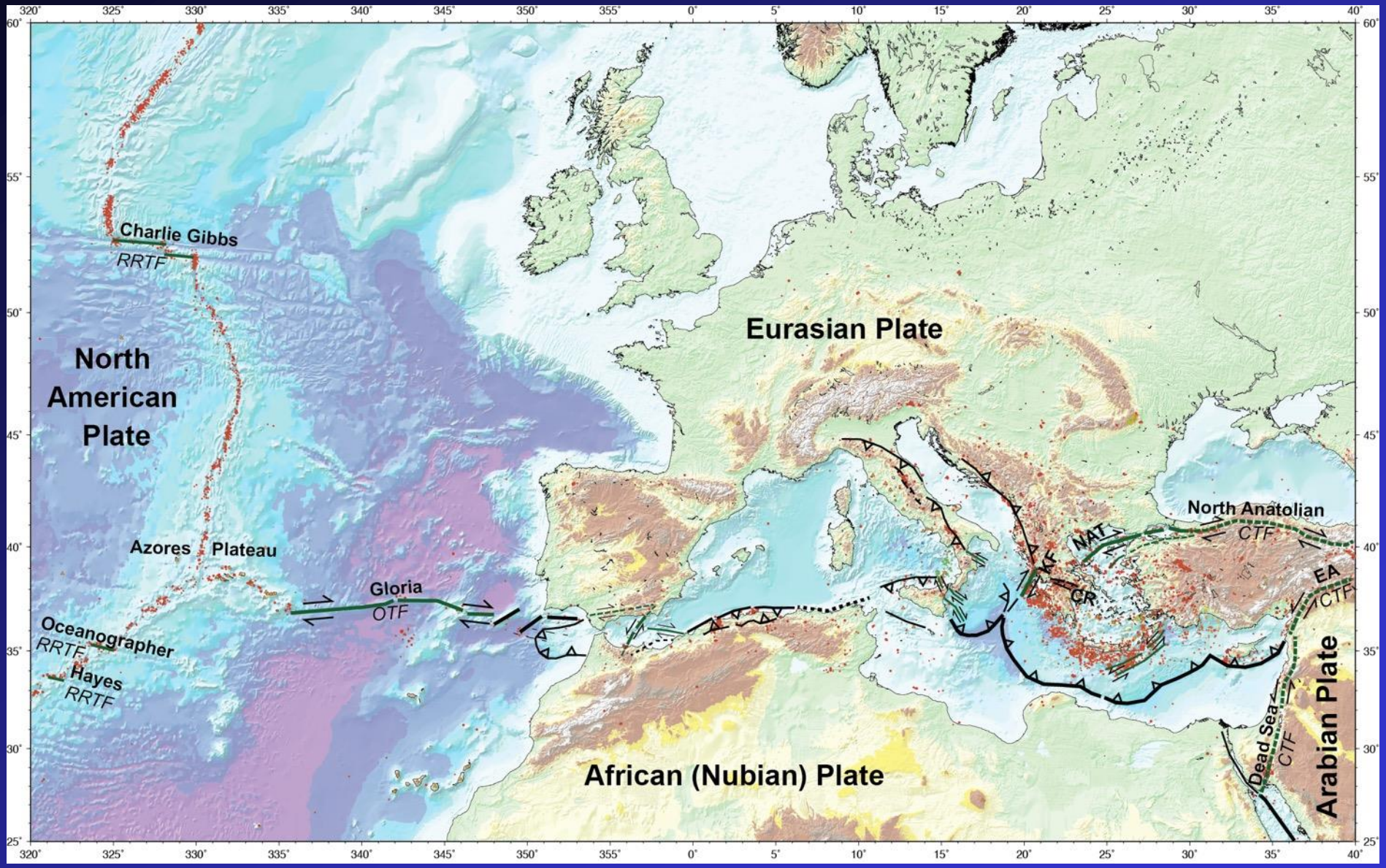
Destruction of Lisbon, XVIII print GEO, Lisboa

M.-A. Gutscher - Geo-Ocean, (CNRS, Univ Brest, Ifremer) FRANCE

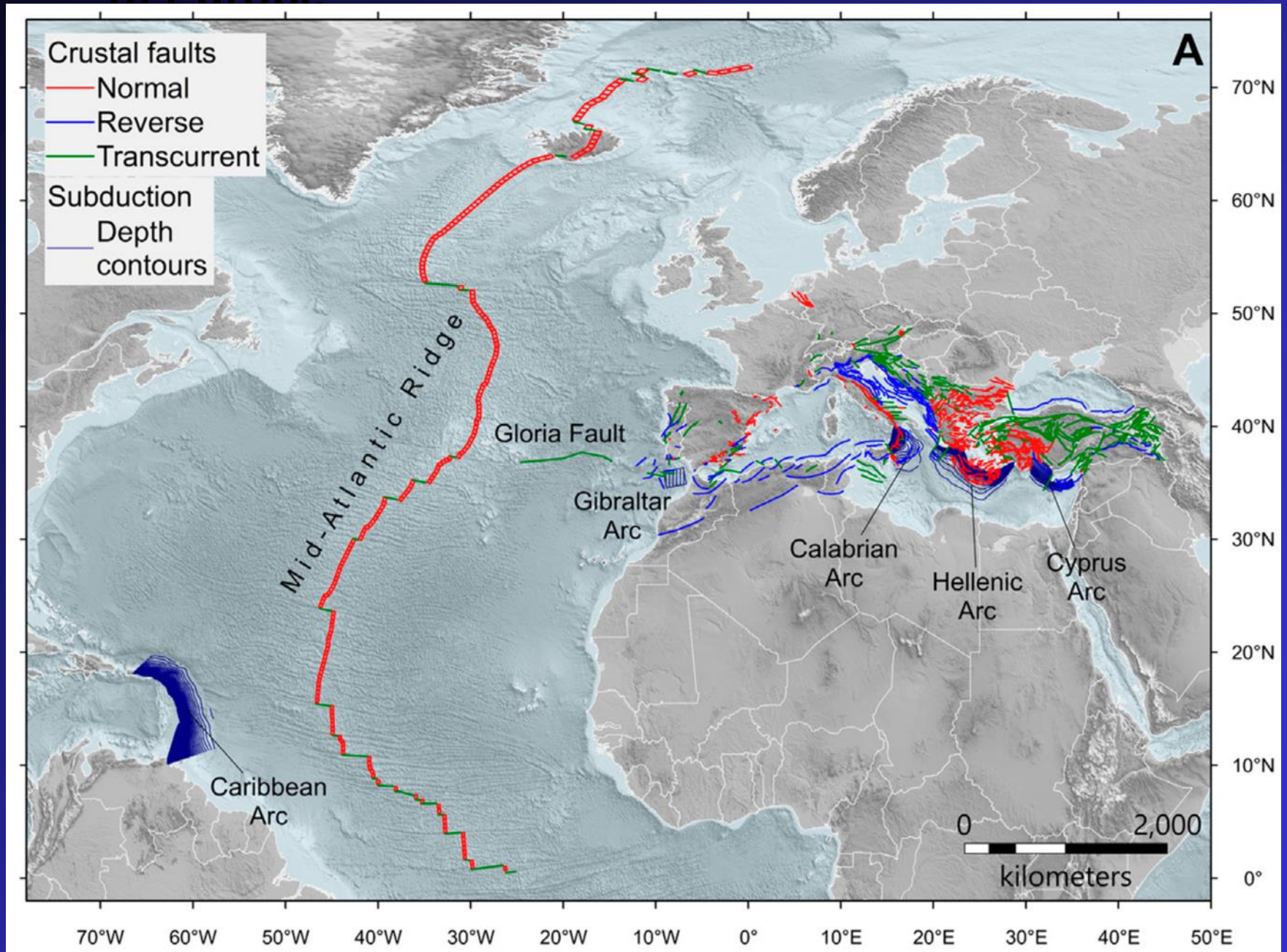
Europe - Mediterranean region: seismicity and relief



NE Atlantic - Euro - Med region: plate boundaries, faults (Hensen et al., 2019, Frontiers Earth Sci.)



North Atlantic - Mediterranean active faults map (Basili et al., 2018)



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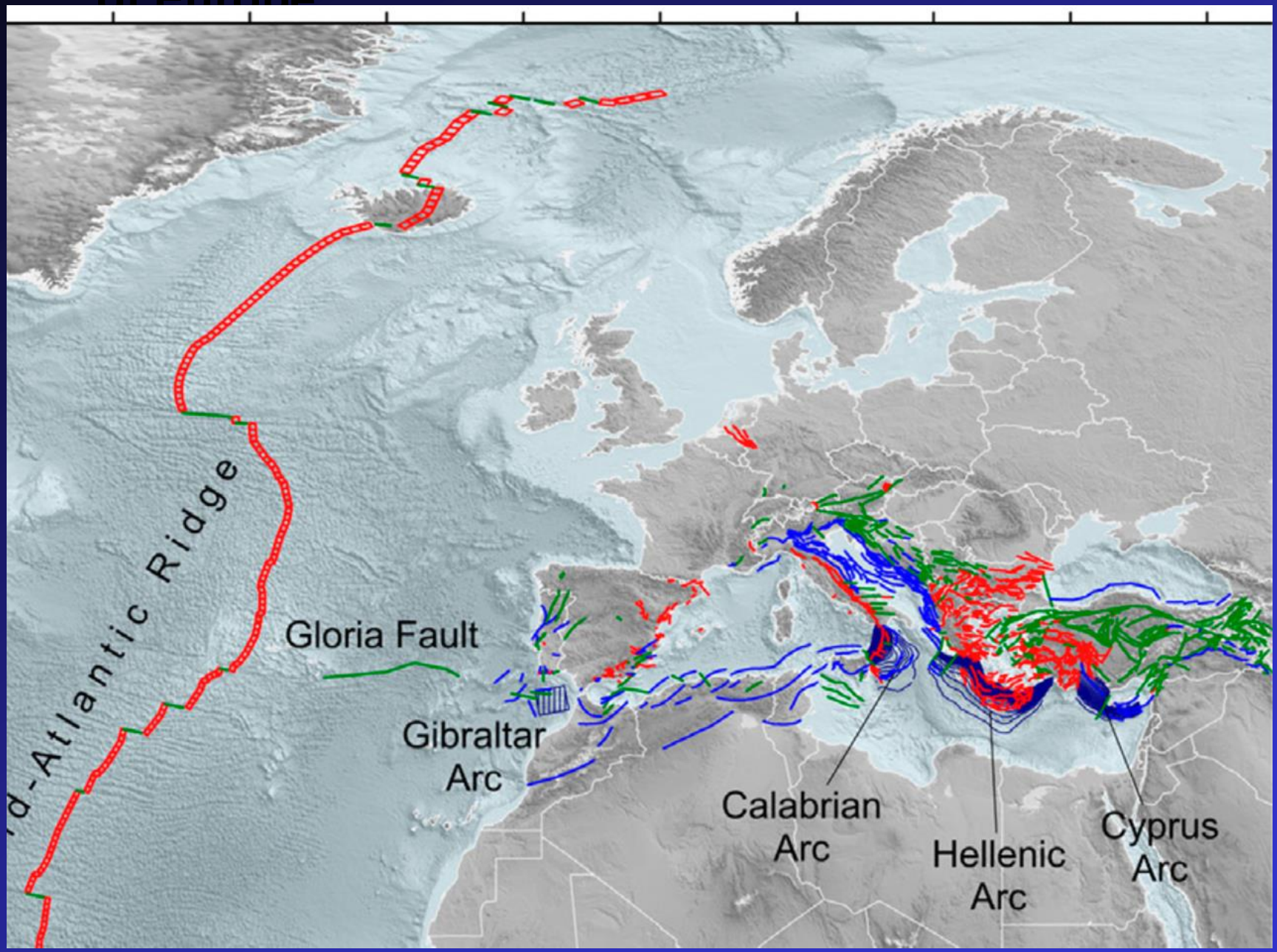
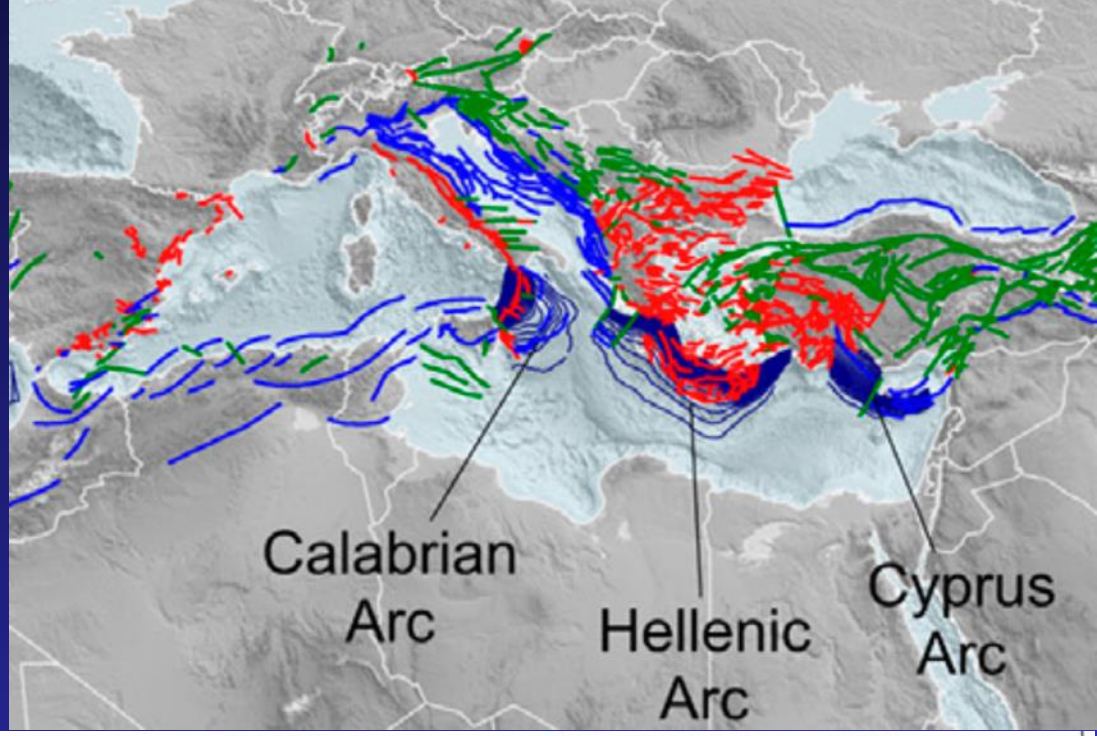
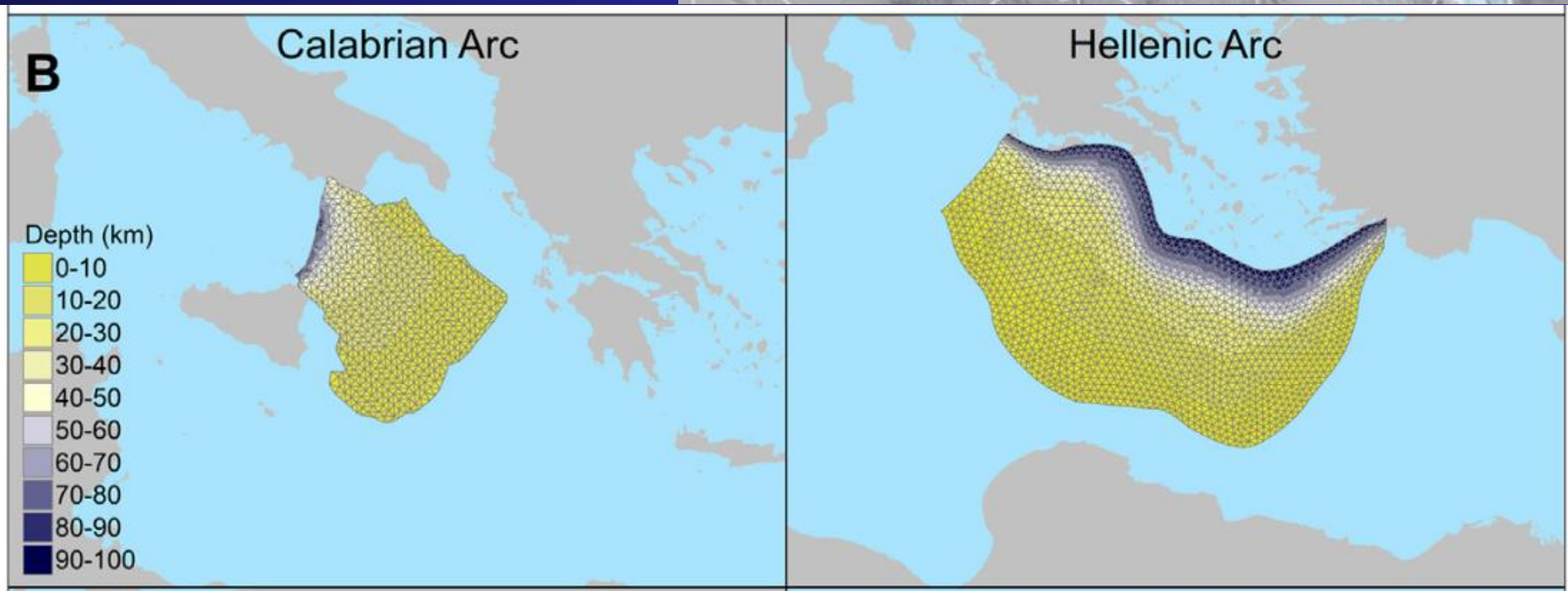
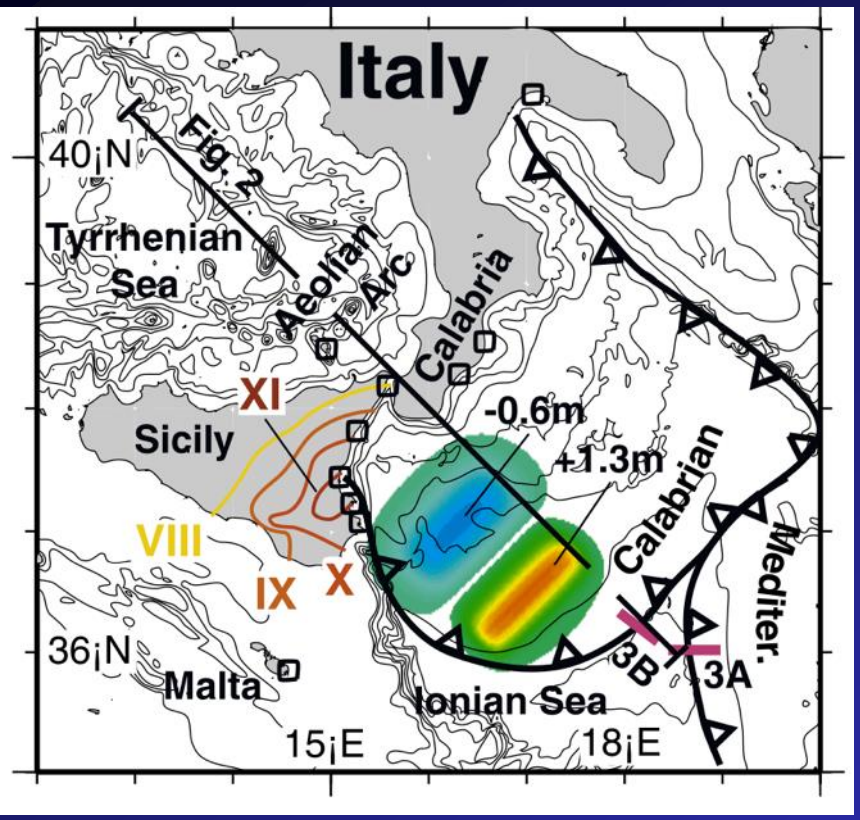


Mediterranean: Calabrian & Hellenic arcs source zones (Basili et al., 2018)

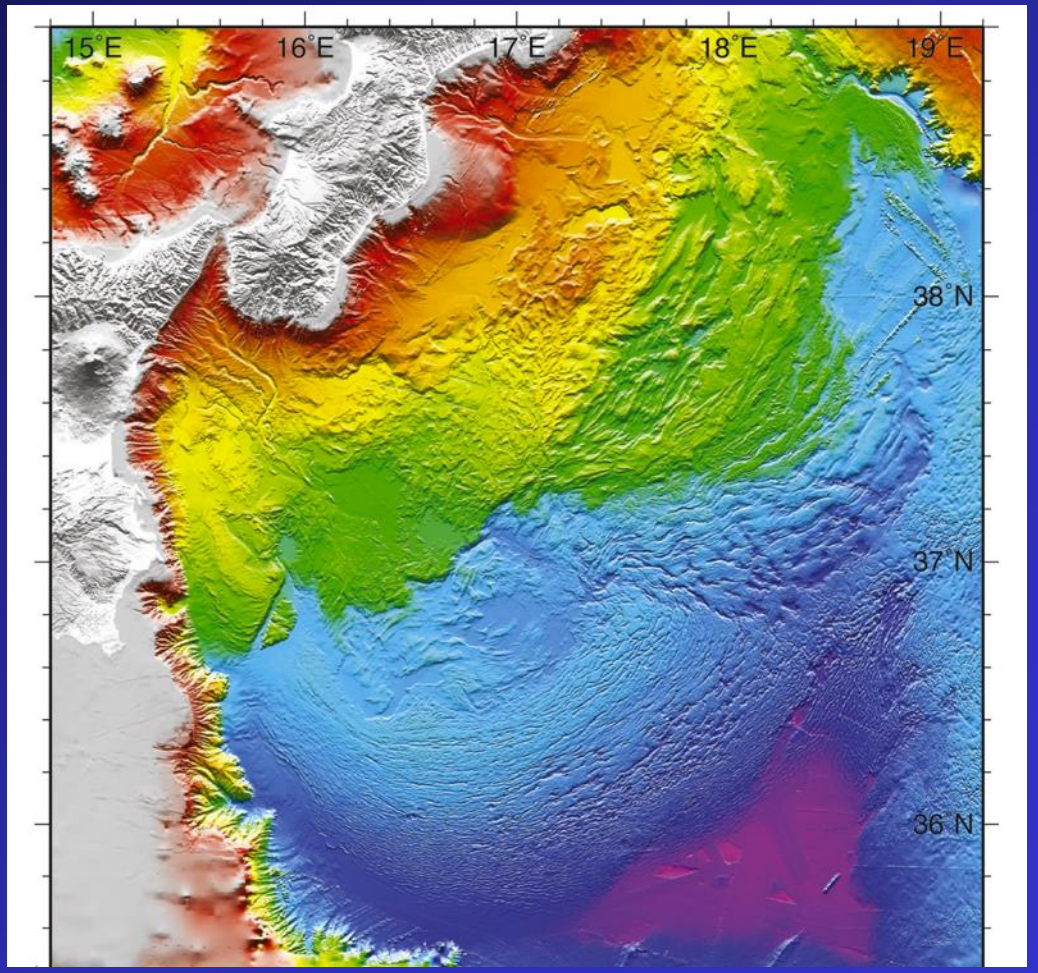


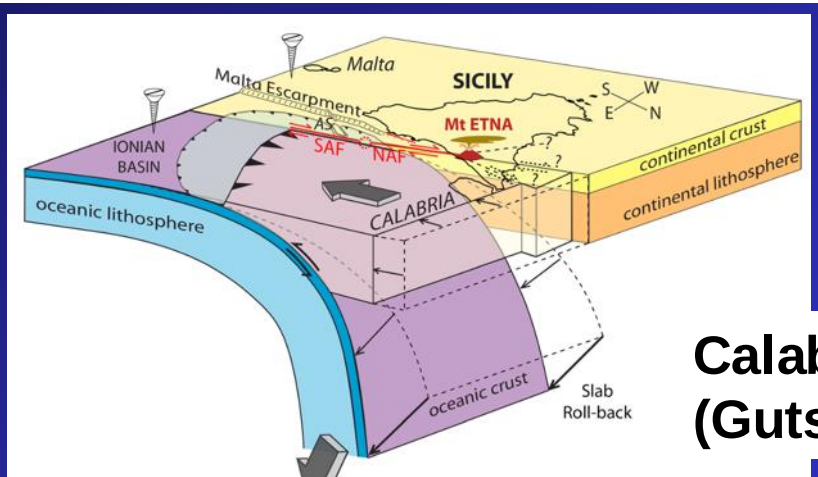


Tsunami modeling (Gutscher et al., 2006, GRL)



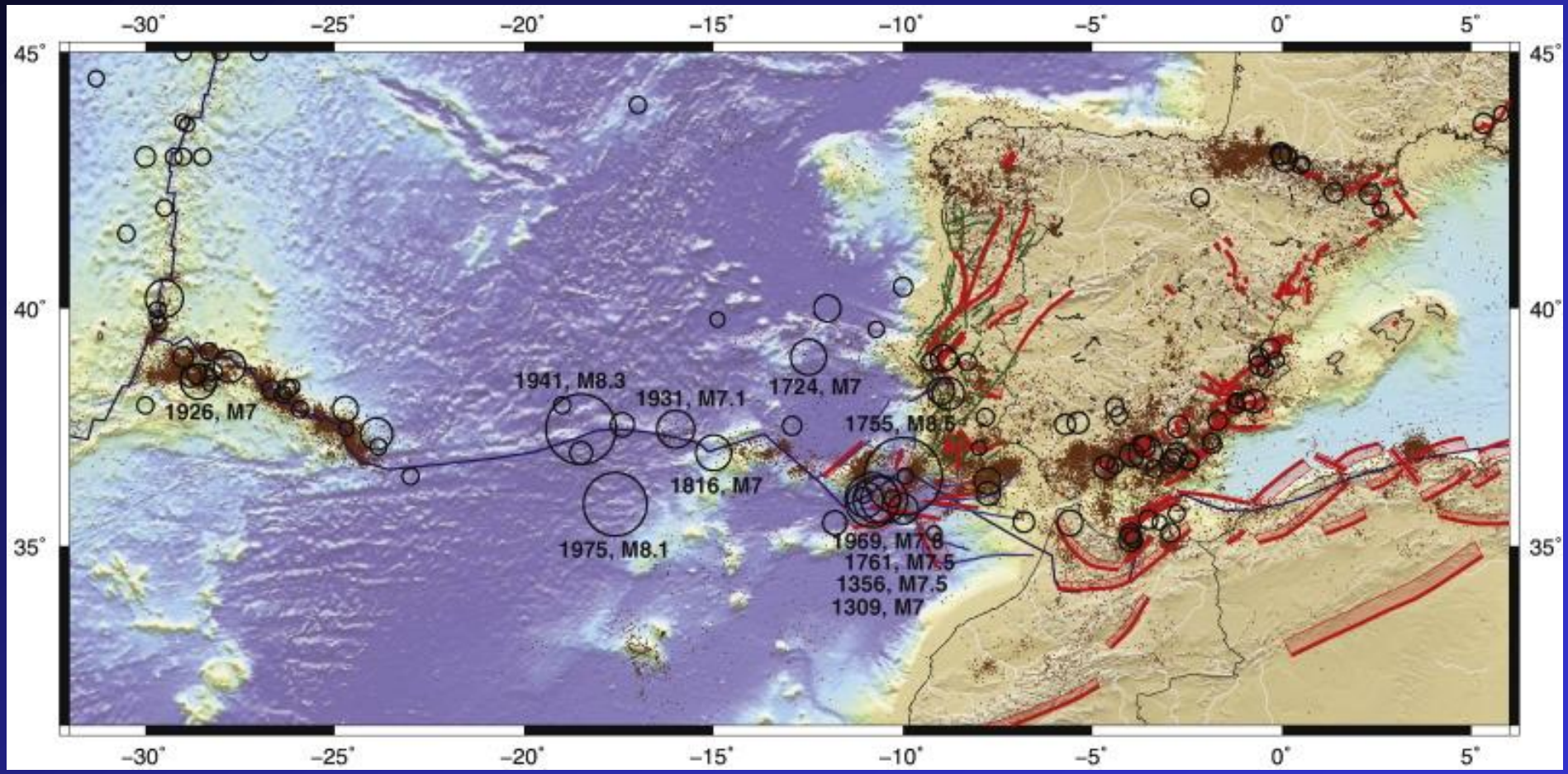
Calabrian arc bathymetric map (Gutscher et al., 2017, EPSL)



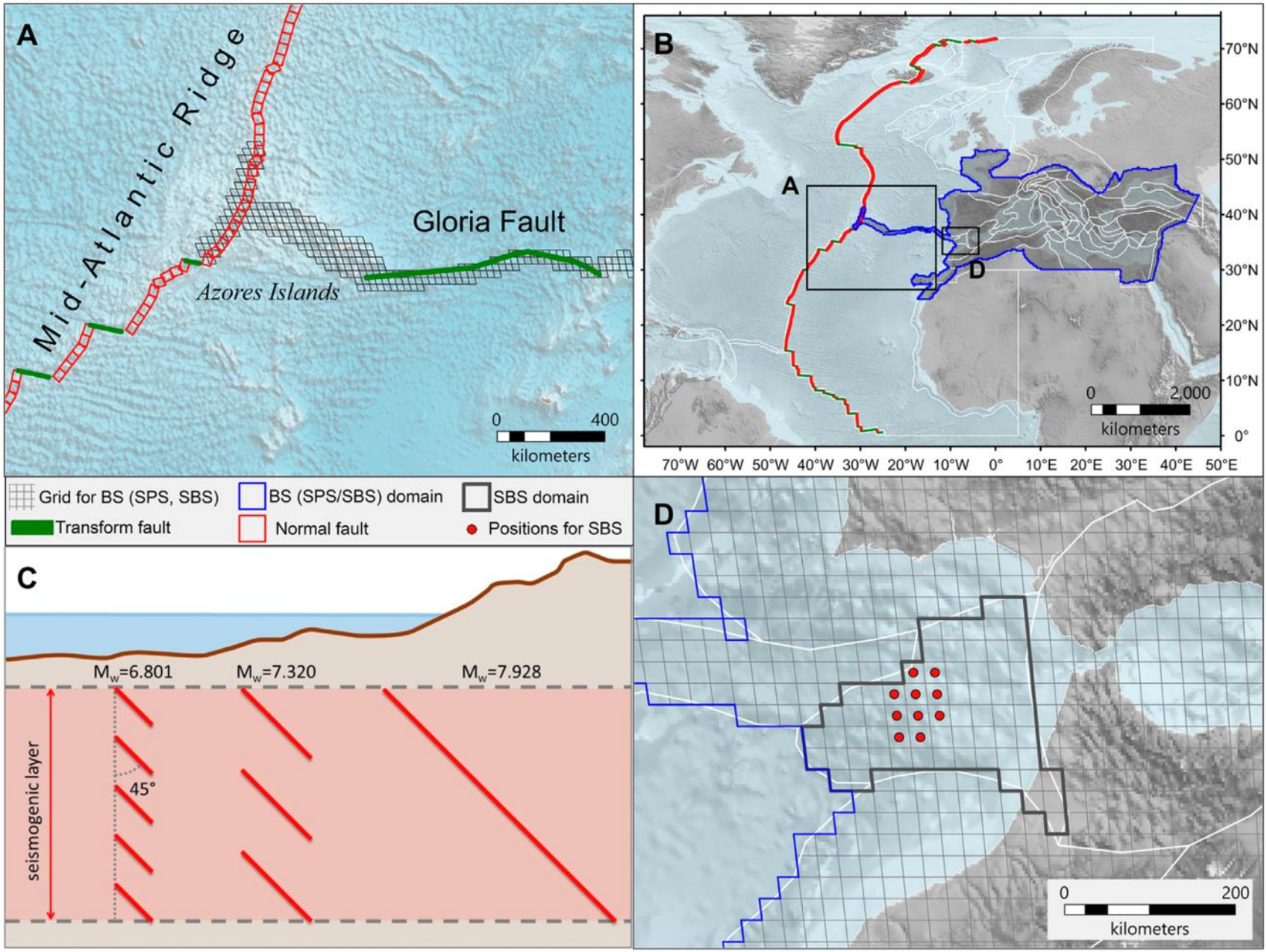


Calabrian subduction 3-D block model (Gutscher et al., 2016,Tectonics)

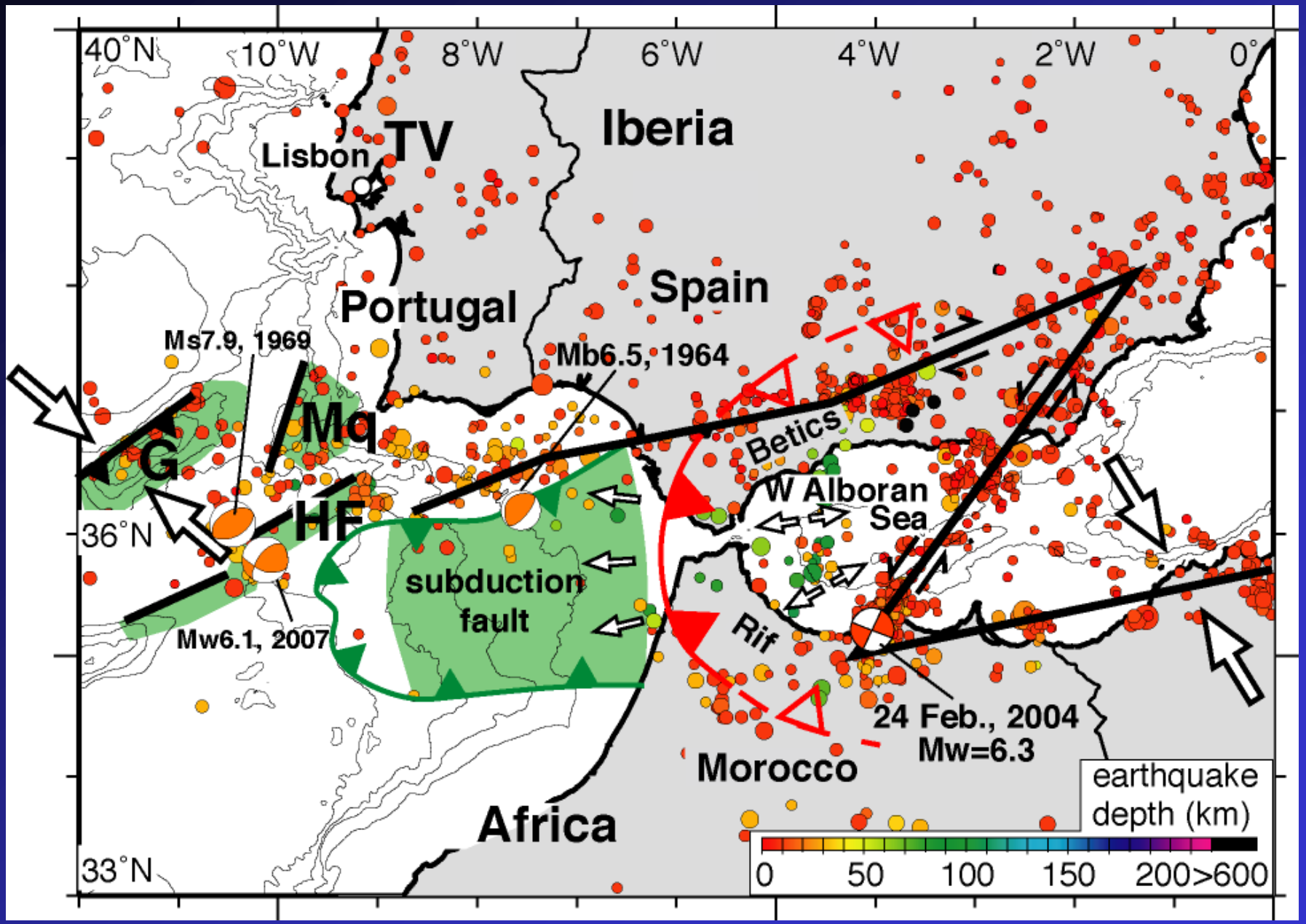
Gloria Fault (Azores - Gibraltar transform) seismicity (Custodio et al., 2016)



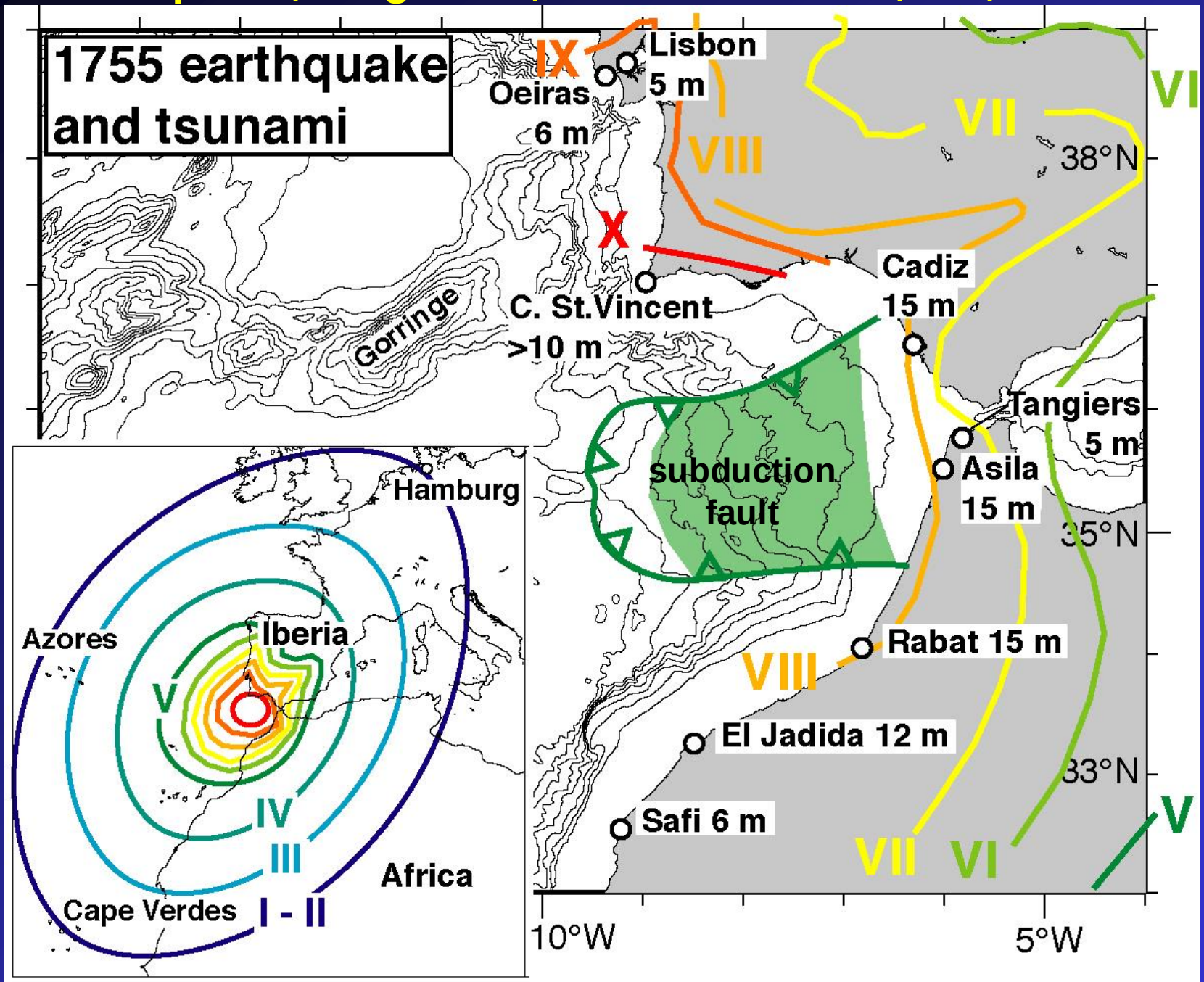
Gloria Fault and Gibraltar Arc possible tsunami sources (Basili et al., 2018)



Recent seismicity and active faults in S. Iberia region

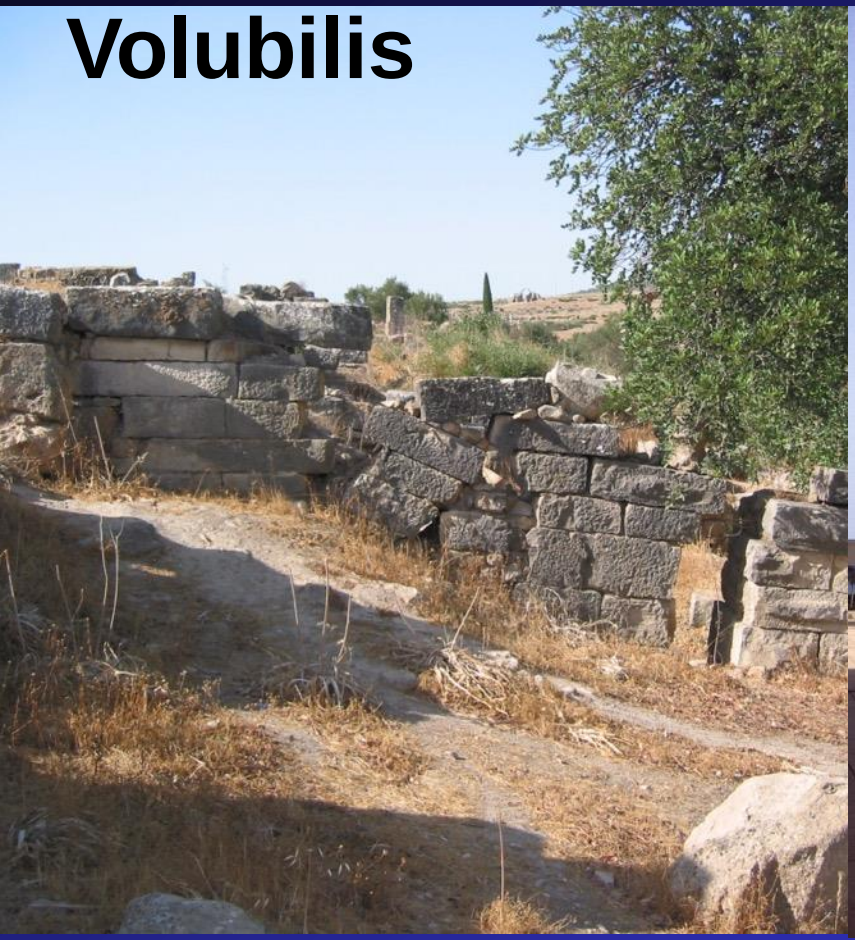


1755 earthquake, magn. 8.7, 5-15 m tsunami, 60,000 victims



Effects of the 1755 earthquake in Morocco

Volubilis

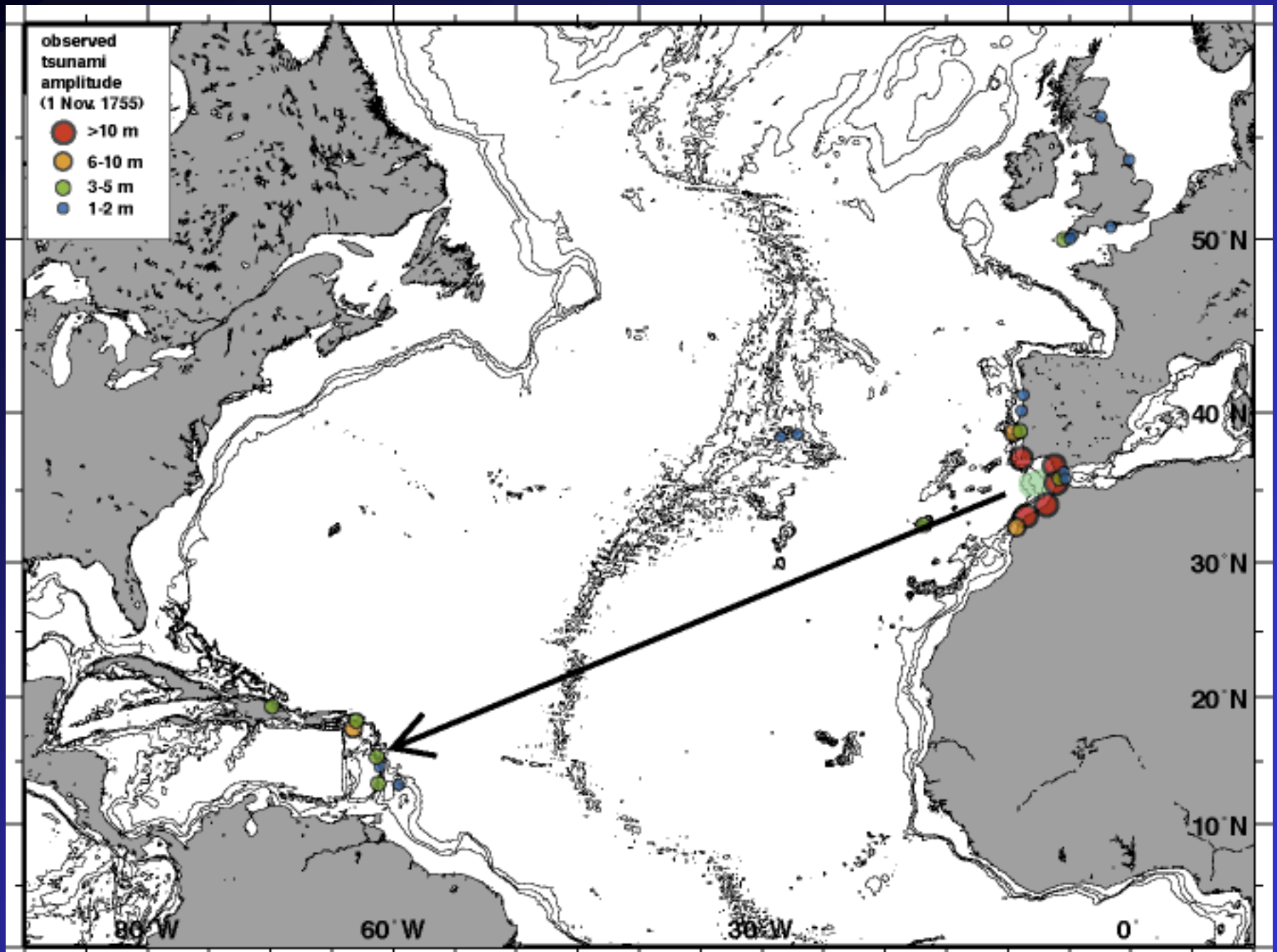


Rabat

1755 tsunami In Morocco

The fortress of Mazagan (El Jadida)

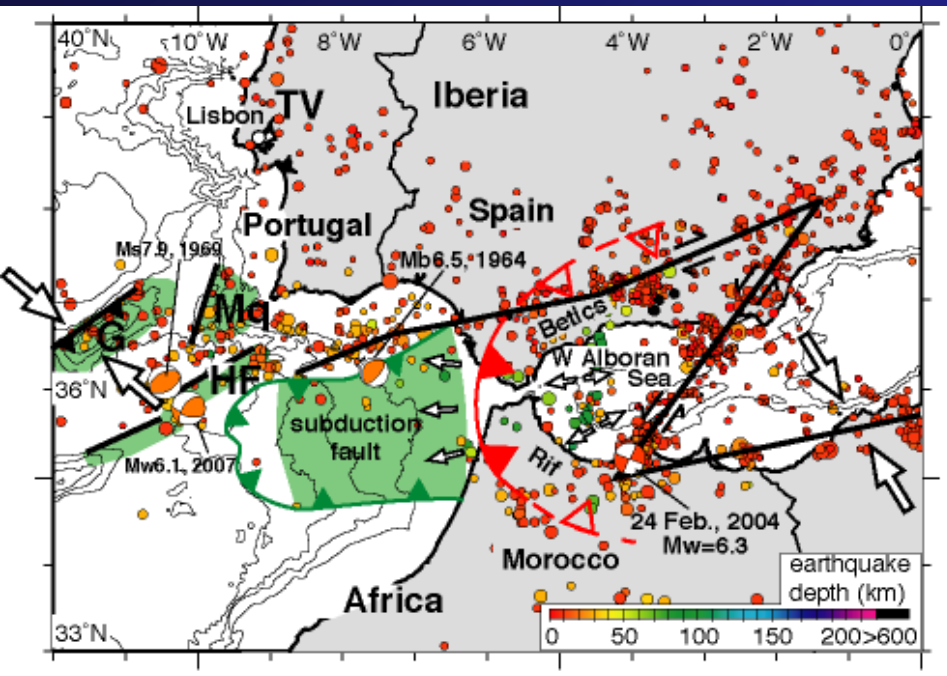
1755 - a trans-Atlantic tsunami

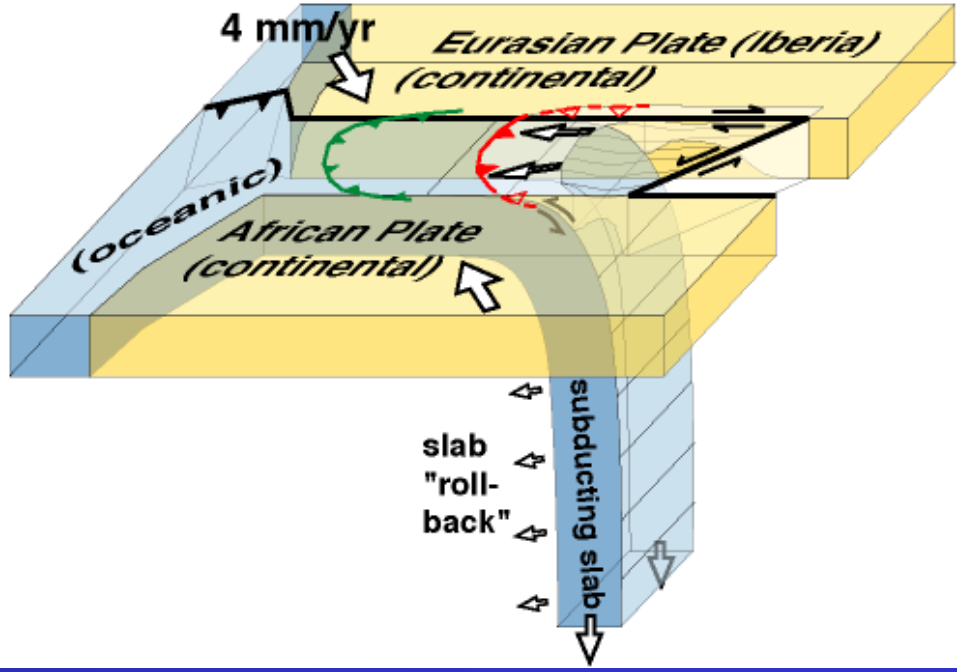


Southern Iberia Region : active faults and small subduction zone

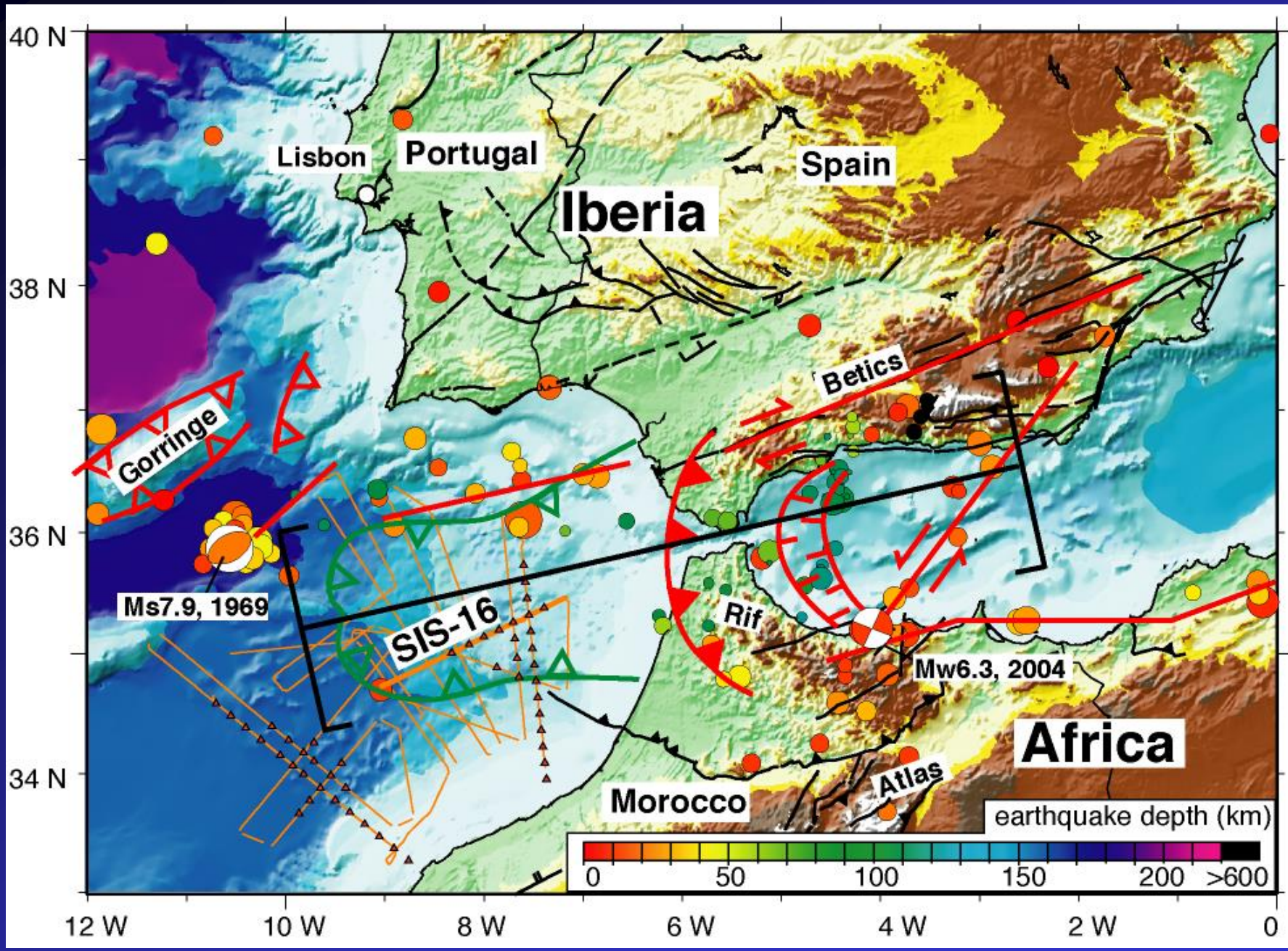
(Gutscher, Science, Aug. 2004)

➡ source of 1755 earthquake and tsunami ?

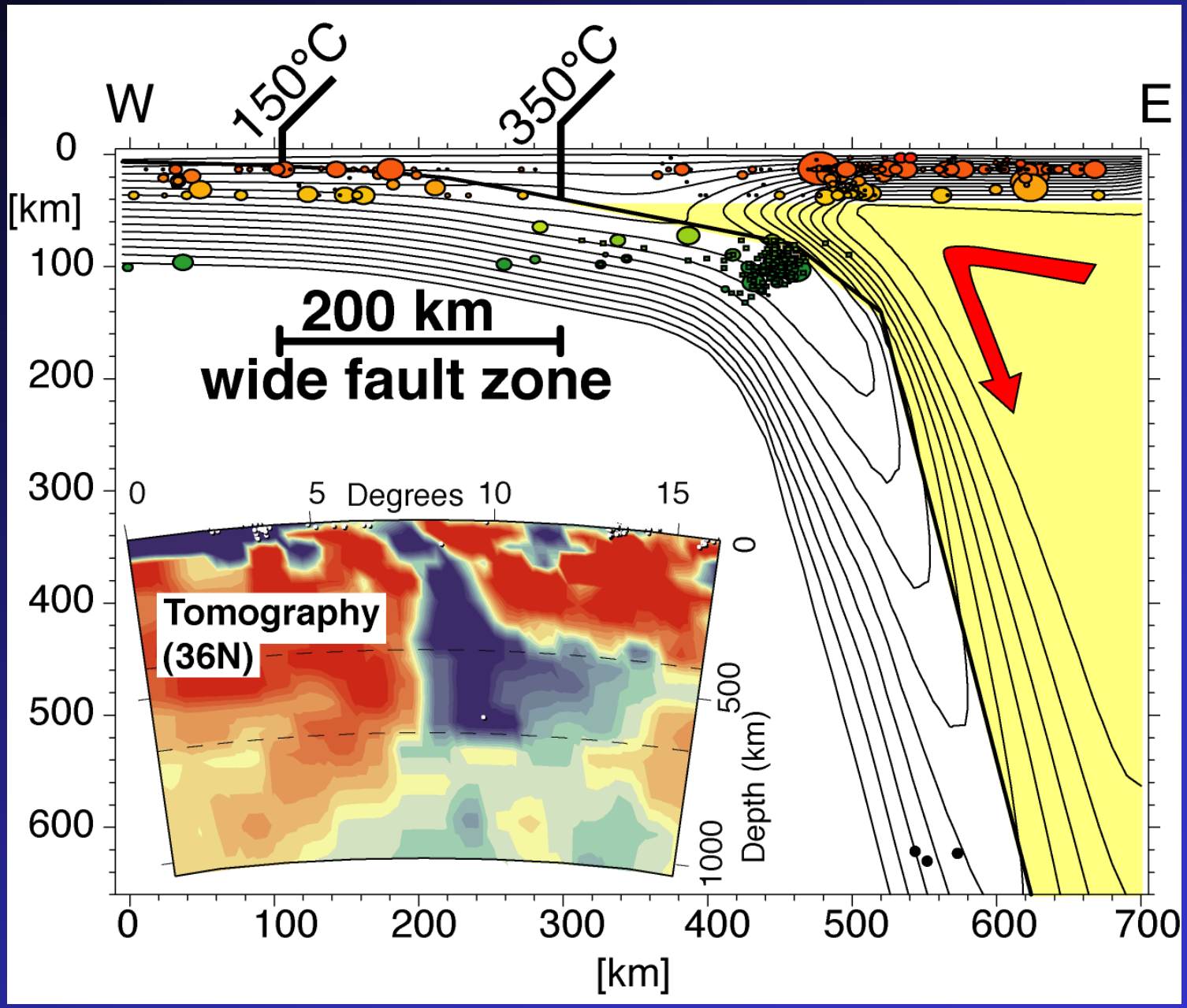




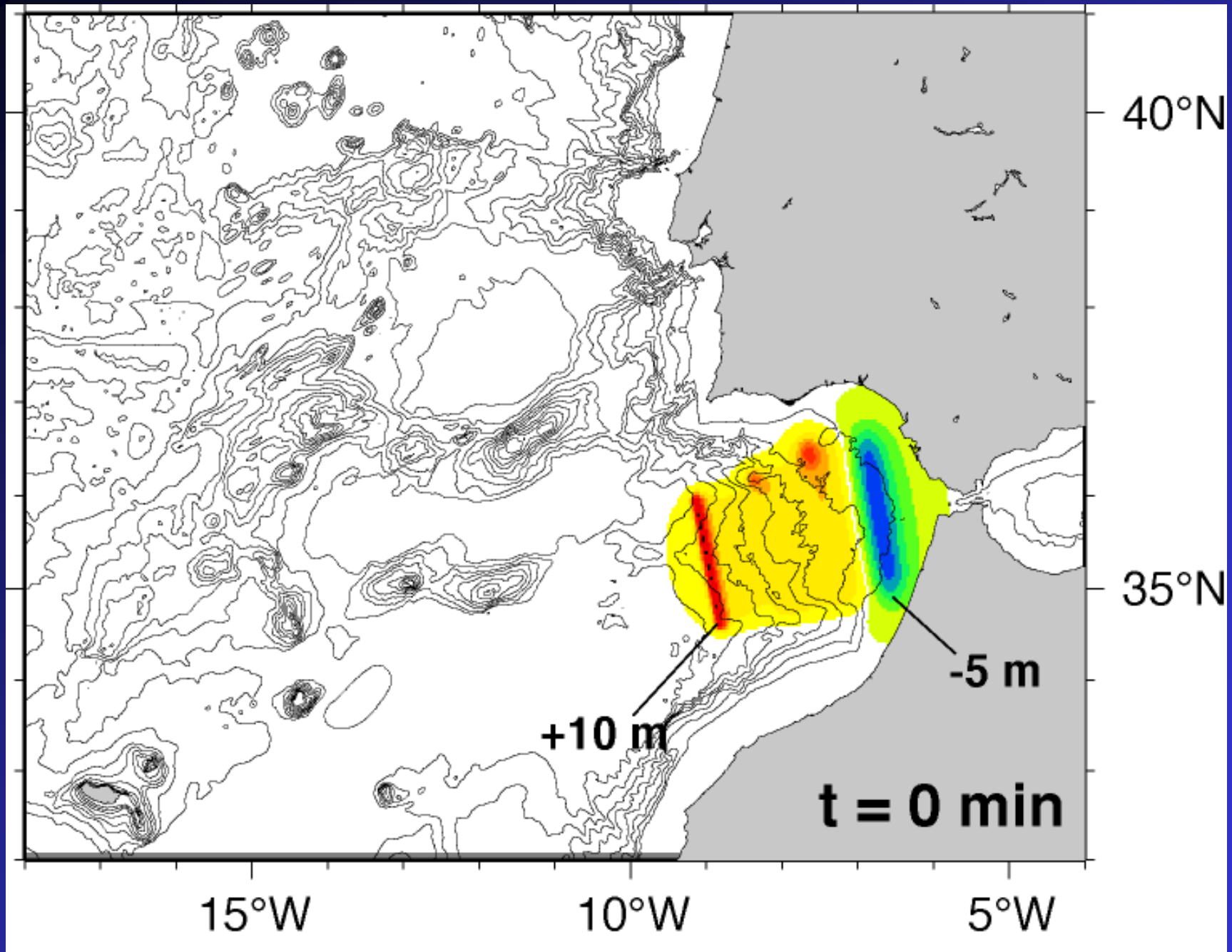
Regional seismicity and cross-section



Subduction thermal model (Thiebot and Gutscher, 2006, Tectonophysics)



Subduction tsunami model (Gutscher, Baptista, Miranda, 2006, Tectonophysics)



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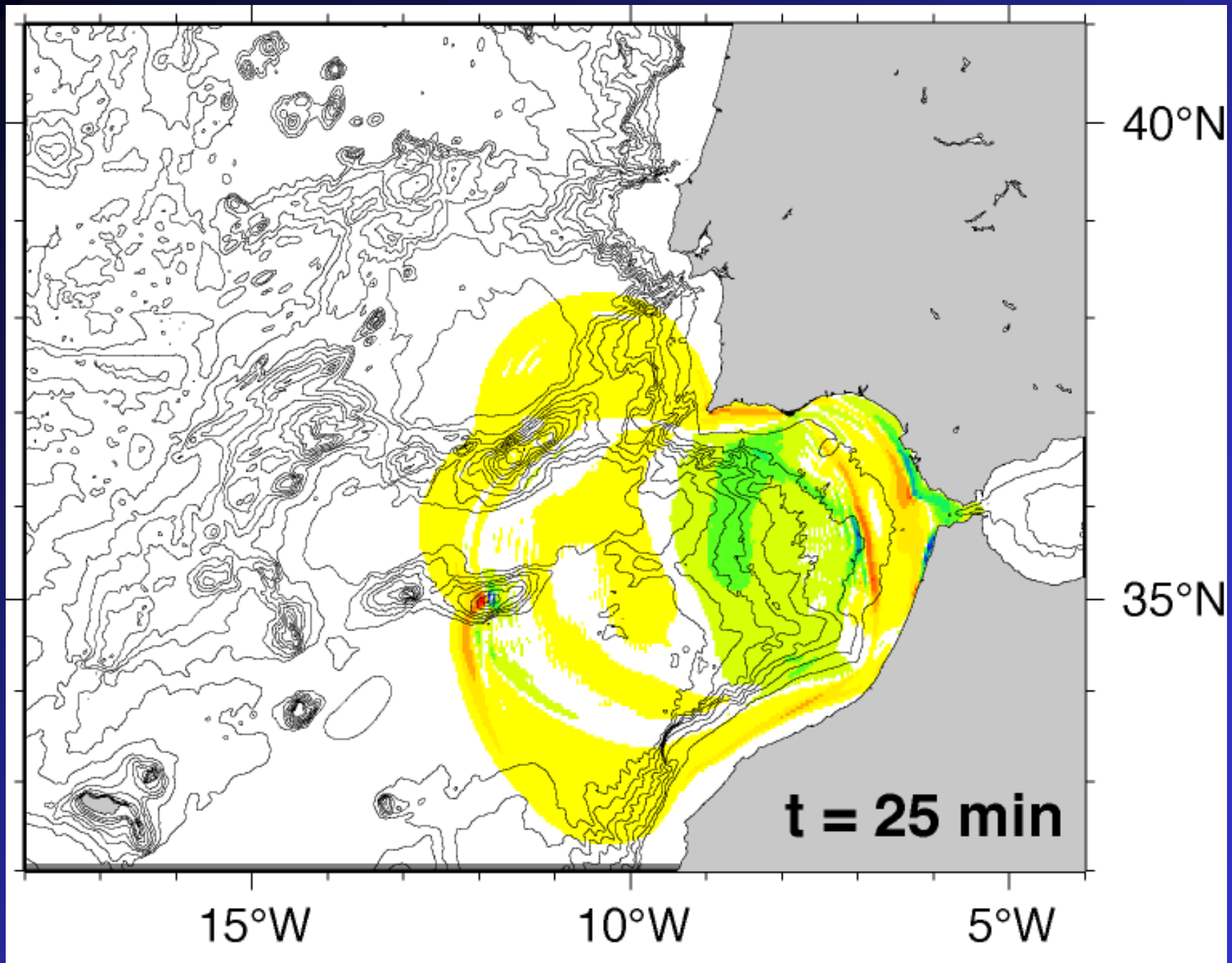

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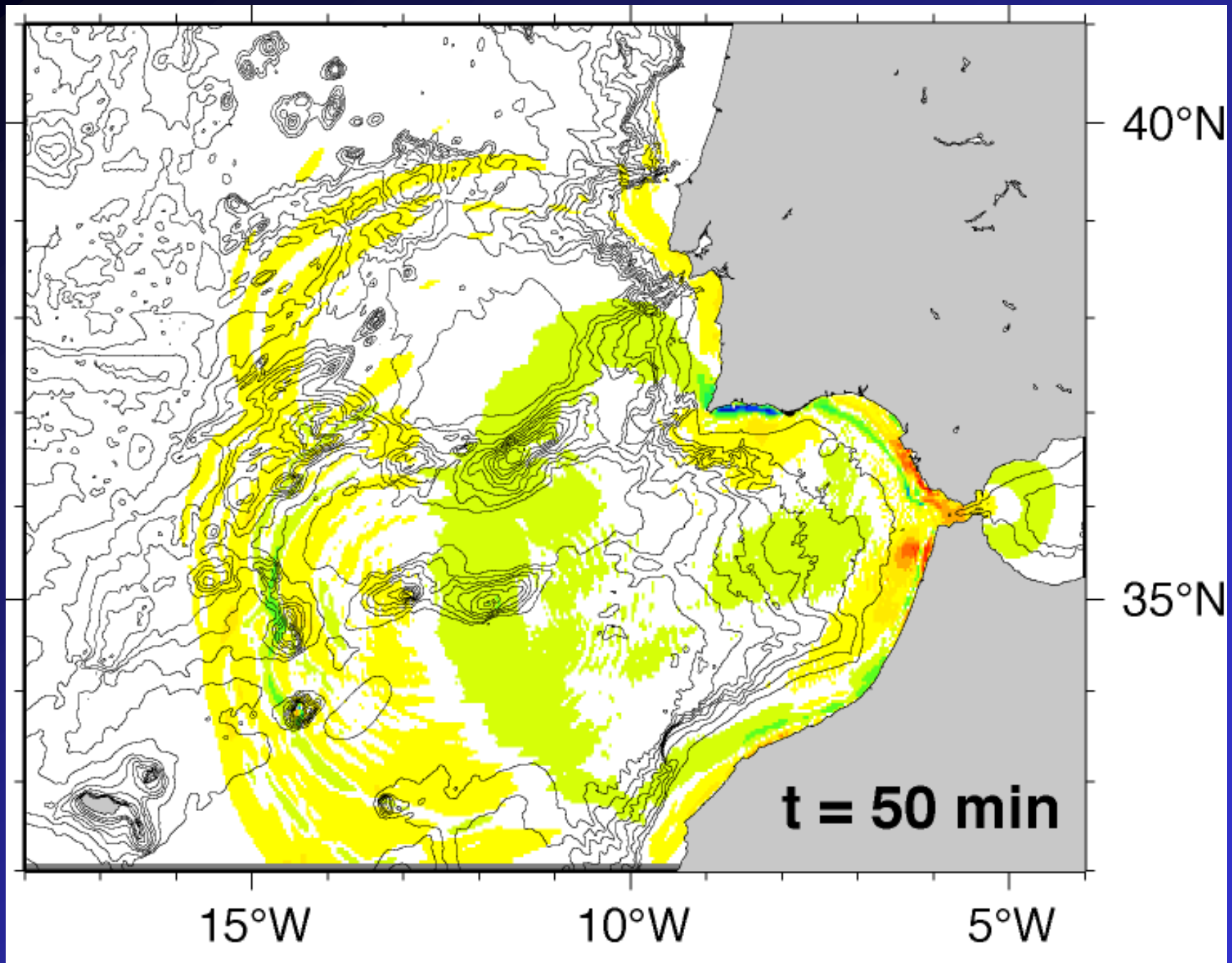
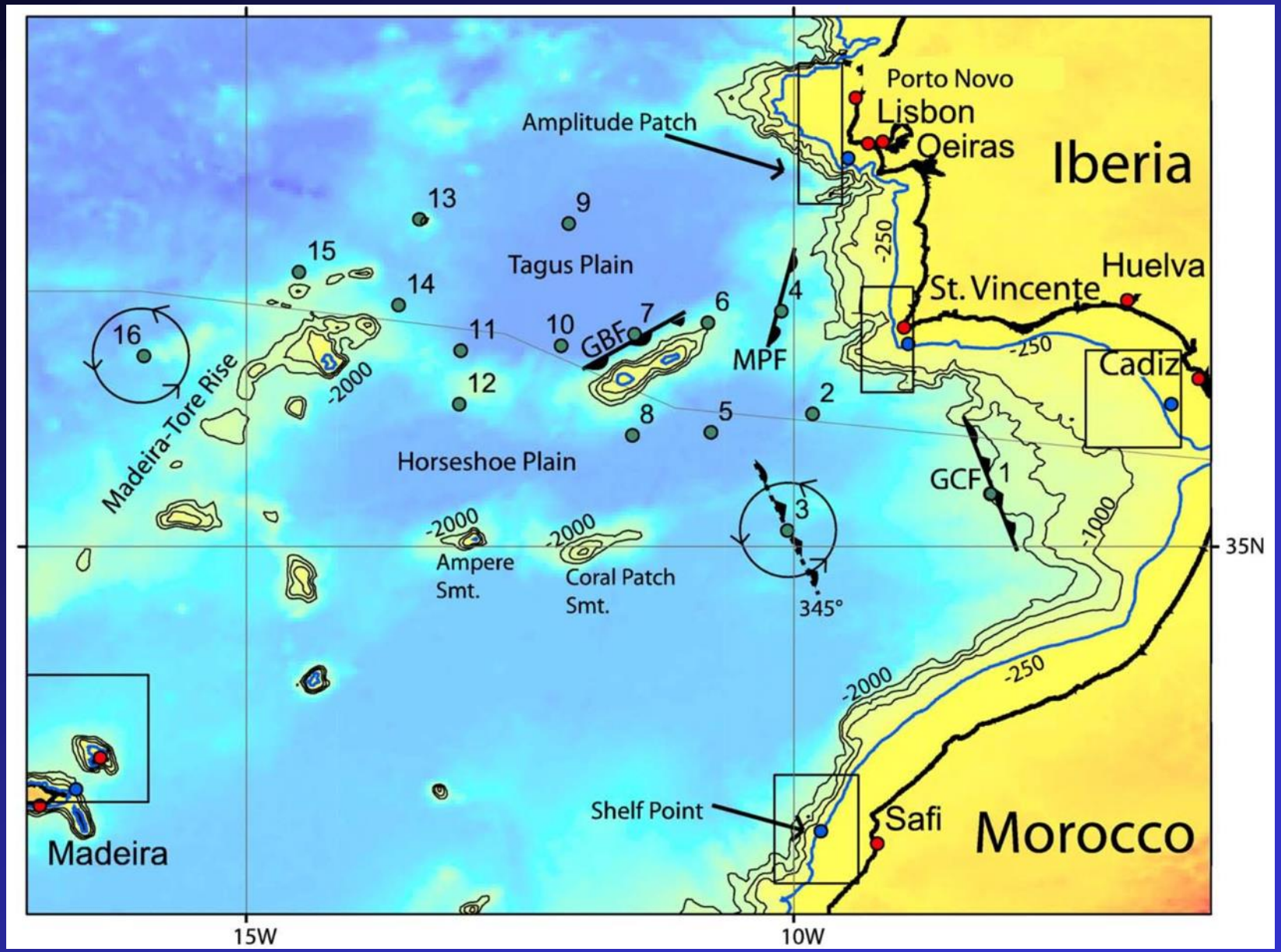


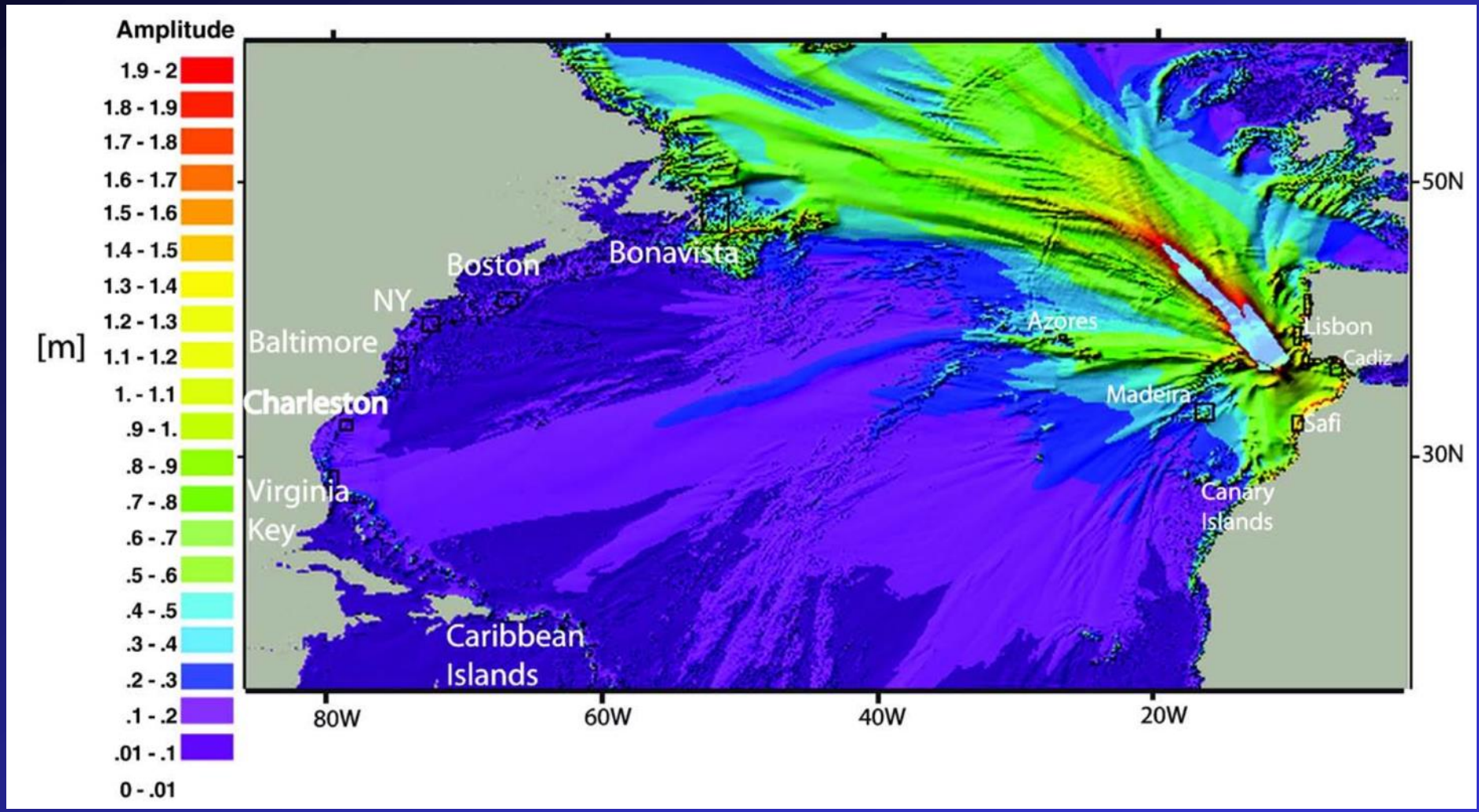
SW Iberia Region : modeling tsunami source zones

(Barkan et al., 2009, Marine Geology)



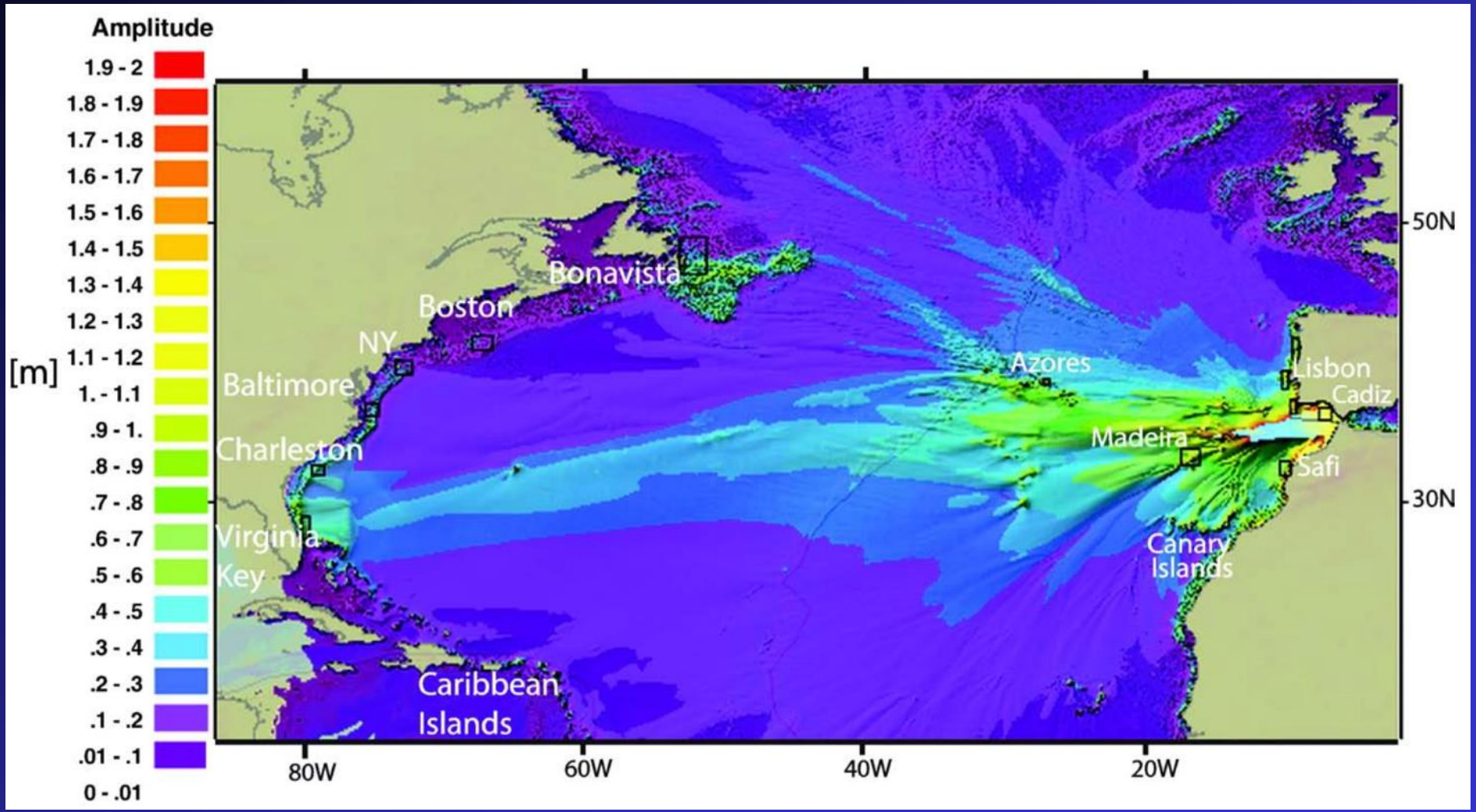
Modeling the Gorringe Bank tsunami source

(Barkan et al., 2009, Marine Geology)



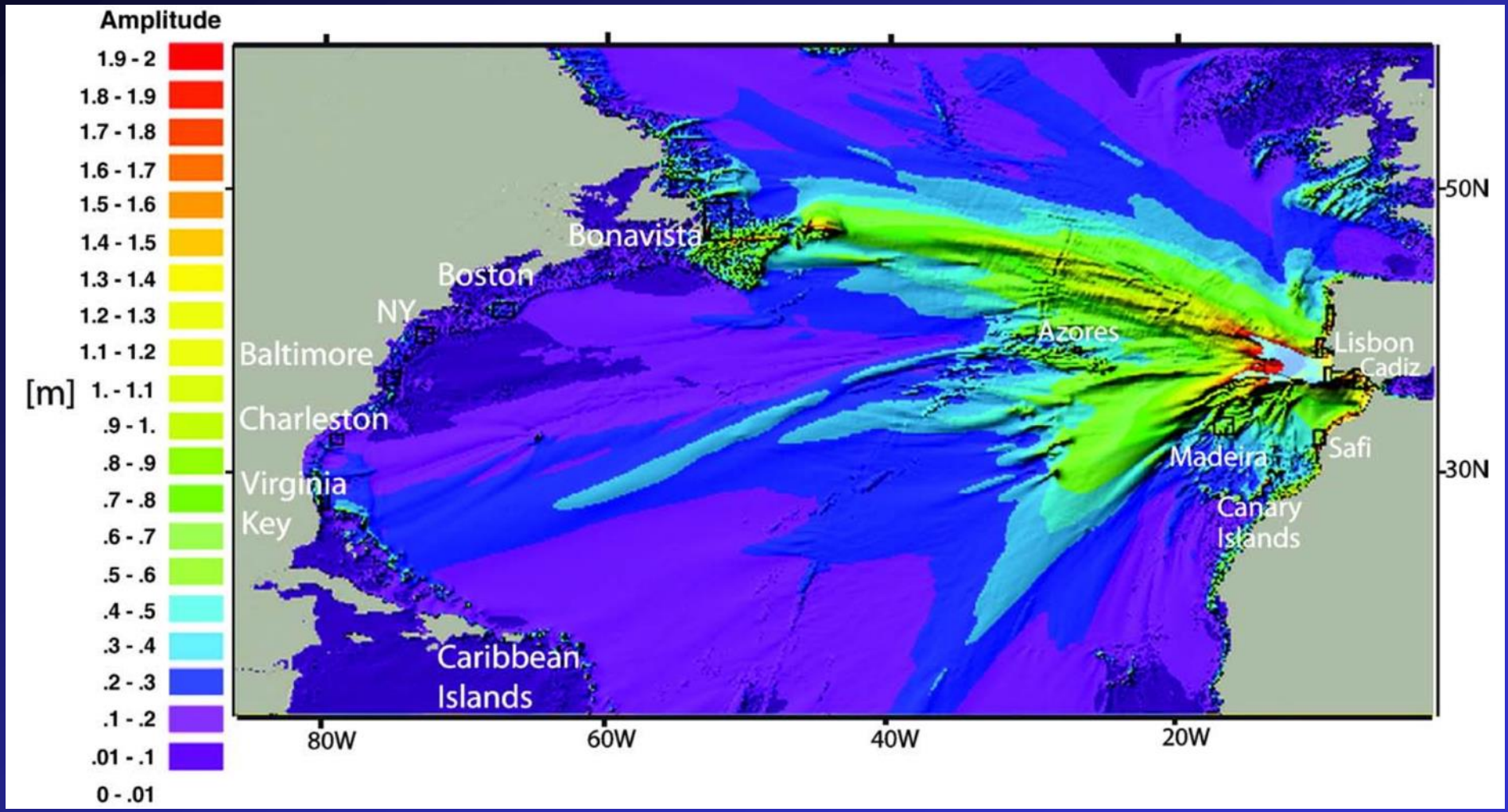
Modeling the Gibraltar subduction tsunami source

(Barkan et al., 2009, Marine Geology)



Modeling the Marques de Pombal tsunami source

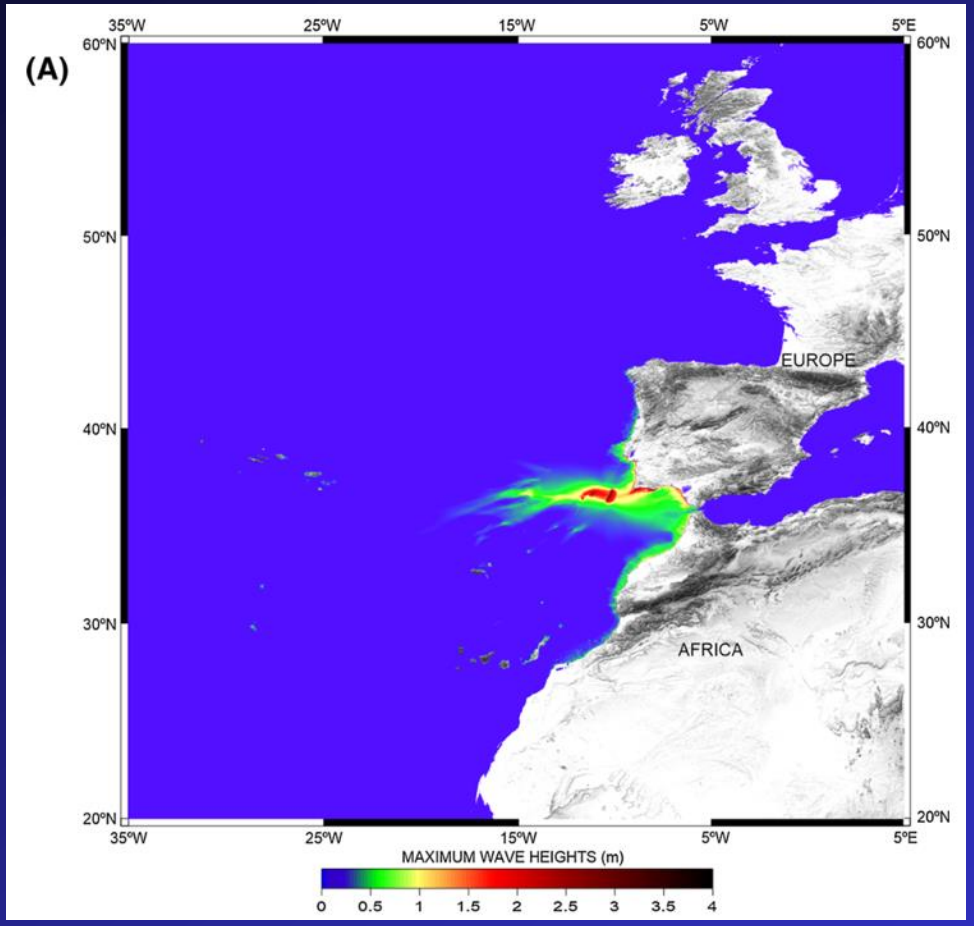
(Barkan et al., 2009, Marine Geology)



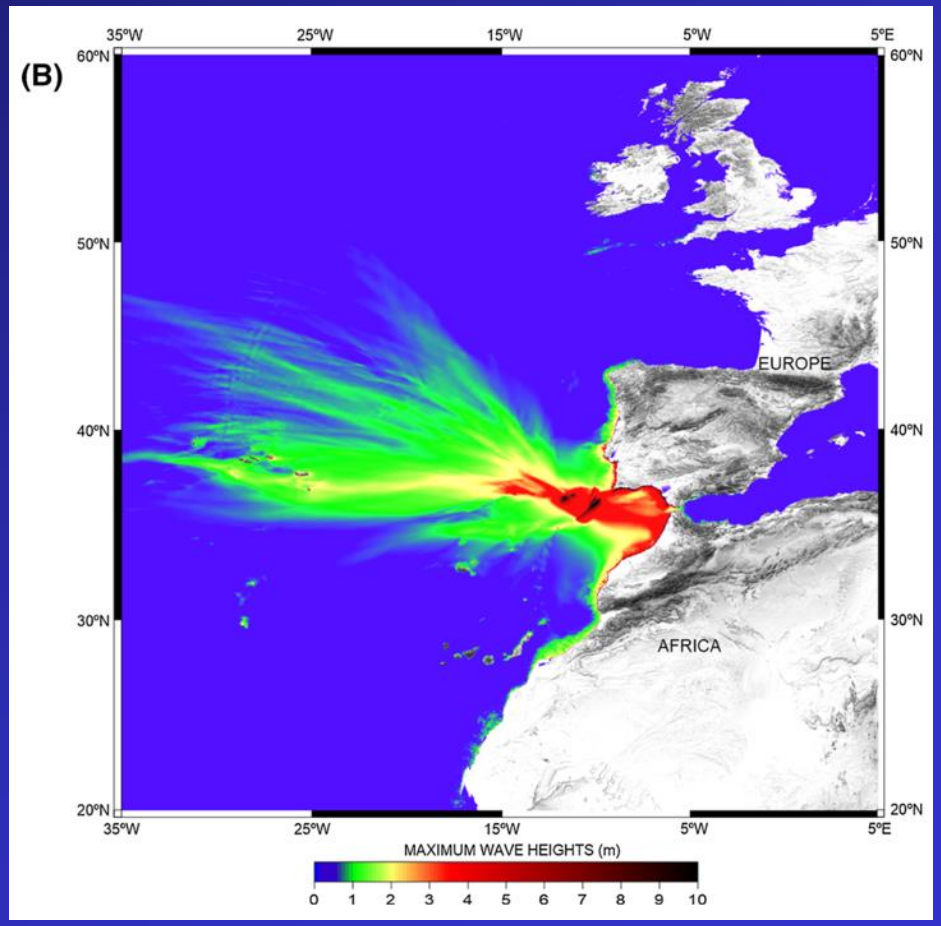
Modeling the Marques de Pombal + Horseshoe fault tsunami source

(Omira et al., 2014, Pure and Applied Geophysics)

M8.0 scenario



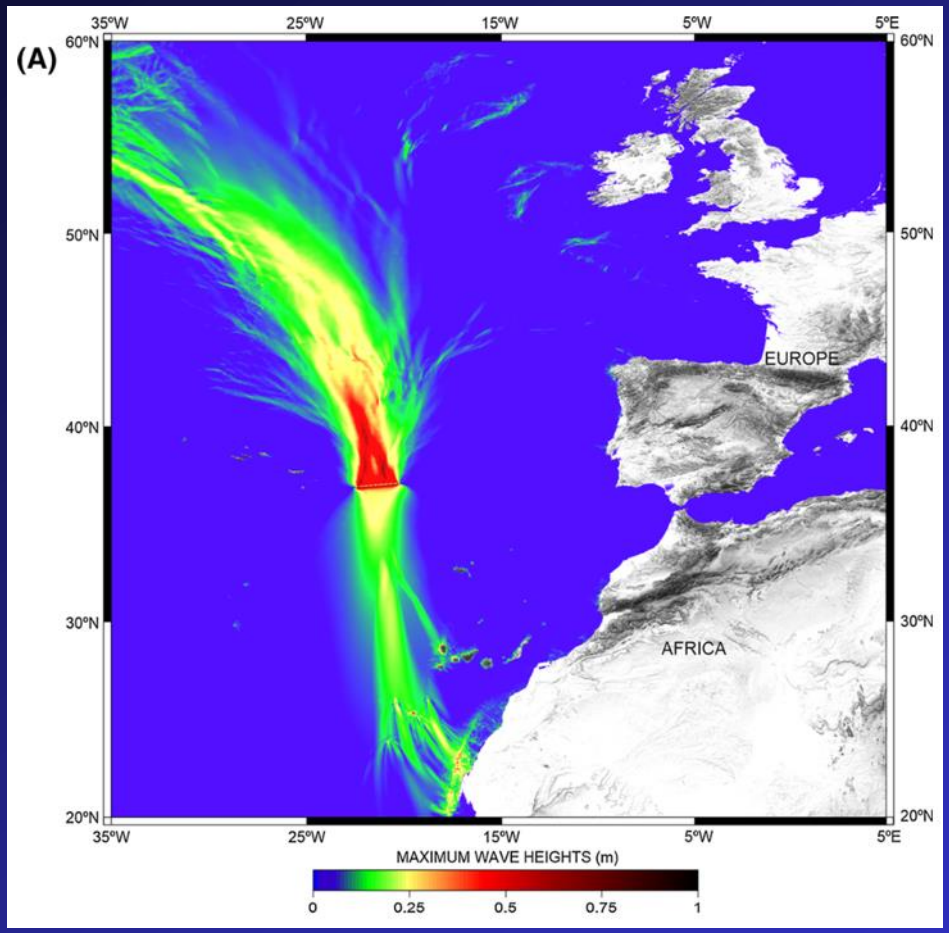
M8.75 scenario



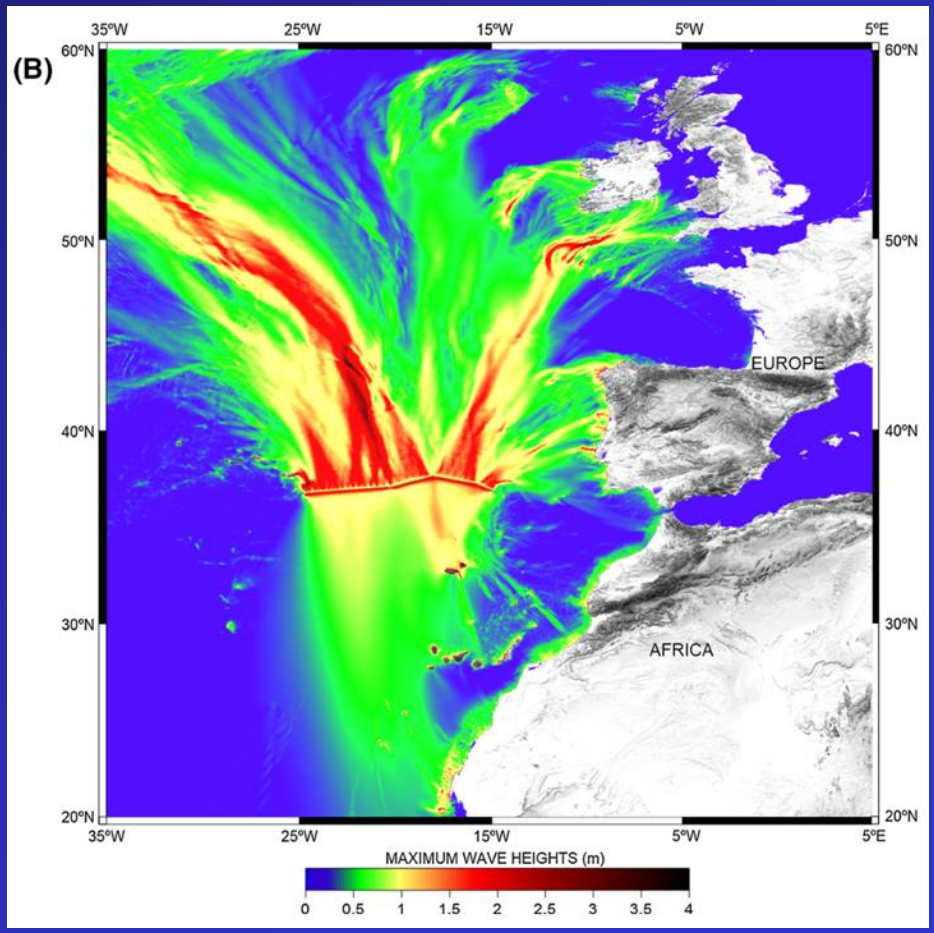
Modeling the Gloria Fault tsunami source

(Omira et al., 2014, Pure and Applied Geophysics)

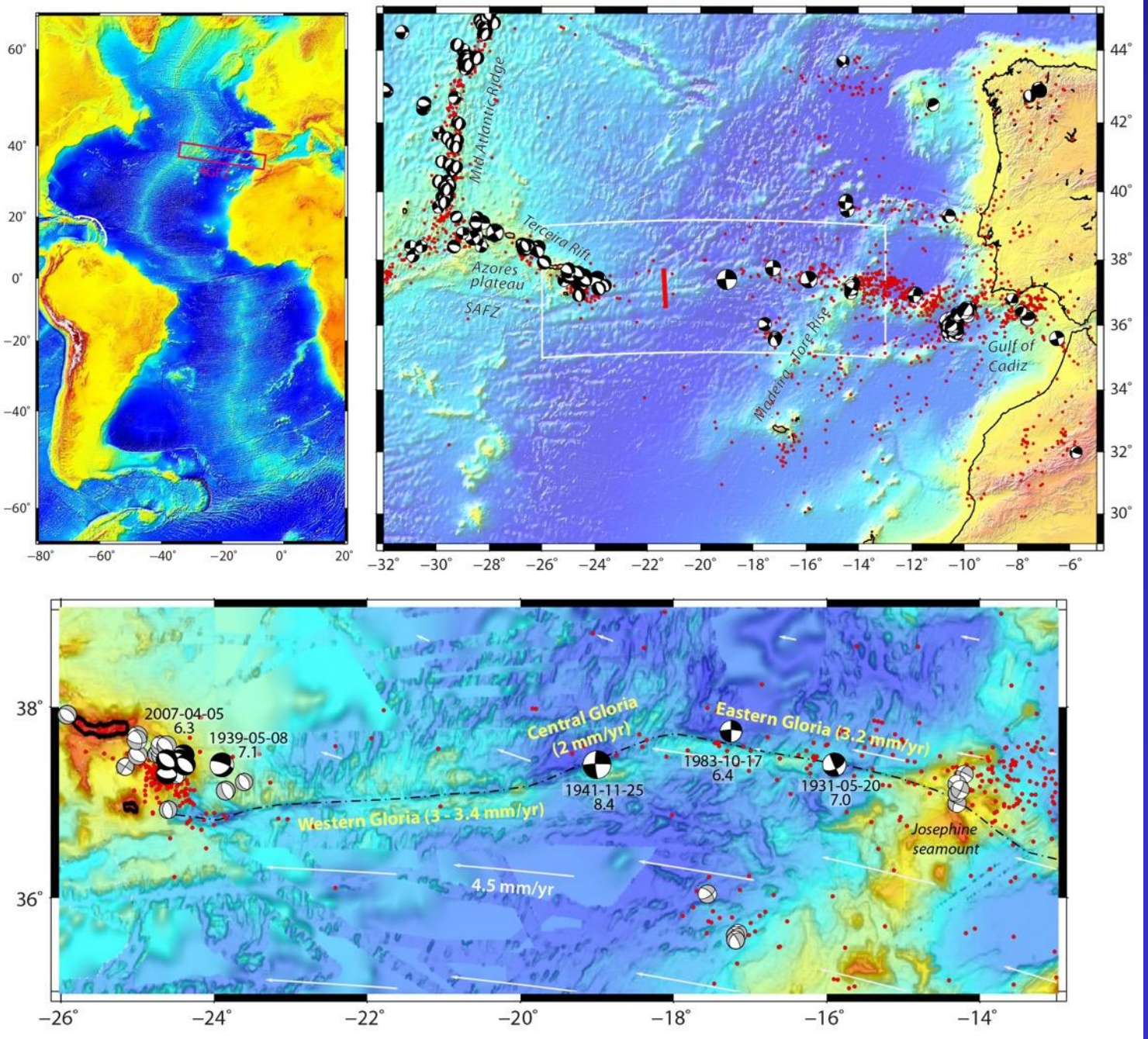
M8.0 scenario



M9.0 scenario



Azores - Gibraltar transform, focal mechanisms (after Custodio et al., 2016)



Summary :

- SW Iberia region has generated historical M8 - M8.7 earthquakes and strong tsunamis

- the source of the 1755 earthquake & tsunami is still uncertain / debated

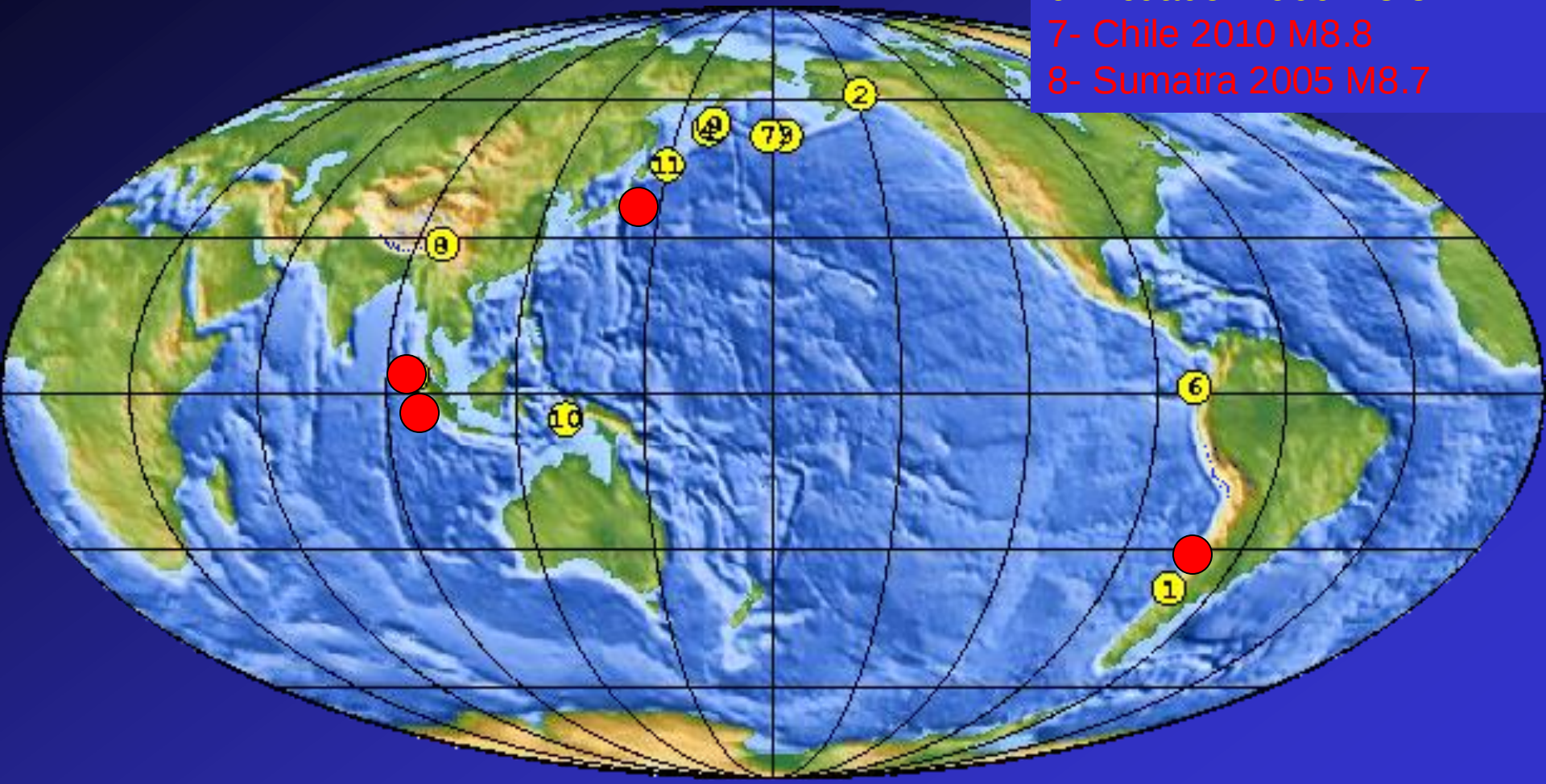
- but a big fault is necessary to produce such an earthquake (M8.7)

- the seismogenic and tsunamigenic potential of the slow subduction zones (Calabria, Gibraltar) is uncertain / debated

Thanks for your attention !

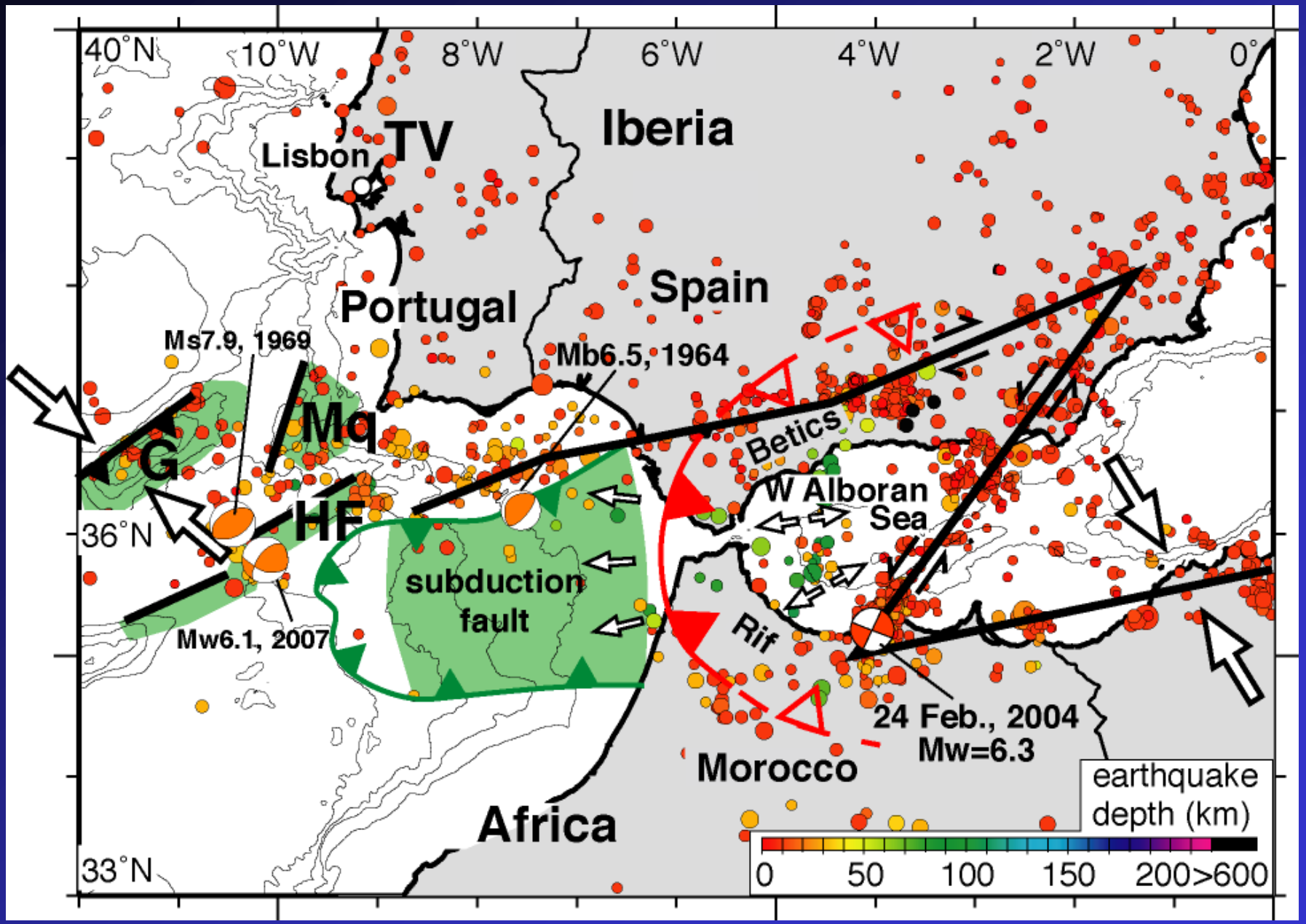
The strongest earthquakes (M≥8.5) in the world since 1900

1- Chile 1960 M9.5
2- Alaska 1964 M9.2
3- Sumatra 2004 M9.1
4- Japan 2011 M9.0
5- Kamchatka 1952 M9.0
6- Ecuador 1906 M8.8
7- Chile 2010 M8.8
8- Sumatra 2005 M8.7

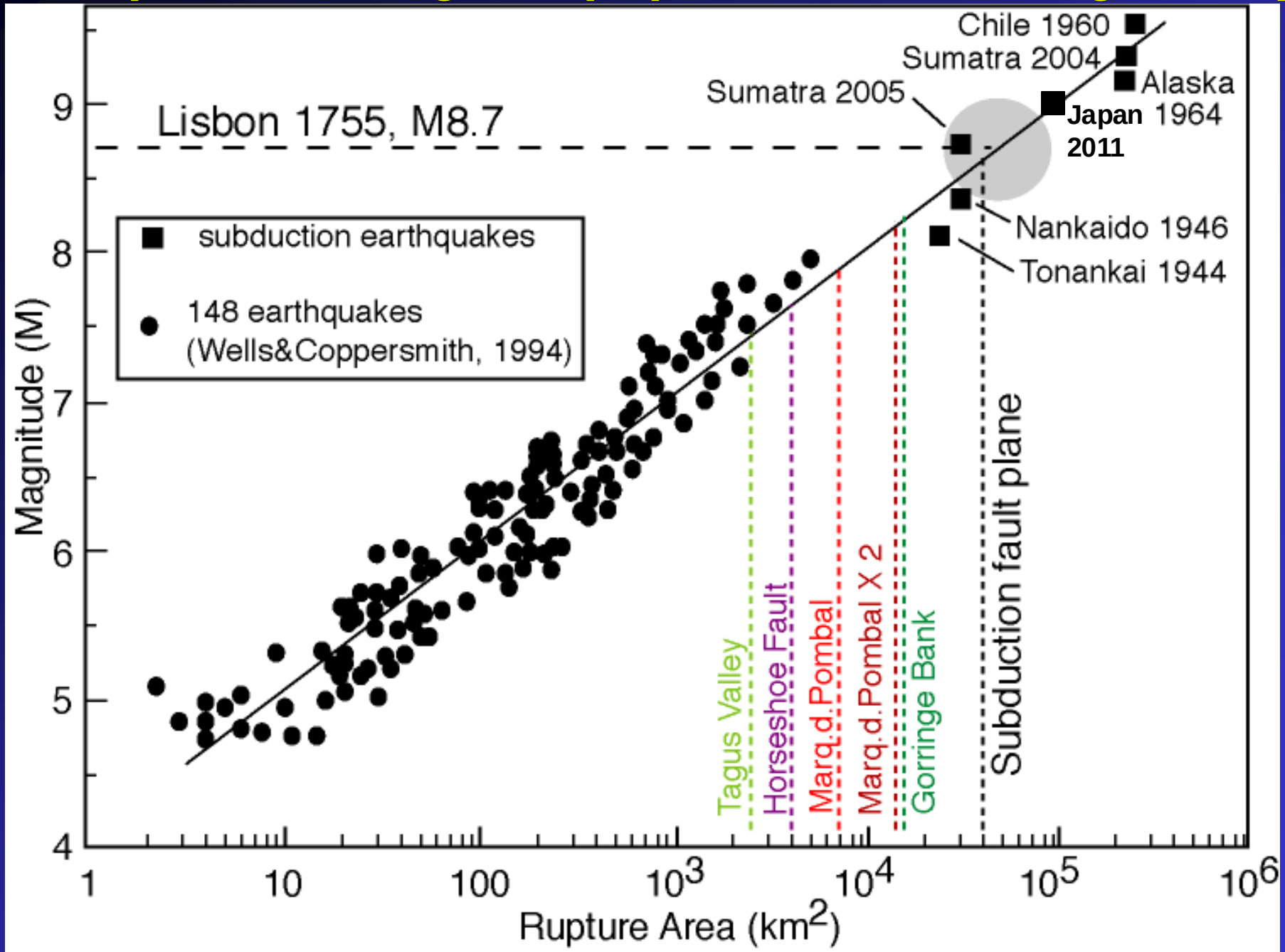


All (except Tibet) occur in subduction zones

Recent seismicity and active faults in S. Iberia region

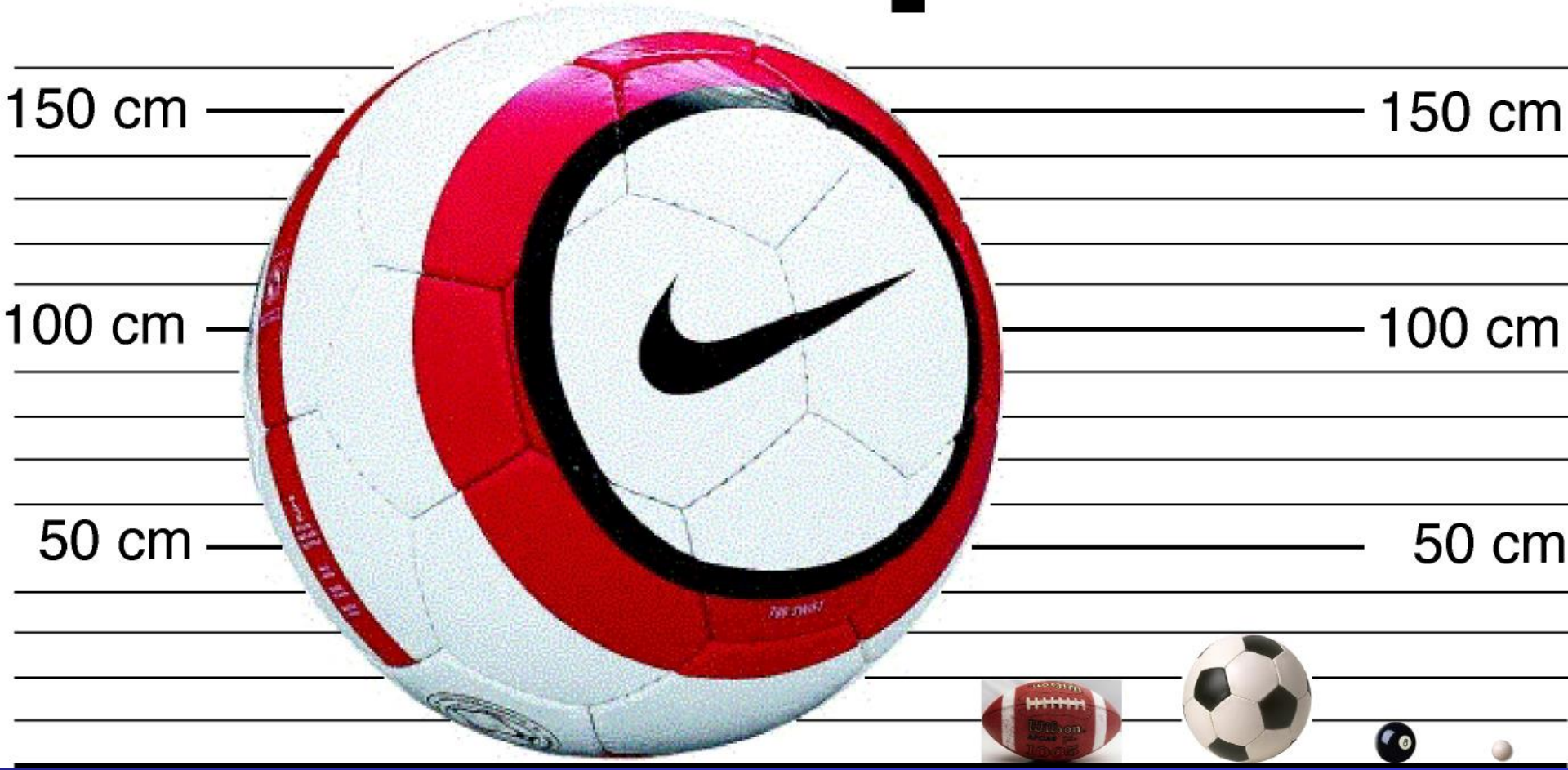


Earthquake scaling law (rupture area vs. magnitude)



Whodunnit?

the suspects



The scene of the crime

(Ad campaign for Nike)