

Seismic zones and sources in the NEAM region –

Their tsunamigenic potential

UNESCO tsunami Meeting, Paris, 18-20 March 2025



1. Les Saines
2. les aqueducs françois
3. les Quatretoys de belle Vue
4. la montee de la Glorie
5. le Palais du Roi
6. le Palais du Due
7. le Palais de la Corte Real
8. le Hotel des Cotes de Villefranche
9. le Chiquitano

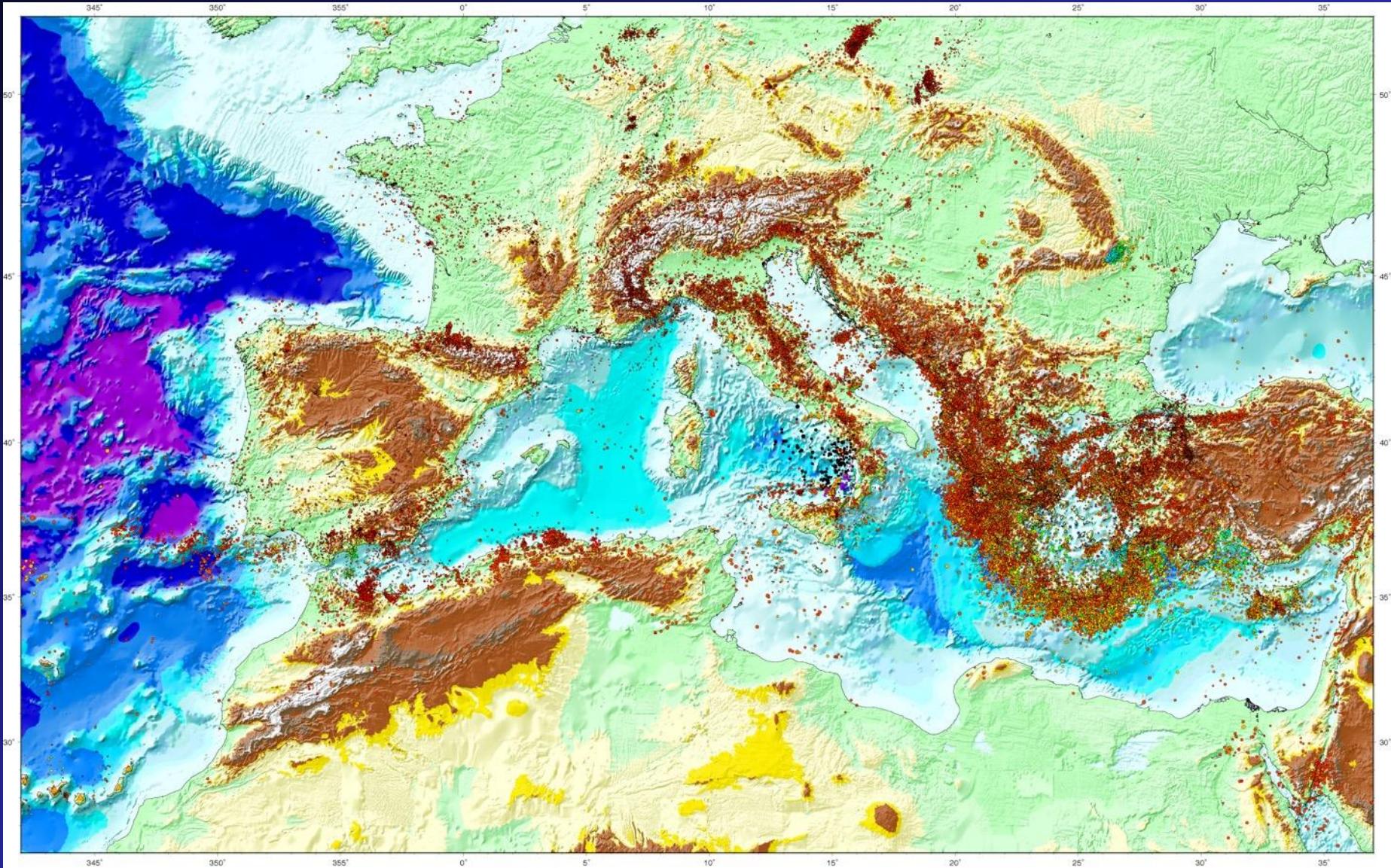
Le 1^{er} Novembre 1755 à 9 heures du matin on a senti dans tout le Portugal et surtout à Lisbonne le plus fort tremblement de terre dont on ait jamais entendu parler. Cette Ville qui a été la plus de l'Europe, et où l'on ne connaît point d'autre menue que lors, n'est plus maintenant qu'un horrible monceau de ruines avec lesquelles ont été ensevelis plus de 200 mille personnes toutes vivantes. L'ambassadeur d'Espagne a été écrasé avec ses domestiques, et pour surcroit de malheurs la mer, asortie de son lit, le feu après dans tous les quartiers de la ville, et consumé, ce que le tremblement avait épargné. Le Roy et la famille Royale ainsi que l'ambassadeur de France ont heureusement échappé à ce désastre, et ont été réduits à lever en rase campagne sans pain et sans argent; se voyans aussi pauvres que leurs sujets car on ne peut trouver dans les marques de Lisbonne un homme, ou une femme de pretre sans protéger aucun souverain. Les Villes de Coimbre et de Braga ont aussi été considérablement endommagées. Il ne reste aucun vestige de Setúbal. On ne peut nombrer la partie que les Anglais ont faite dans ce désastre.

10. le Palais du Roi
11. les Carmes
12. François
13. la Dame du mont
14. la Douane
15. le Chateau
16. St. Et.
17. les Balles
18. l'Hotel des Comtes

Destruction of Lisbon, XVIII print GEO, Lisboa

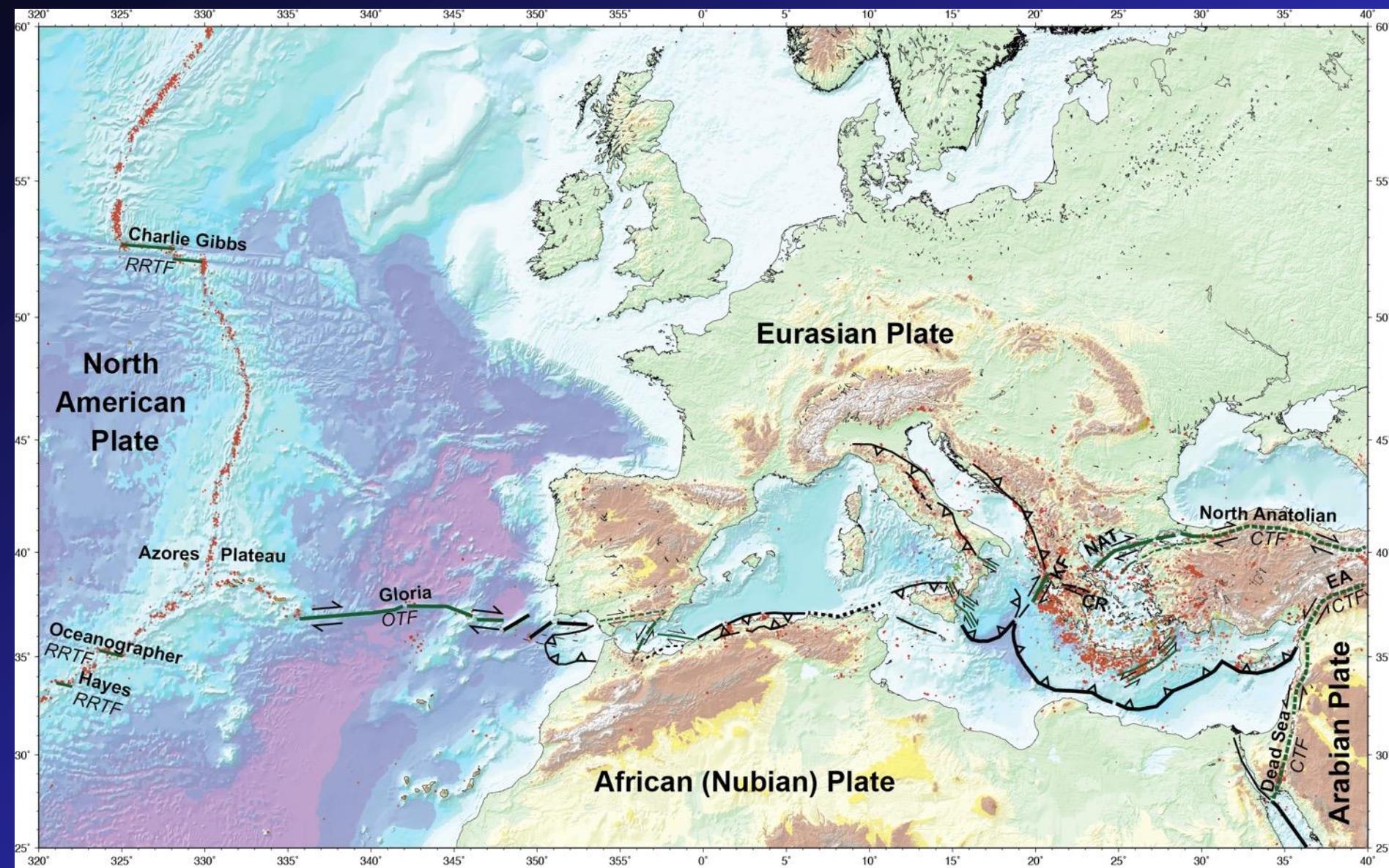
M.-A. Gutscher - Geo-Ocean, (CNRS, Univ Brest, Ifremer) FRANCE

Seismicity map Europe - Mediterranean region: seismicity and relief

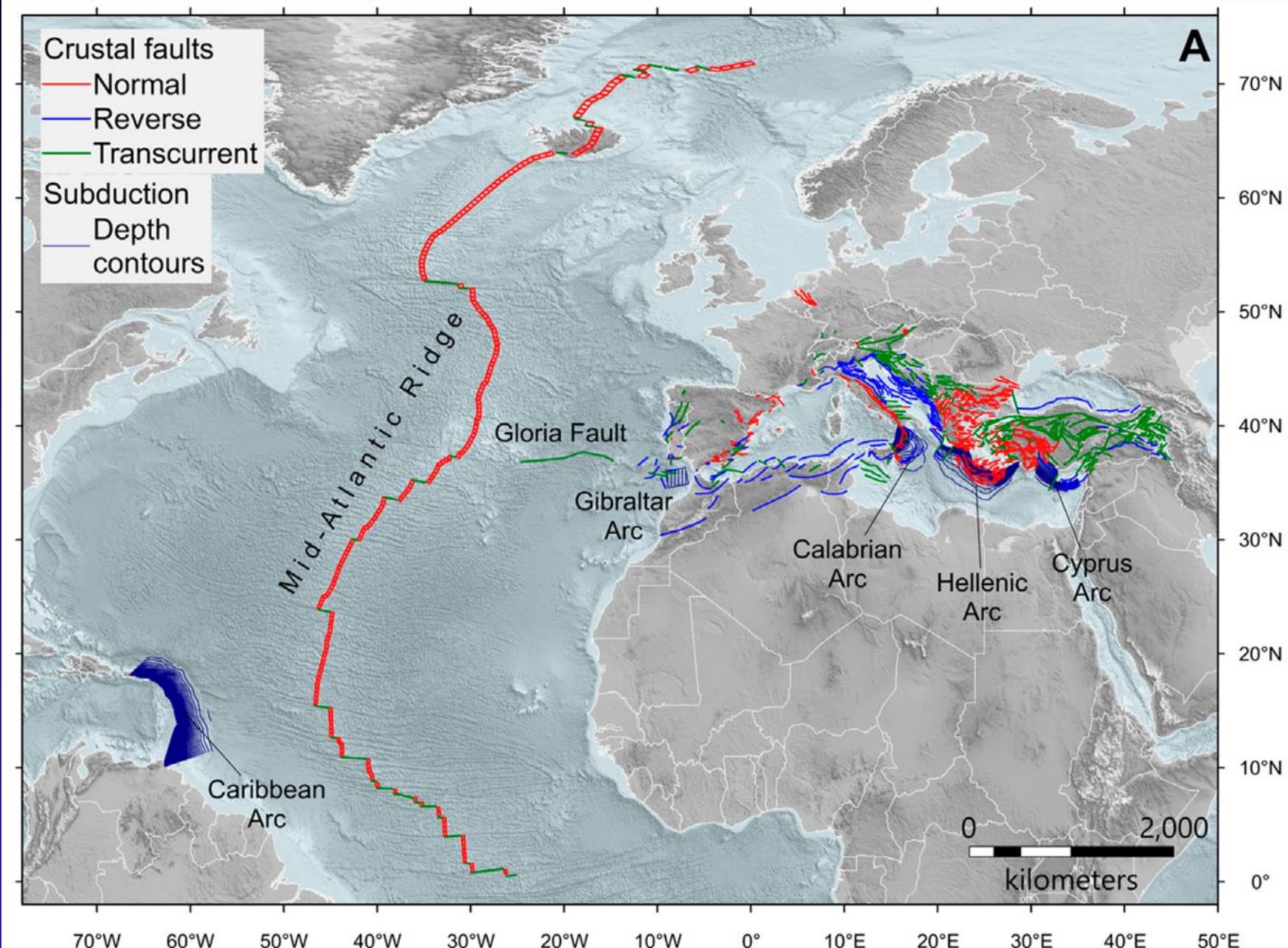


Seismicity map of Europe

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

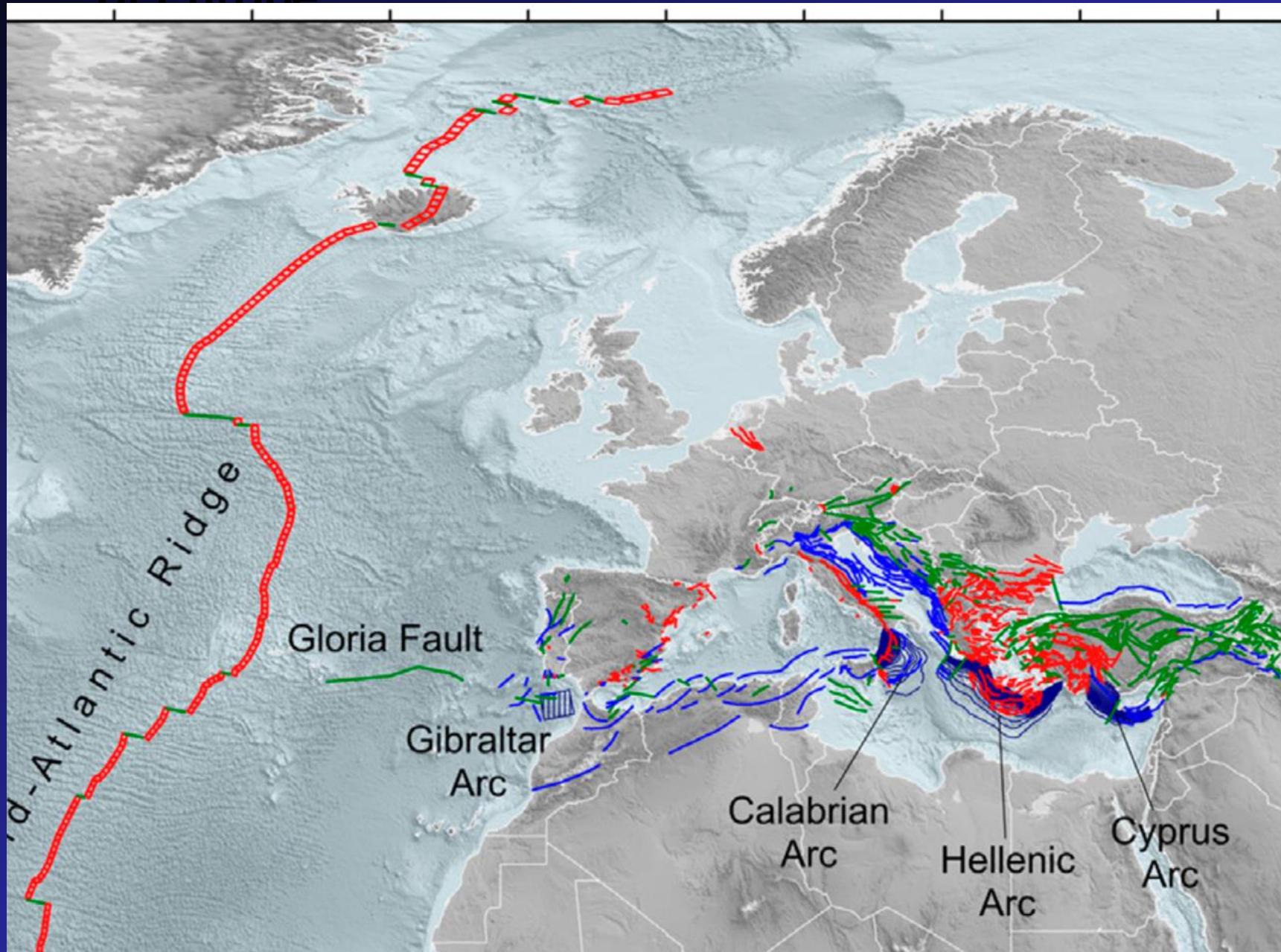


Seismicity map North Atlantic - Mediterranean active faults map (Basili et al., 2018) of Europe

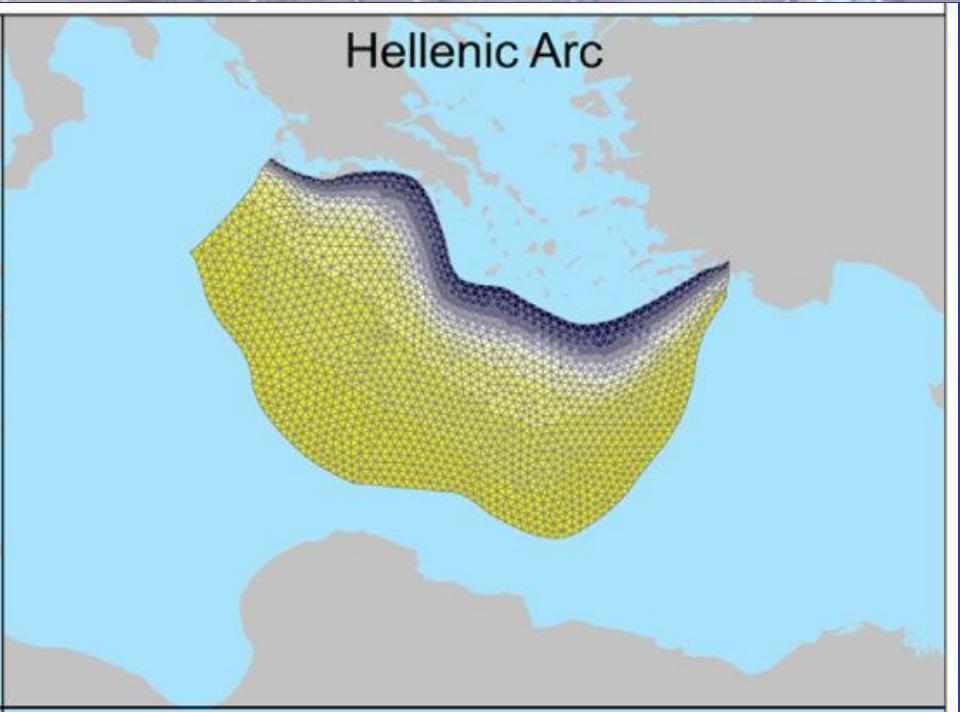
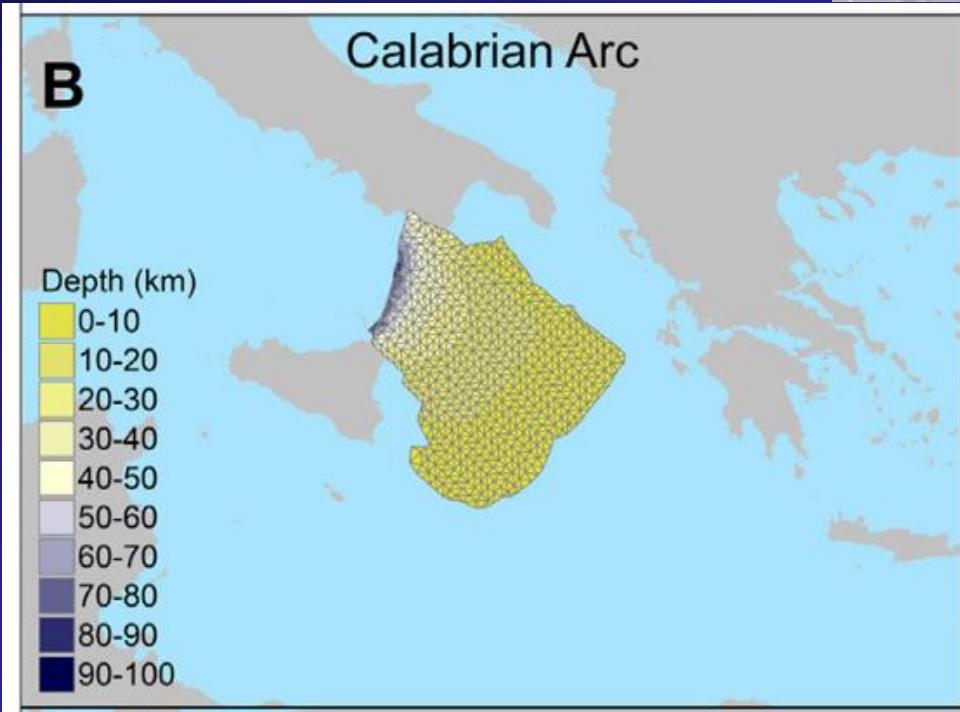
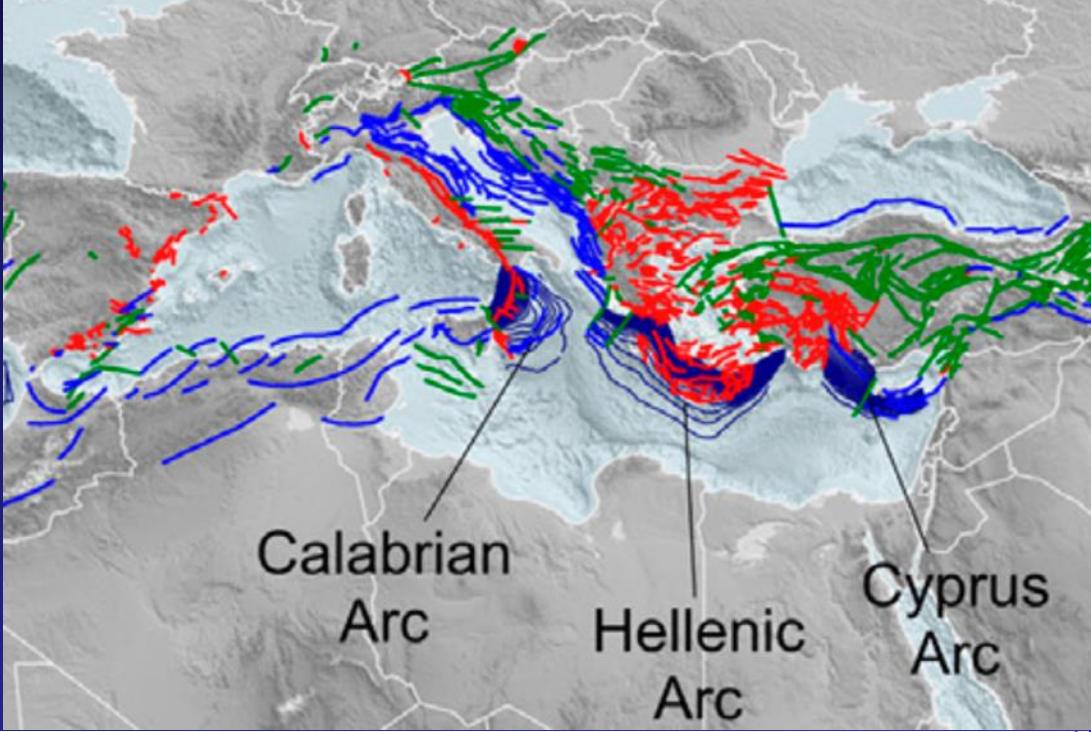


Seismicity map NE Atlantic - Mediterranean active faults map (Basili et al., 2018)

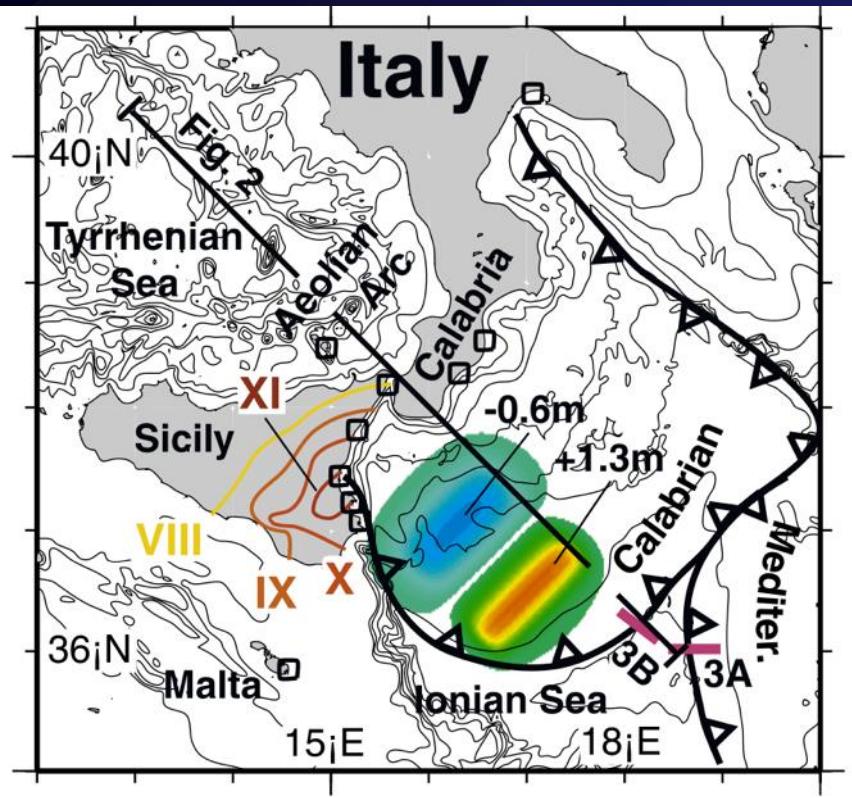
of Europe



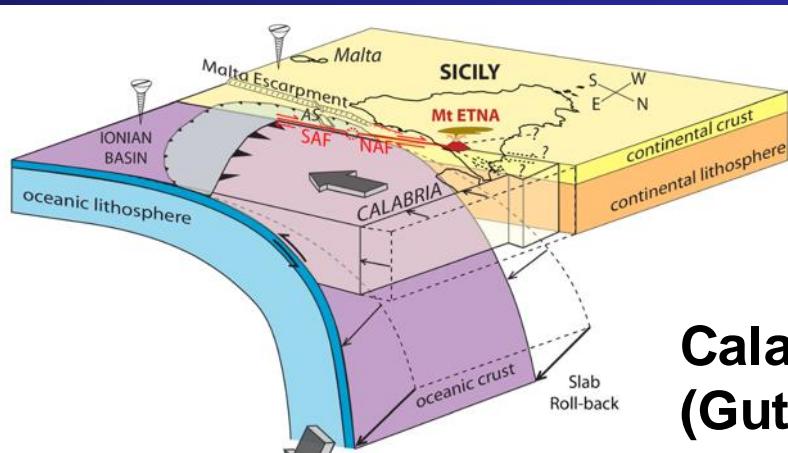
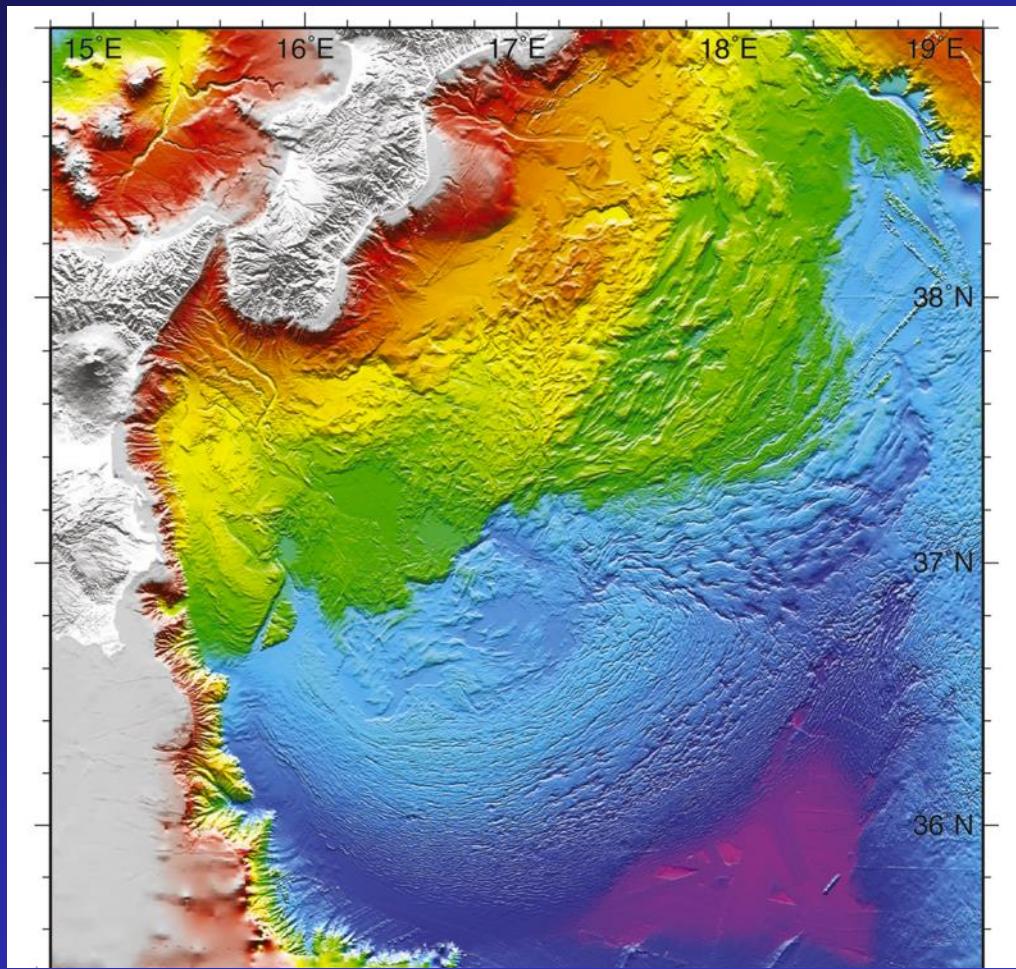
Seismicity map
Mediterranean: Calabrian &
Hellenic arcs source zones
(Basili et al., 2018)



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

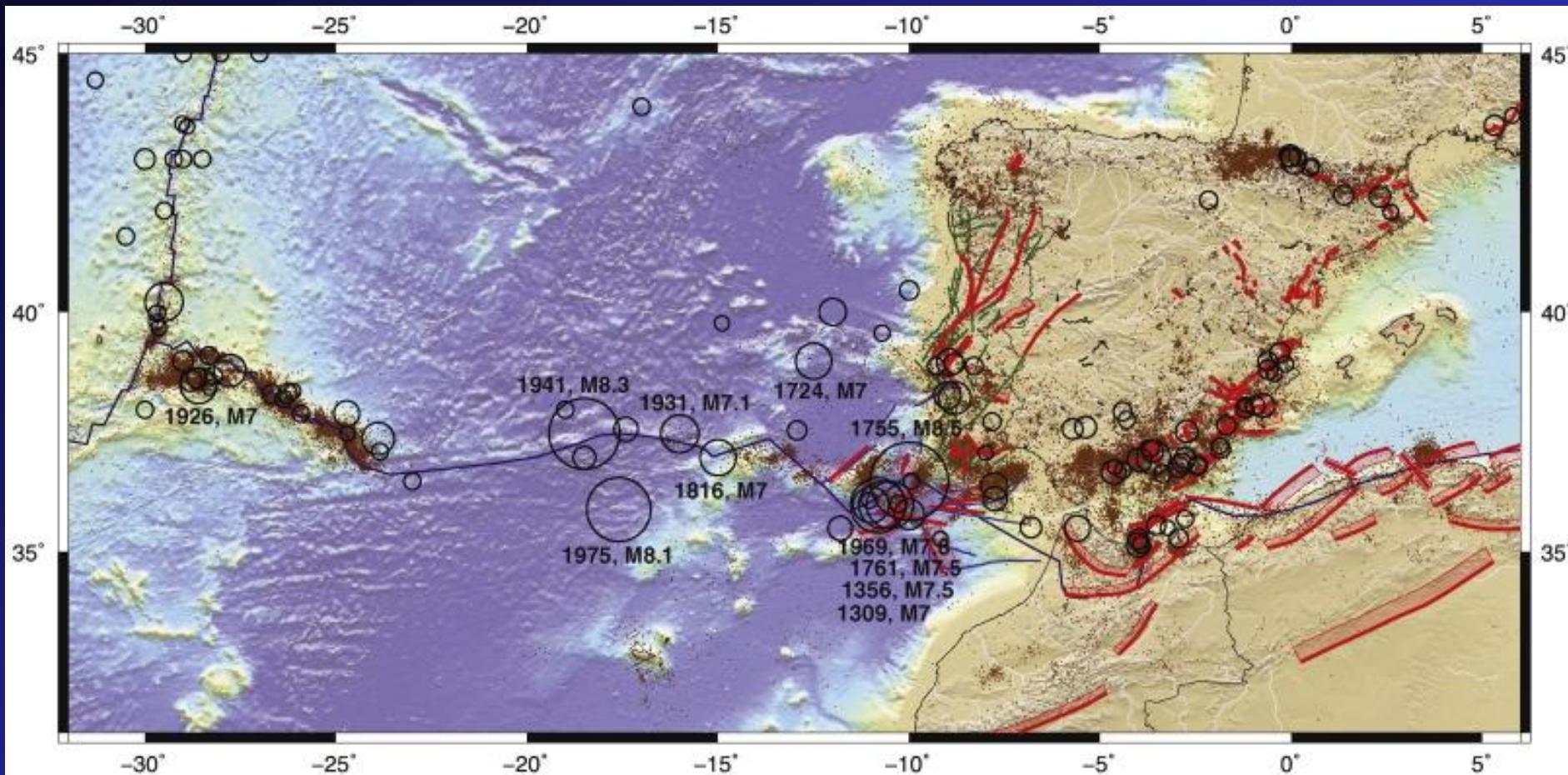


Calabrian arc bathymetric map (Gutscher et al., 2017, EPSL)

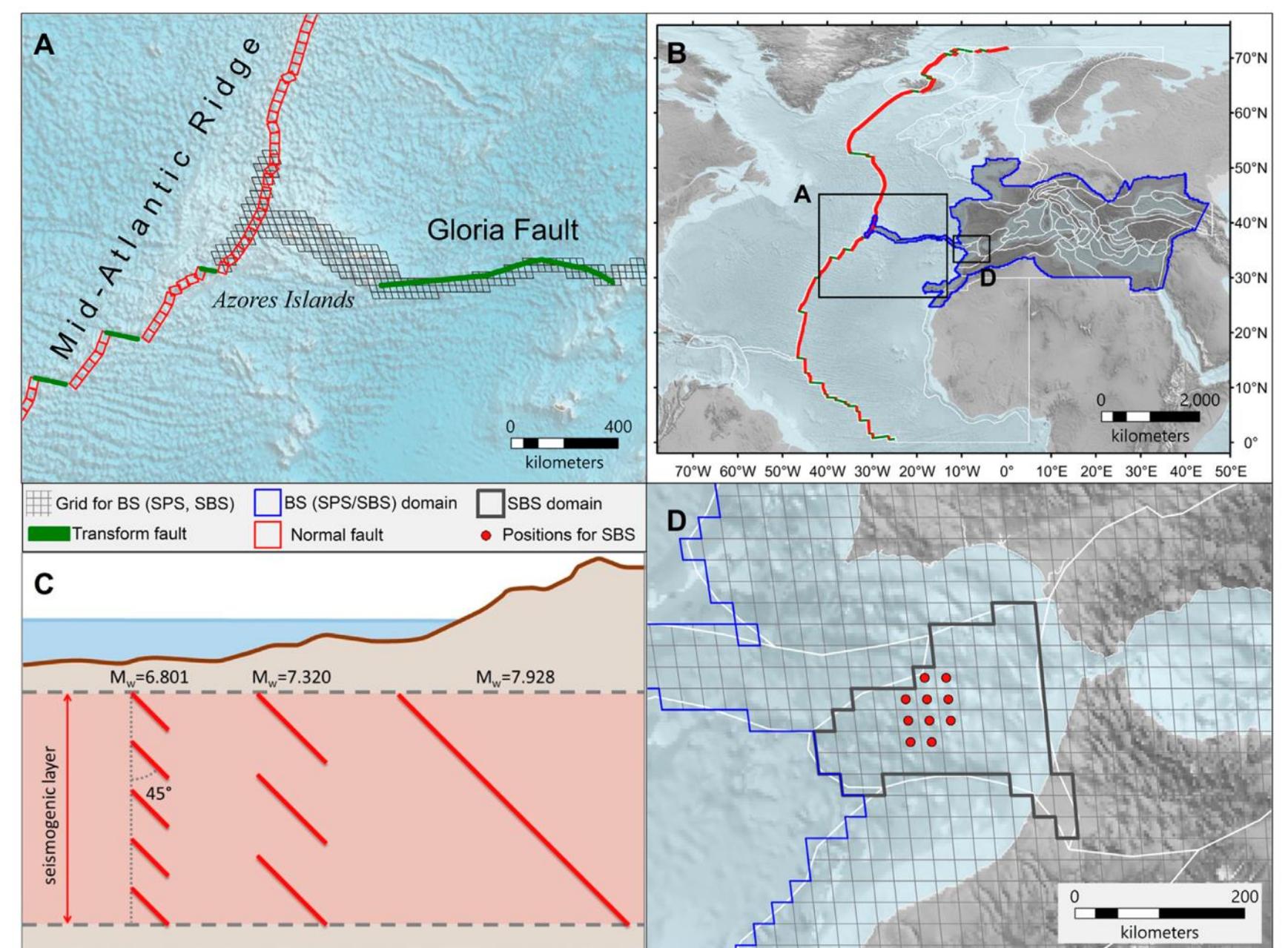


Calabrian subduction 3-D block model
(Gutscher et al., 2016, Tectonics)

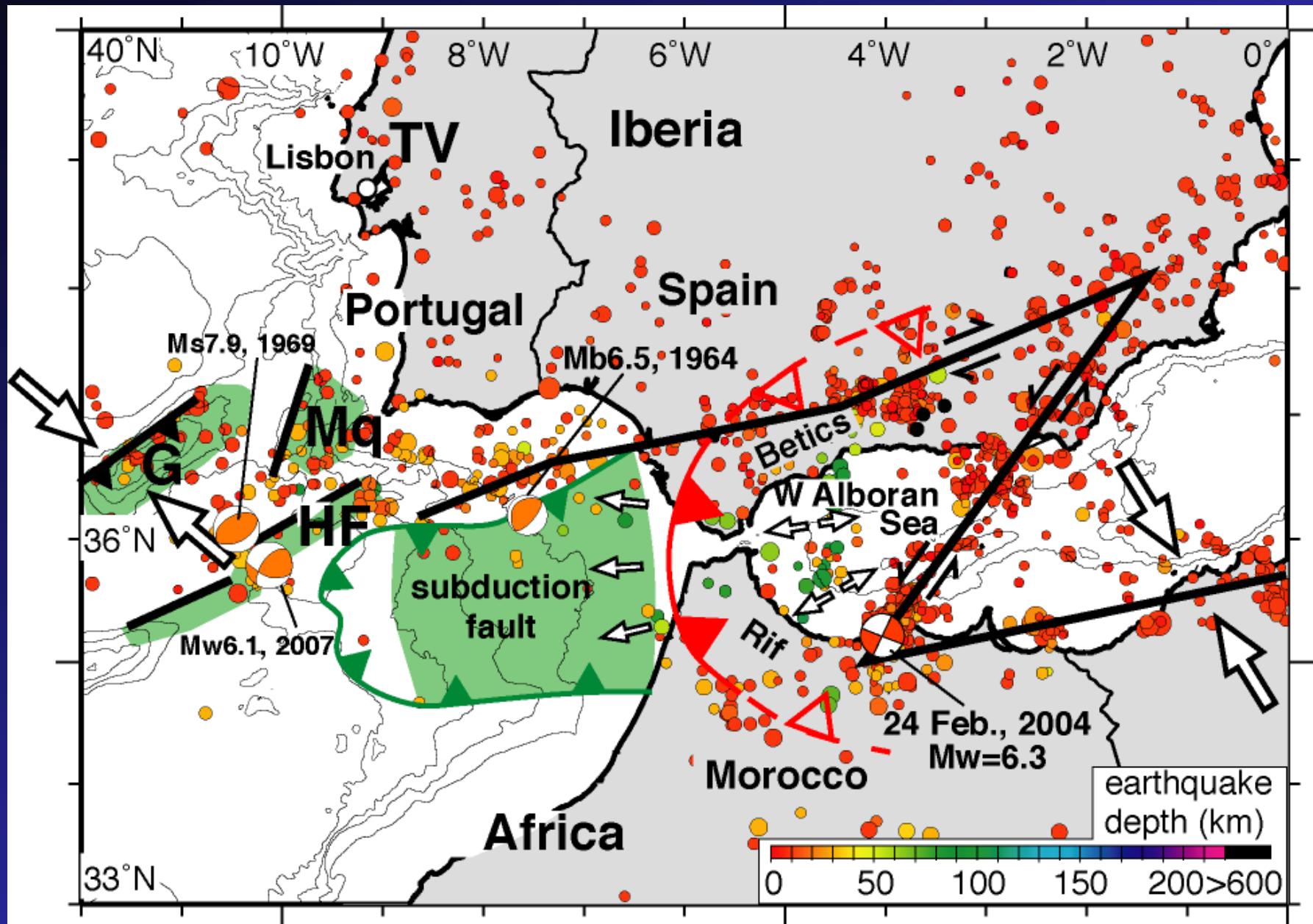
Seismicity map
Gloria Fault (Azores - Gibraltar transform) seismicity
of Europe
(Custodio et al., 2016)



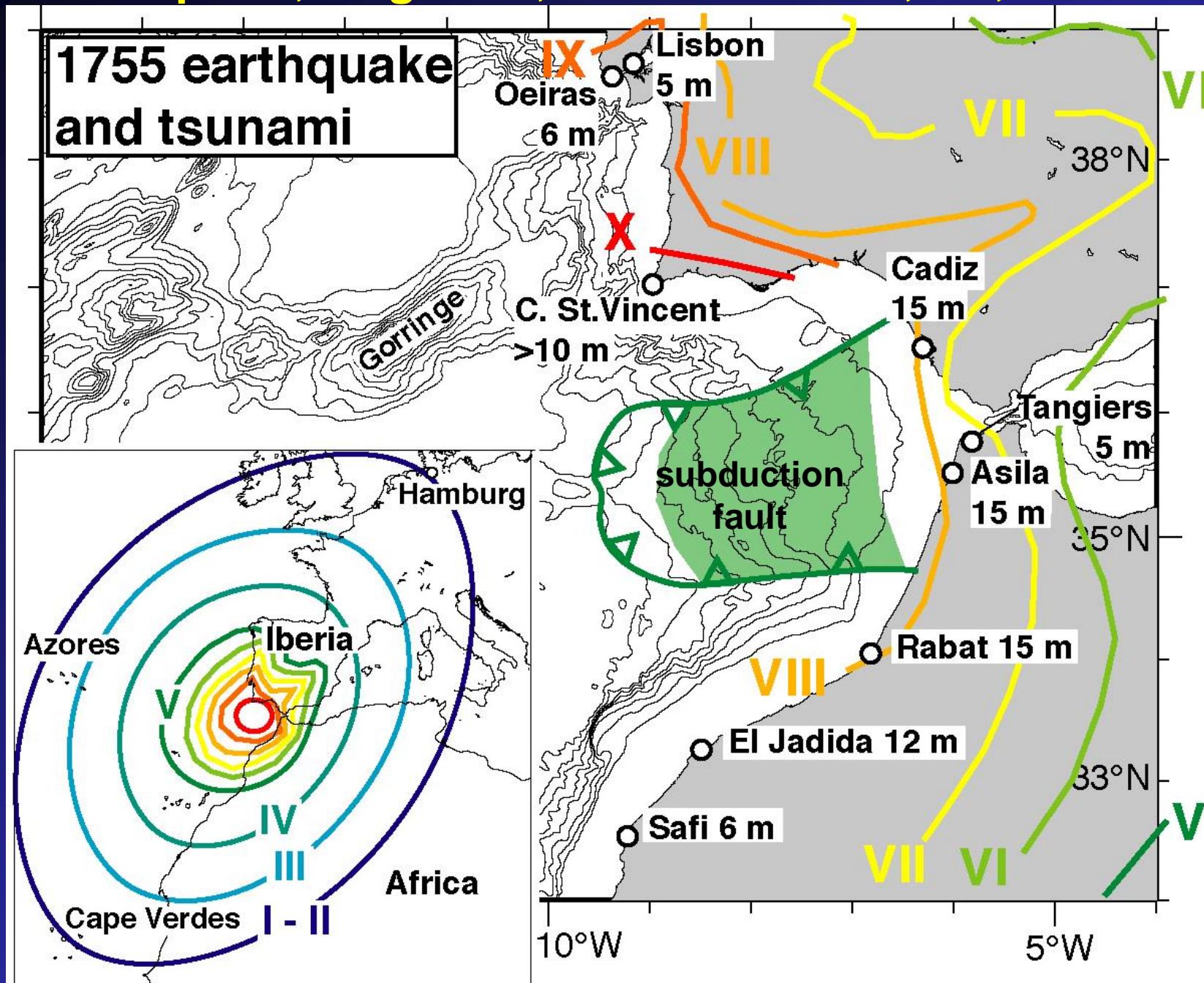
Seismicity map Gloria Fault and Gibraltar Arc possible tsunami sources (Basili et al., 2018)



Recent seismicity and active faults in S. Iberia region

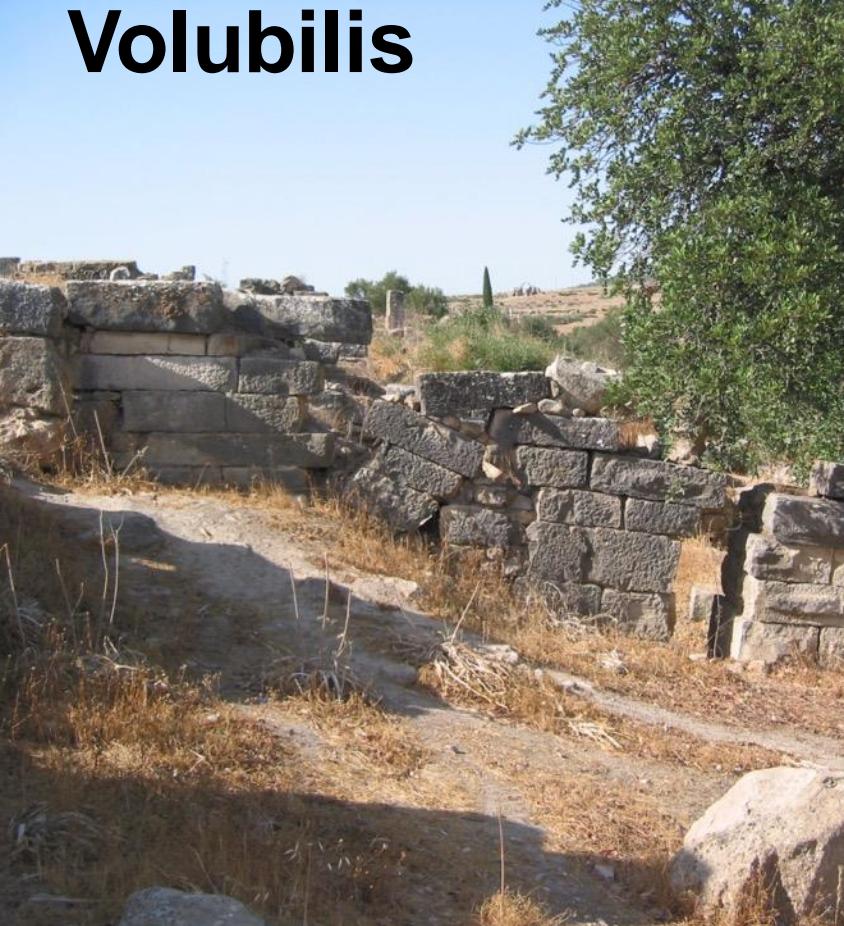


1755 earthquake, magn. 8.7, 5-15 m tsunami, 60,000 victims



Effects of the 1755 earthquake in Morocco

Volubilis



Rabat

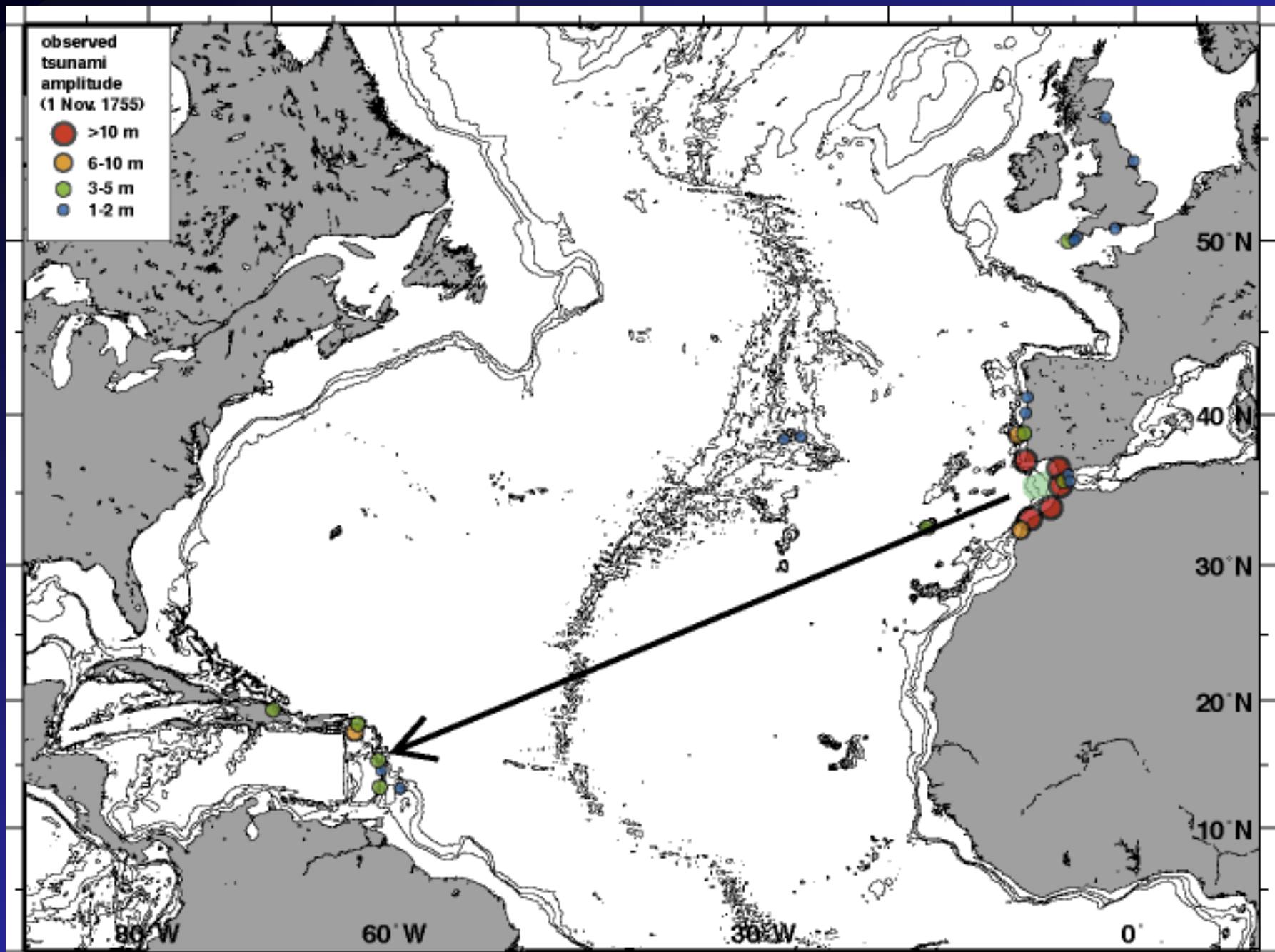


1755 tsunami In Morocco



The fortress of
Mazagan
(El Jadida)

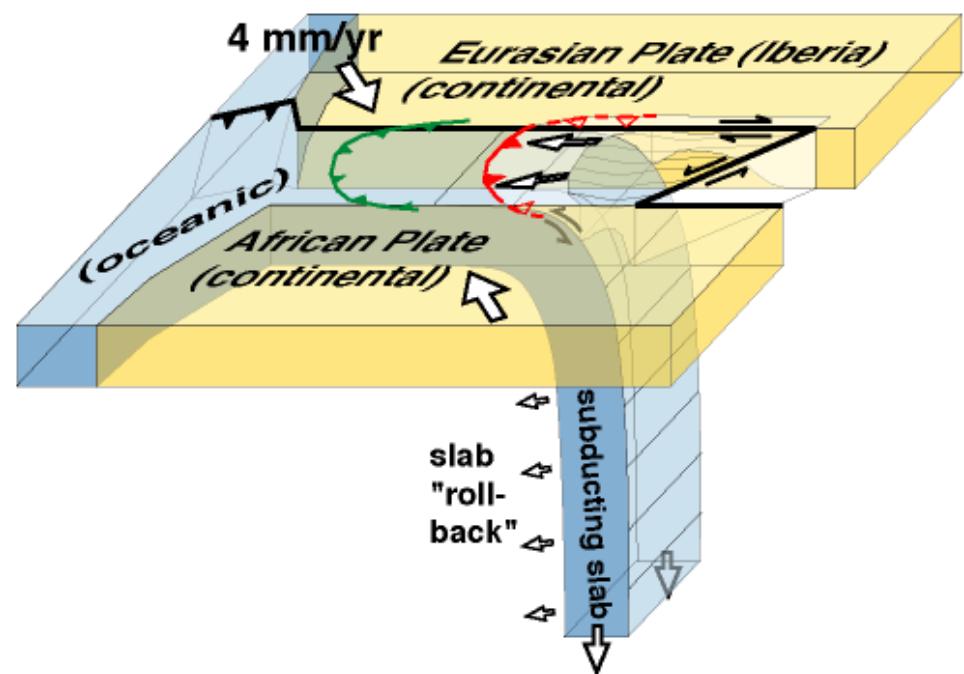
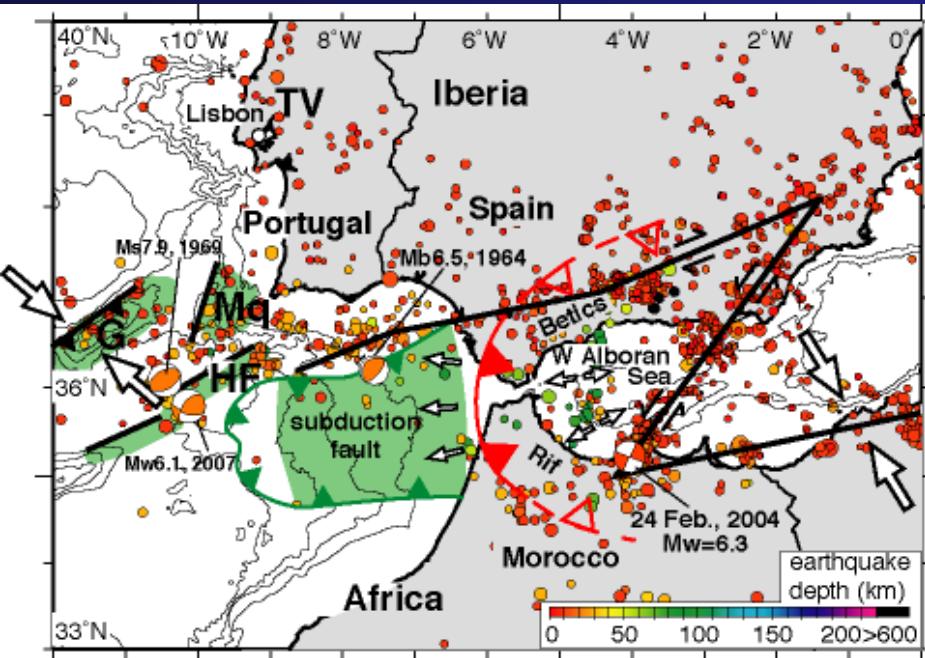
1755 - a trans-Atlantic tsunami



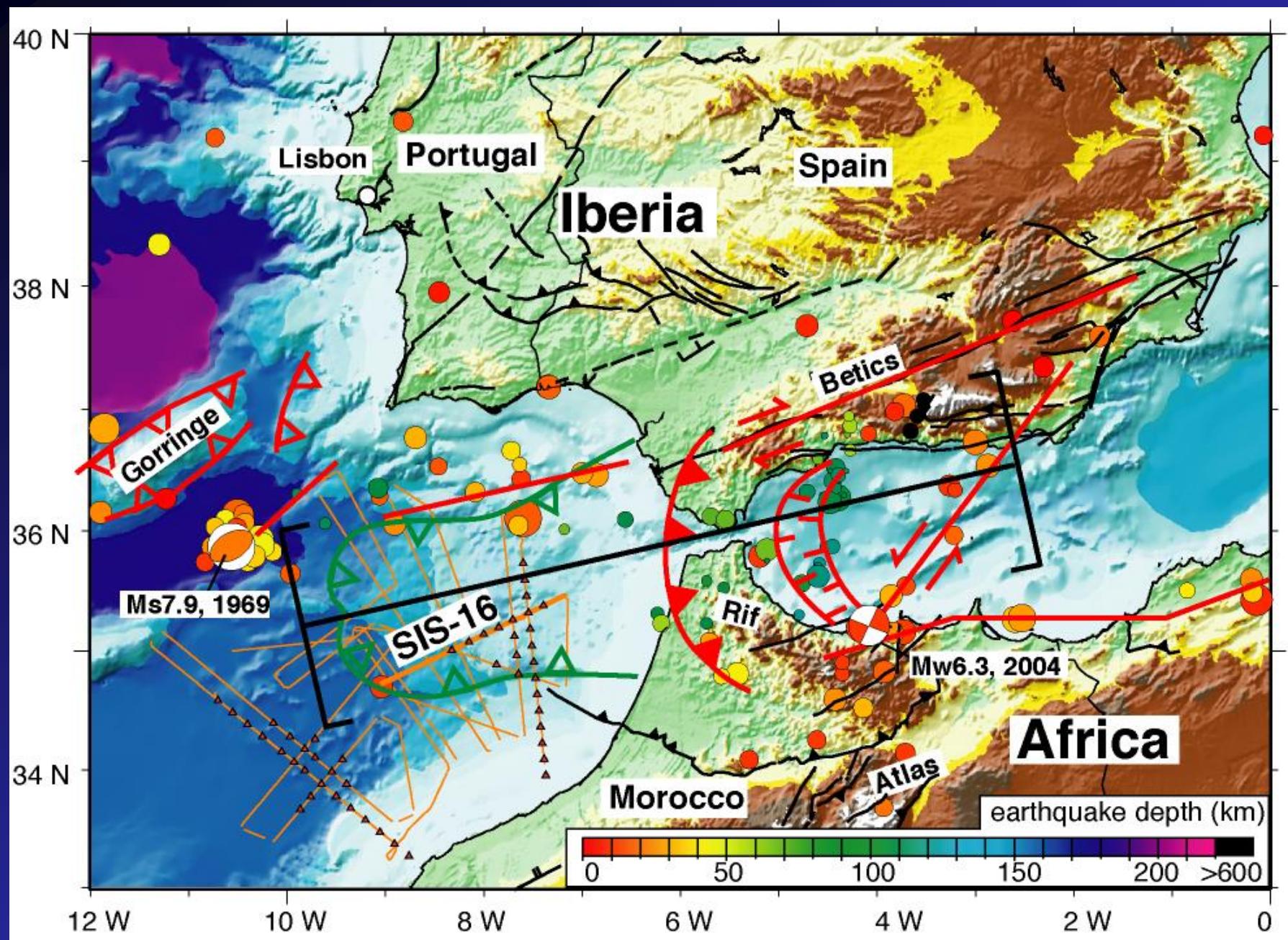
Southern Iberia Region : active faults and small subduction zone

(Gutscher, Science, Aug. 2004)

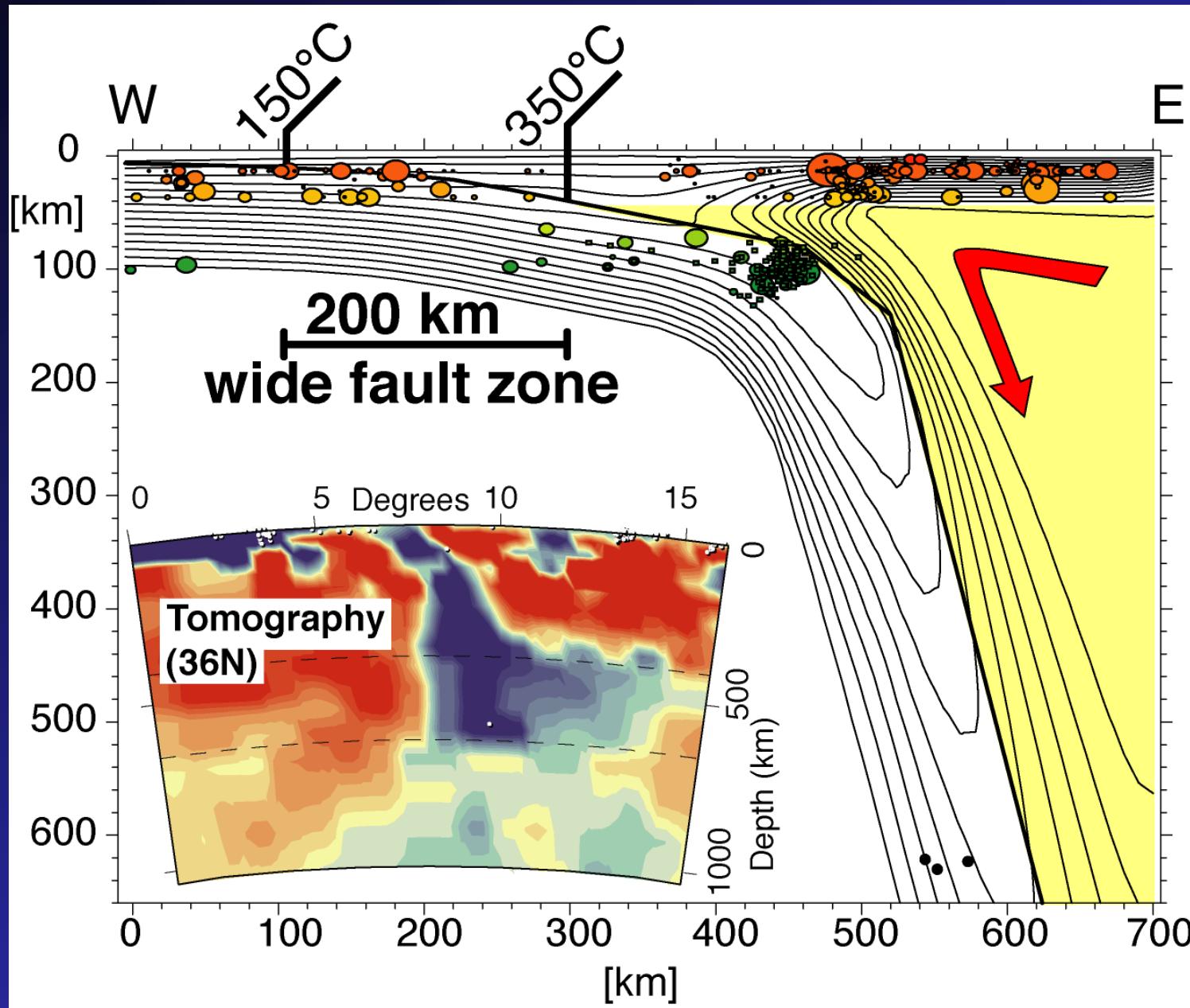
→ source of 1755 earthquake and tsunami ?



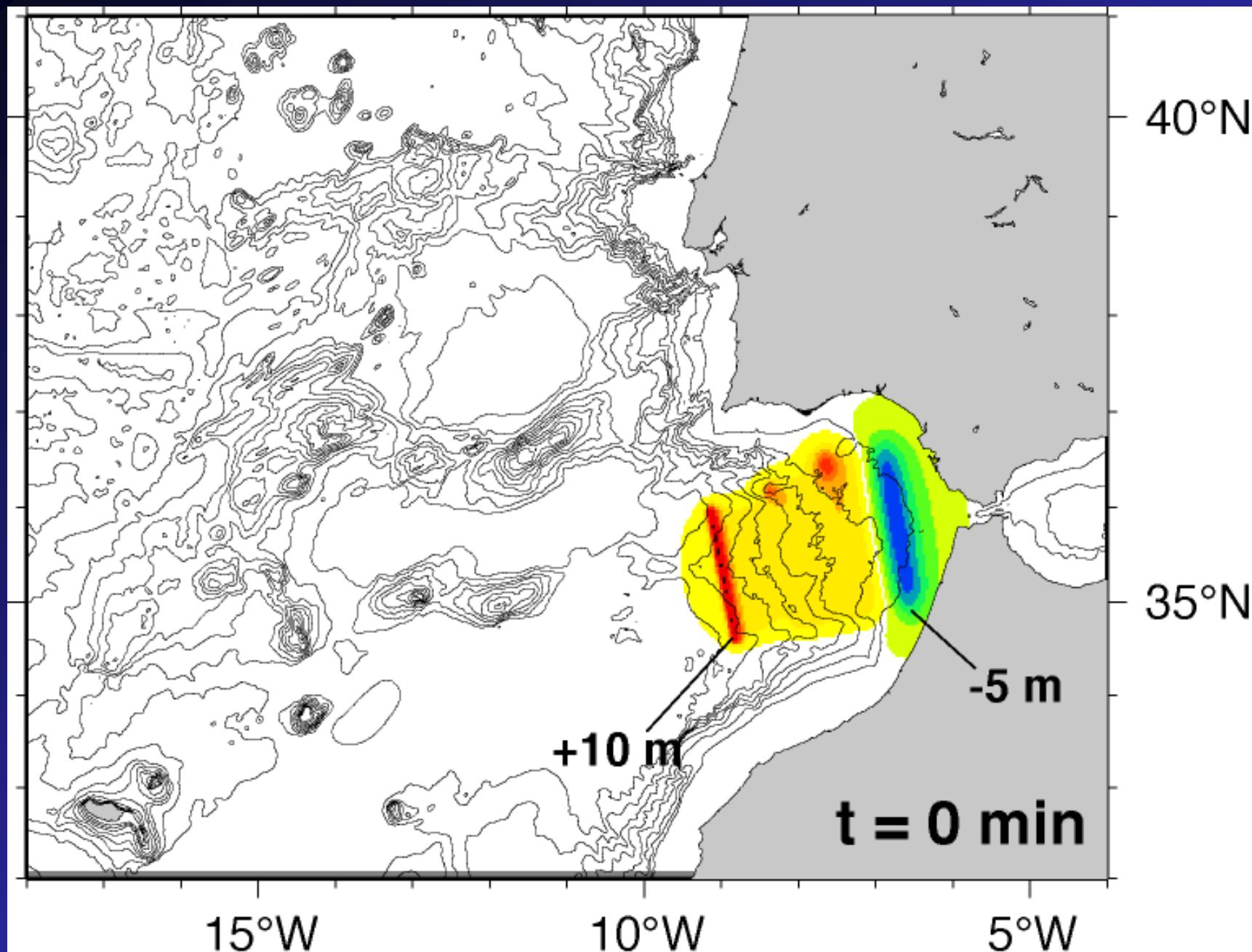
Regional seismicity and cross-section



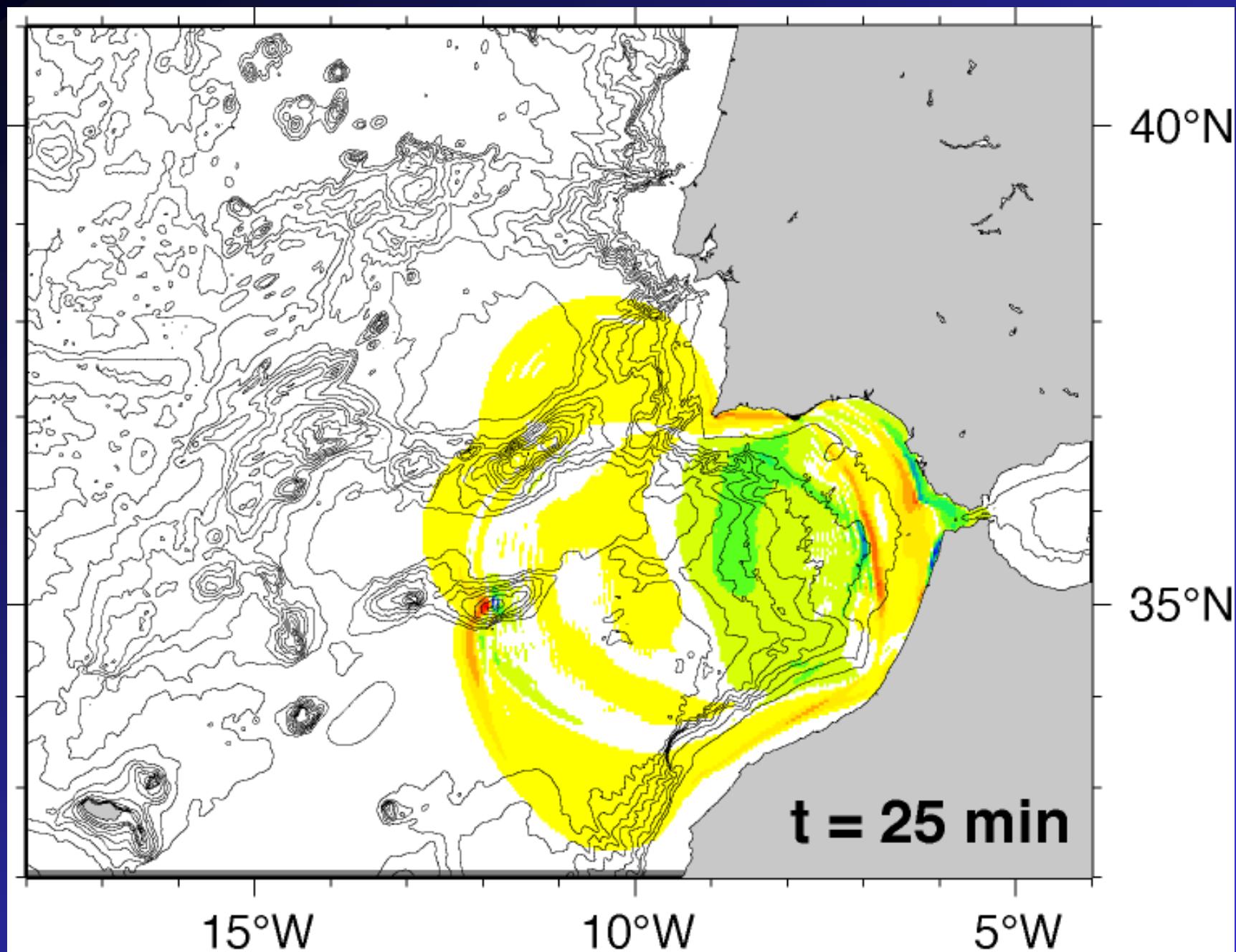
Subduction thermal model (Thiebot and Gutscher, 2006, Tectonophysics)



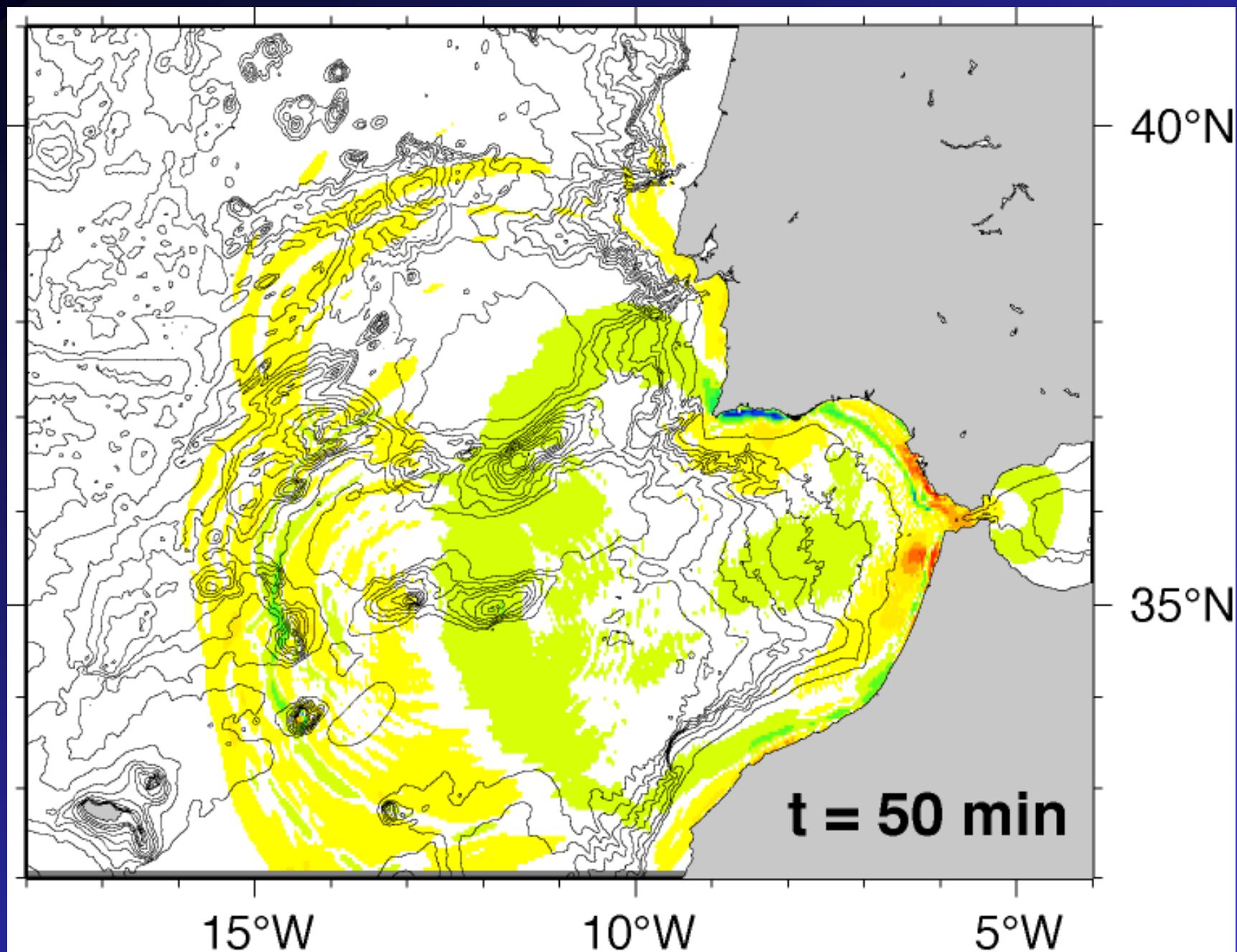
Subduction tsunami model (Gutscher, Baptista, Miranda, 2006, Tectonophysics)



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

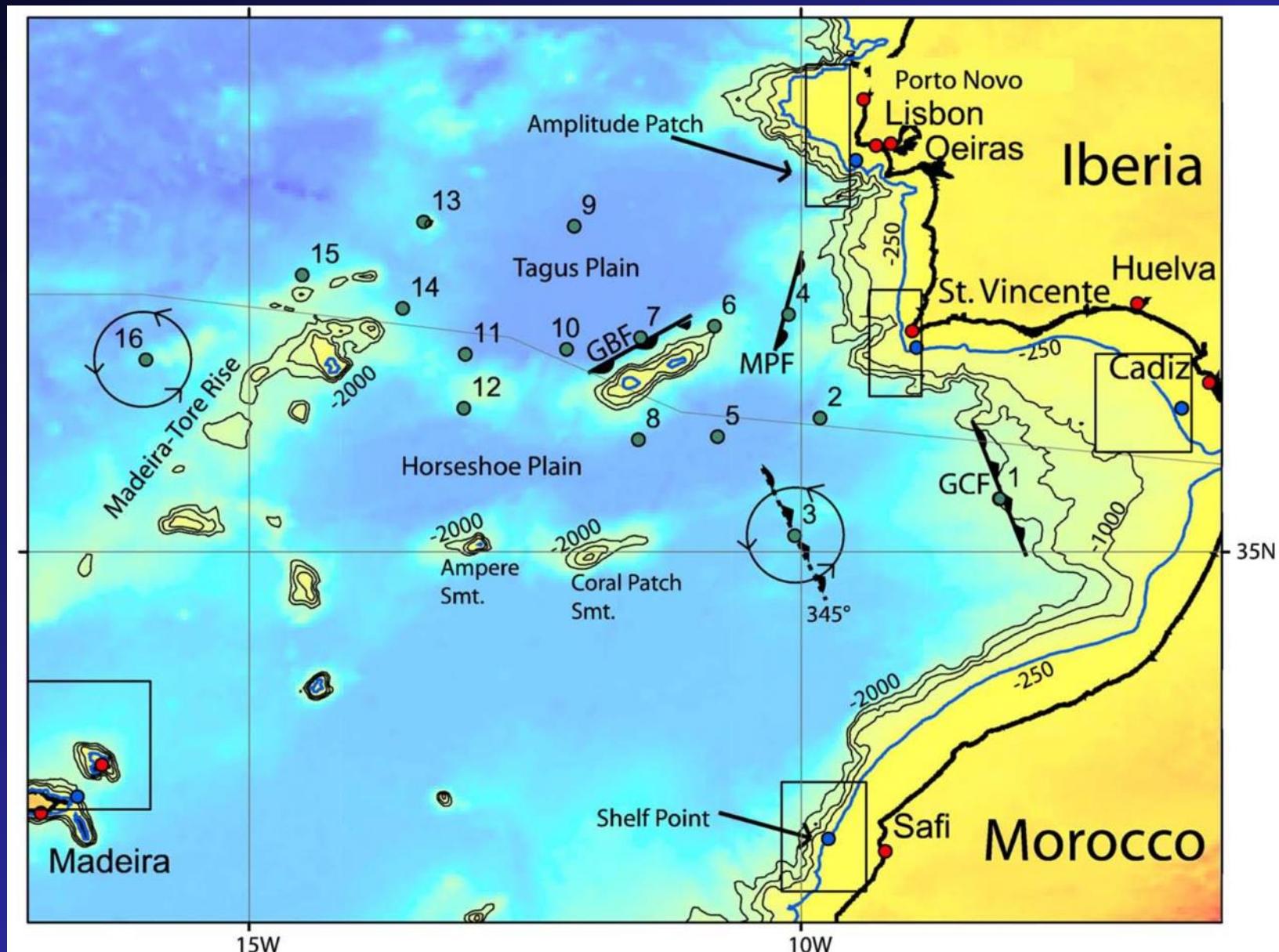


Subduction tsunami model (Gutscher, Baptista, Miranda, 2006, Tectonophysics)



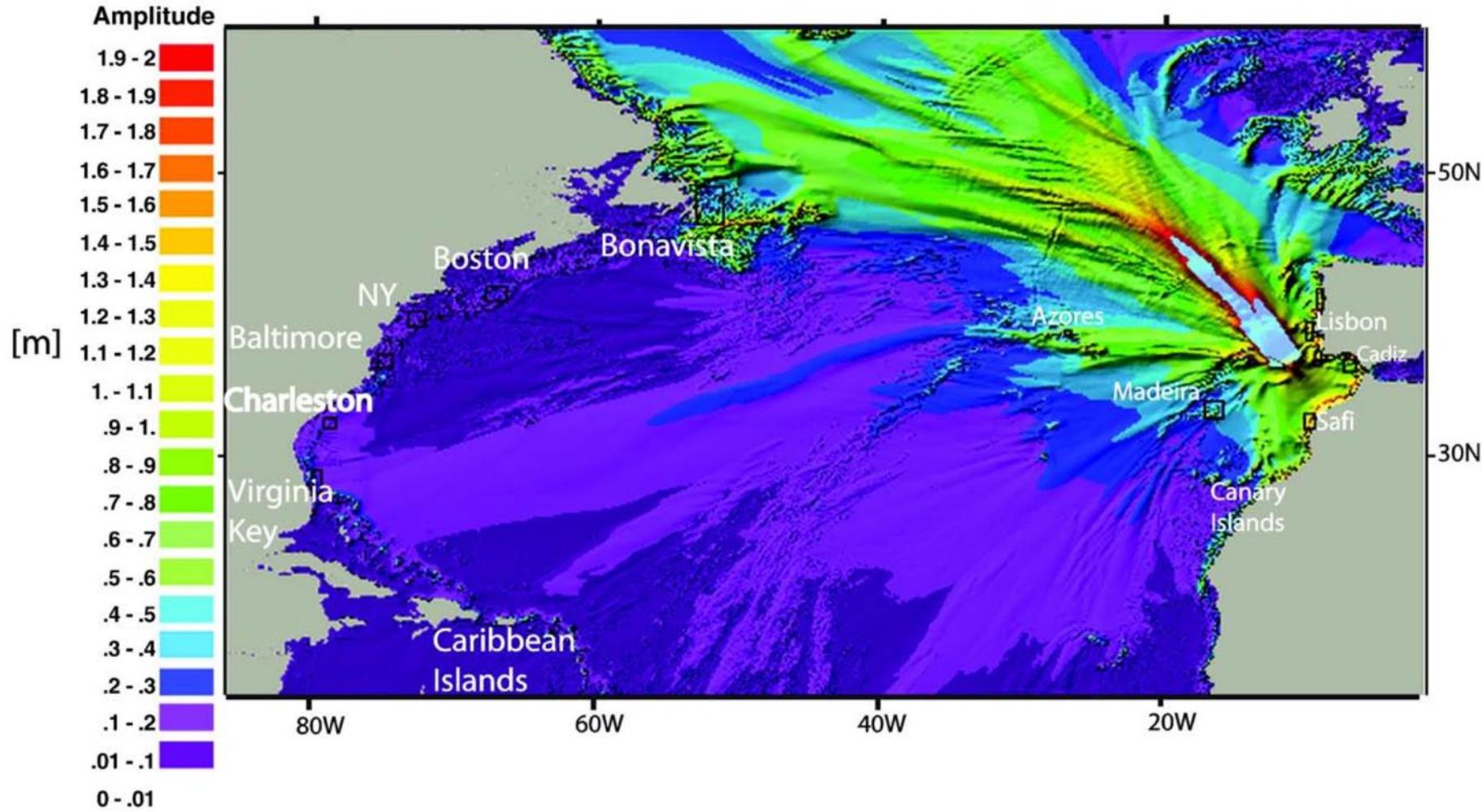
SW Iberia Region : modeling tsunami source zones

(Barkan et al., 2009, Marine Geology)



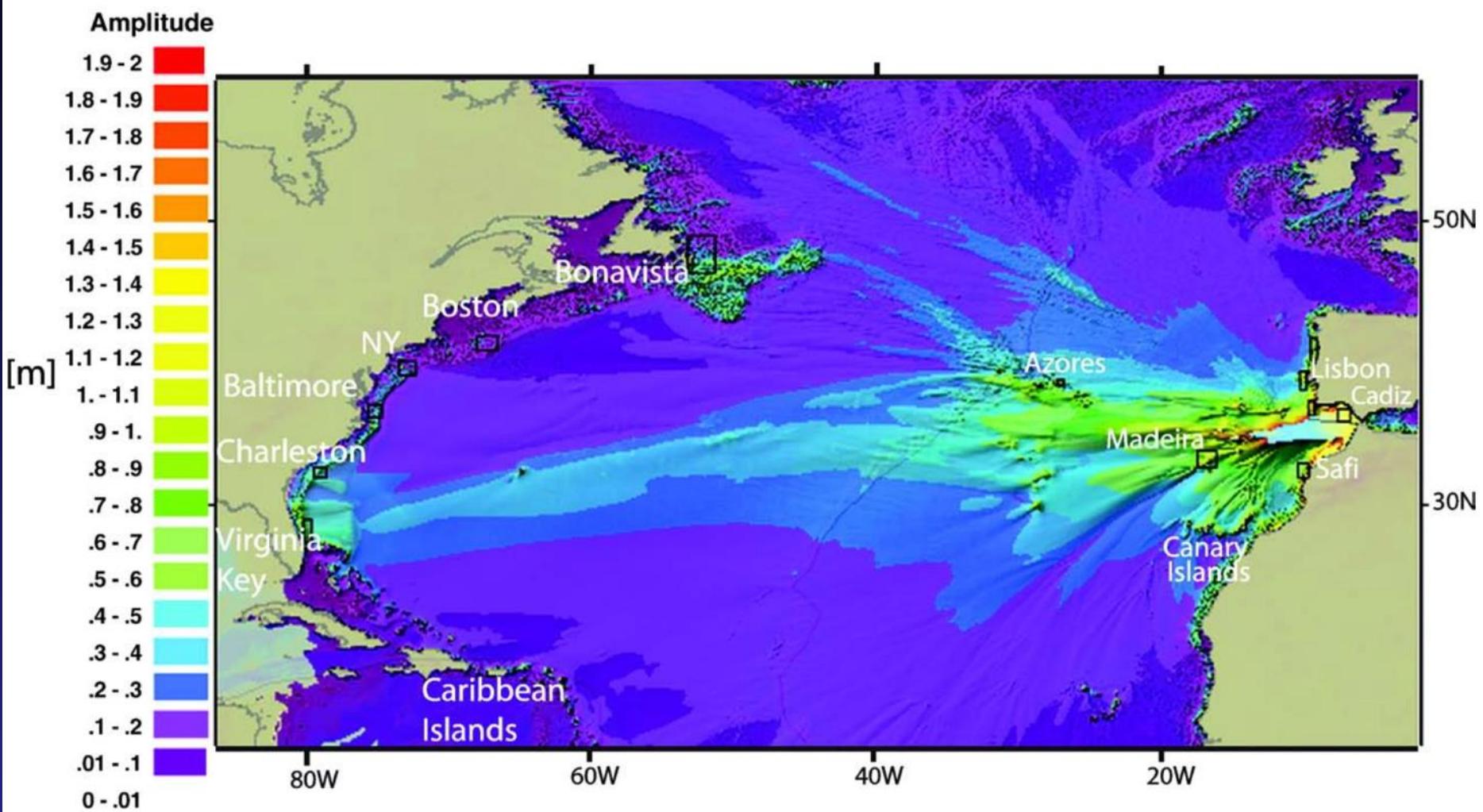
Modeling the Gorringe Bank tsunami source

(Barkan et al., 2009, Marine Geology)



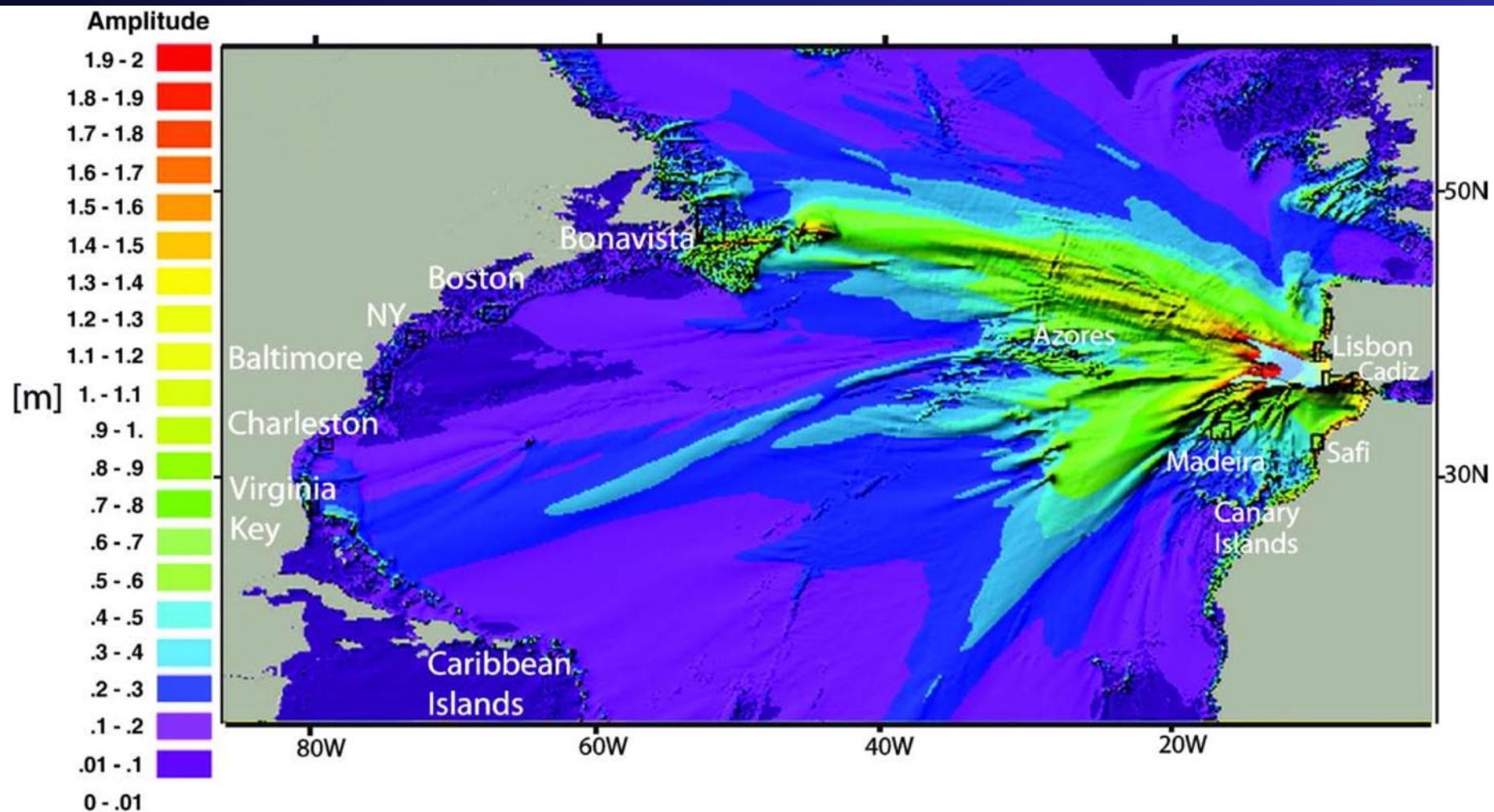
Modeling the Gibraltar subduction tsunami source

(Barkan et al., 2009, Marine Geology)



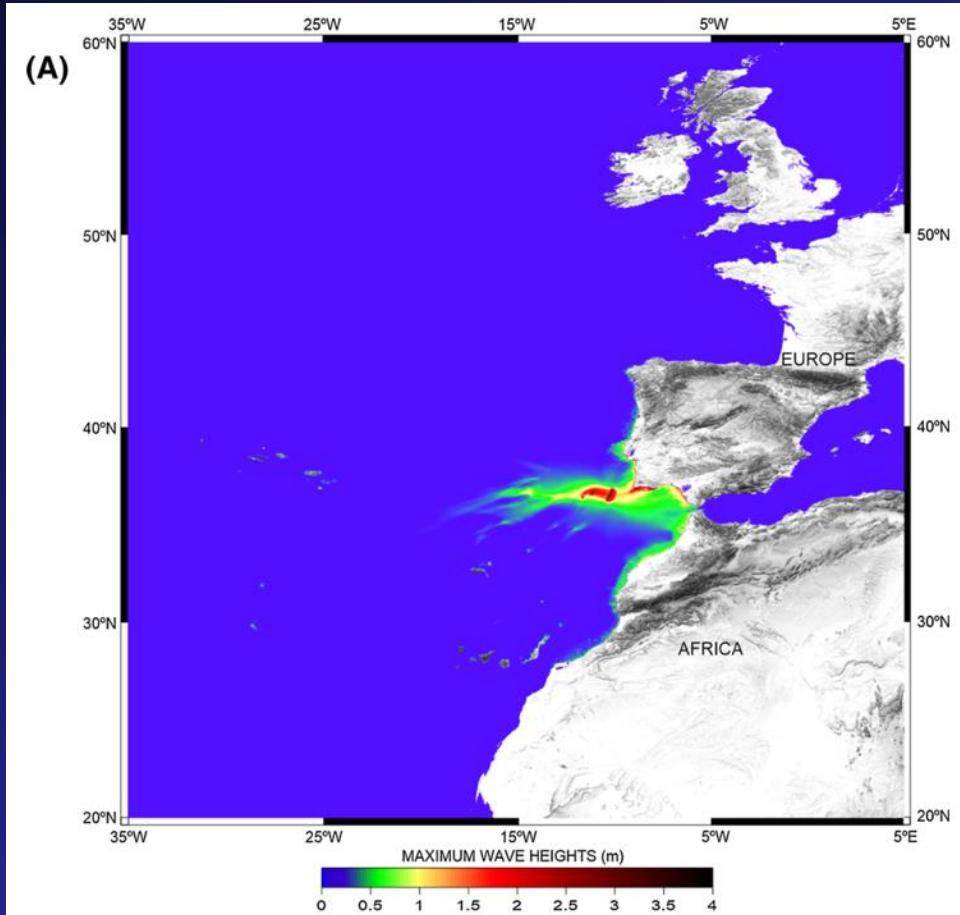
Modeling the Marques de Pombal tsunami source

(Barkan et al., 2009, Marine Geology)

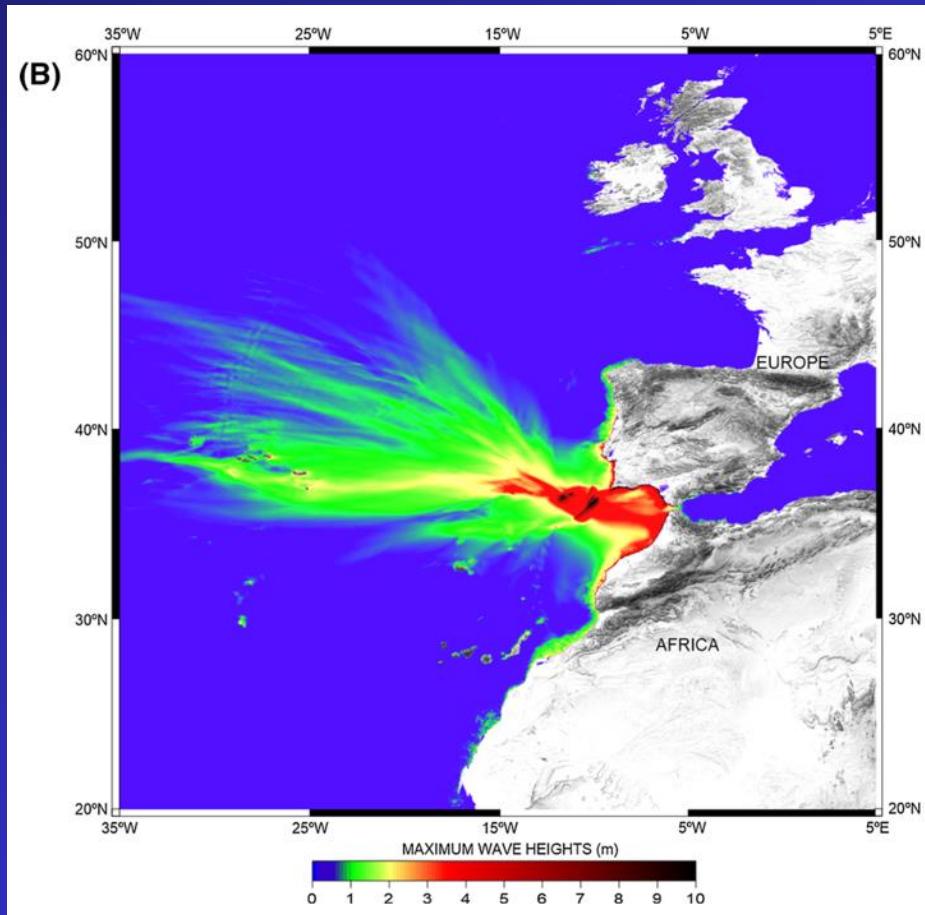


Modeling the Marques de Pombal + Horseshoe fault tsunami source (Omira et al., 2014, Pure and Applied Geophysics)

M8.0 scenario



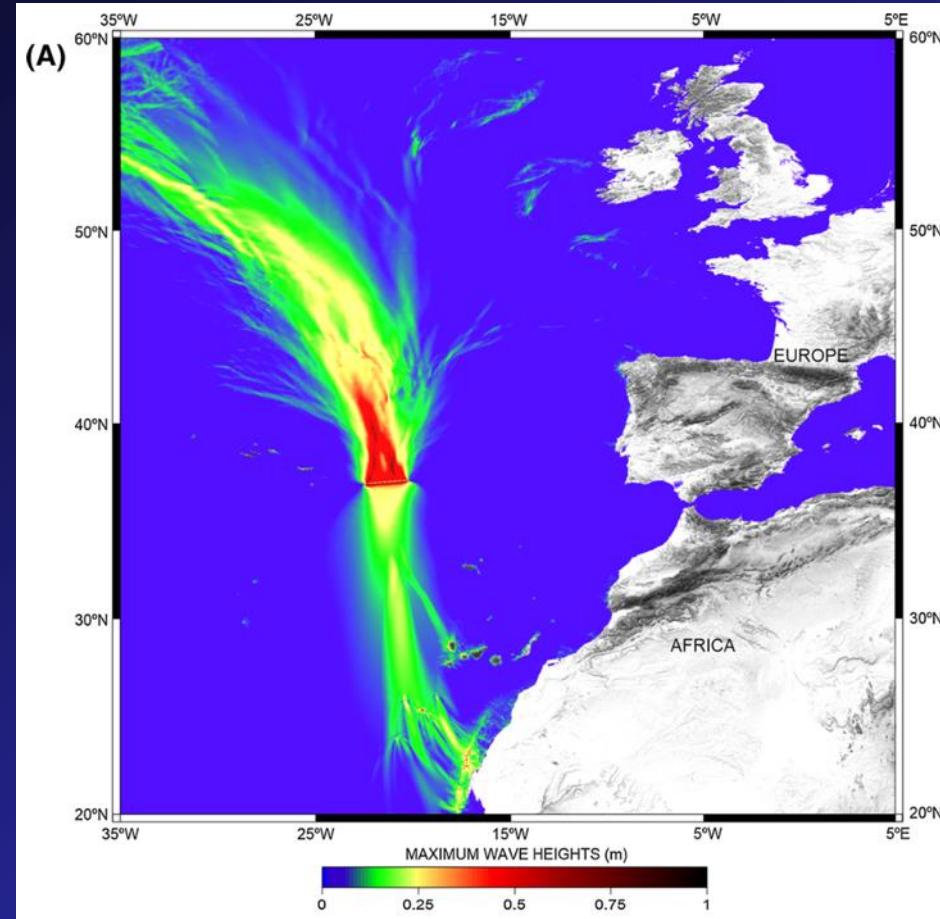
M8.75 scenario



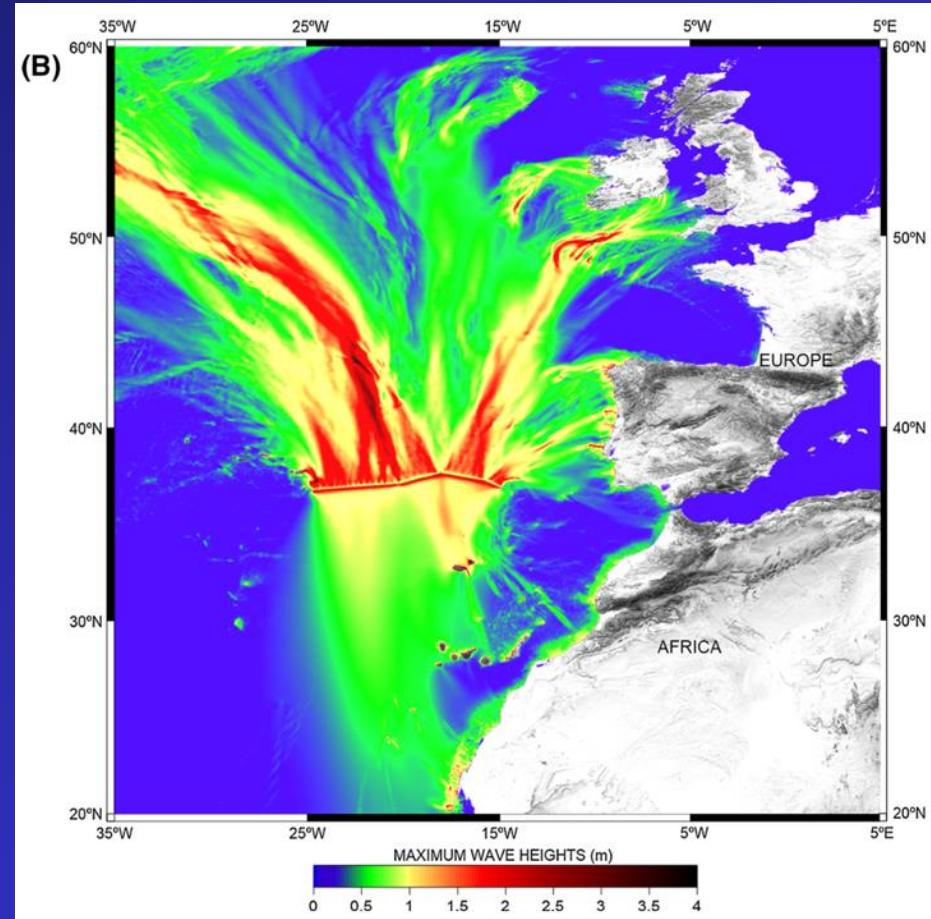
Modeling the Gloria Fault tsunami source

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

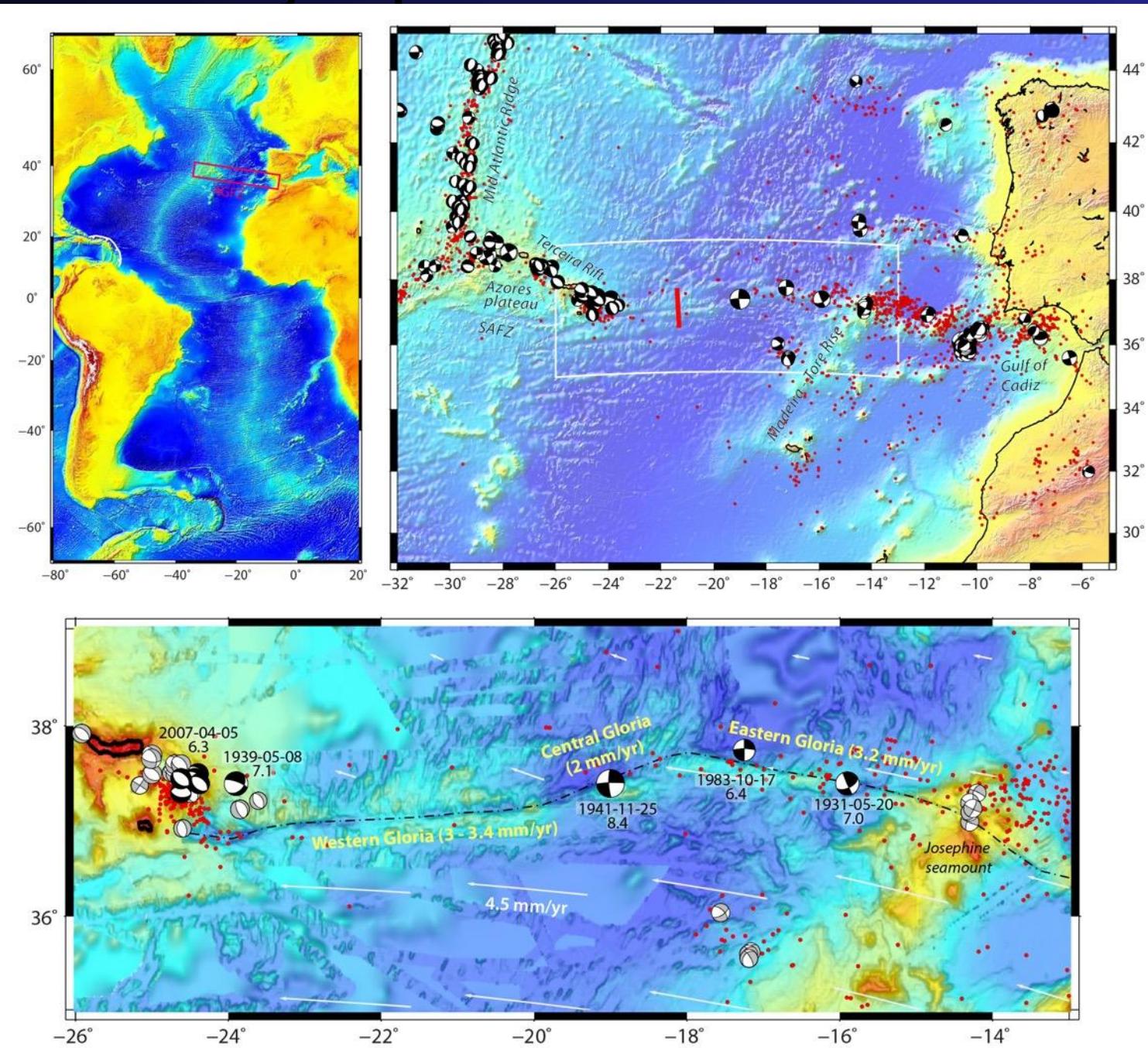
M8.0 scenario



M9.0 scenario



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



Summary :

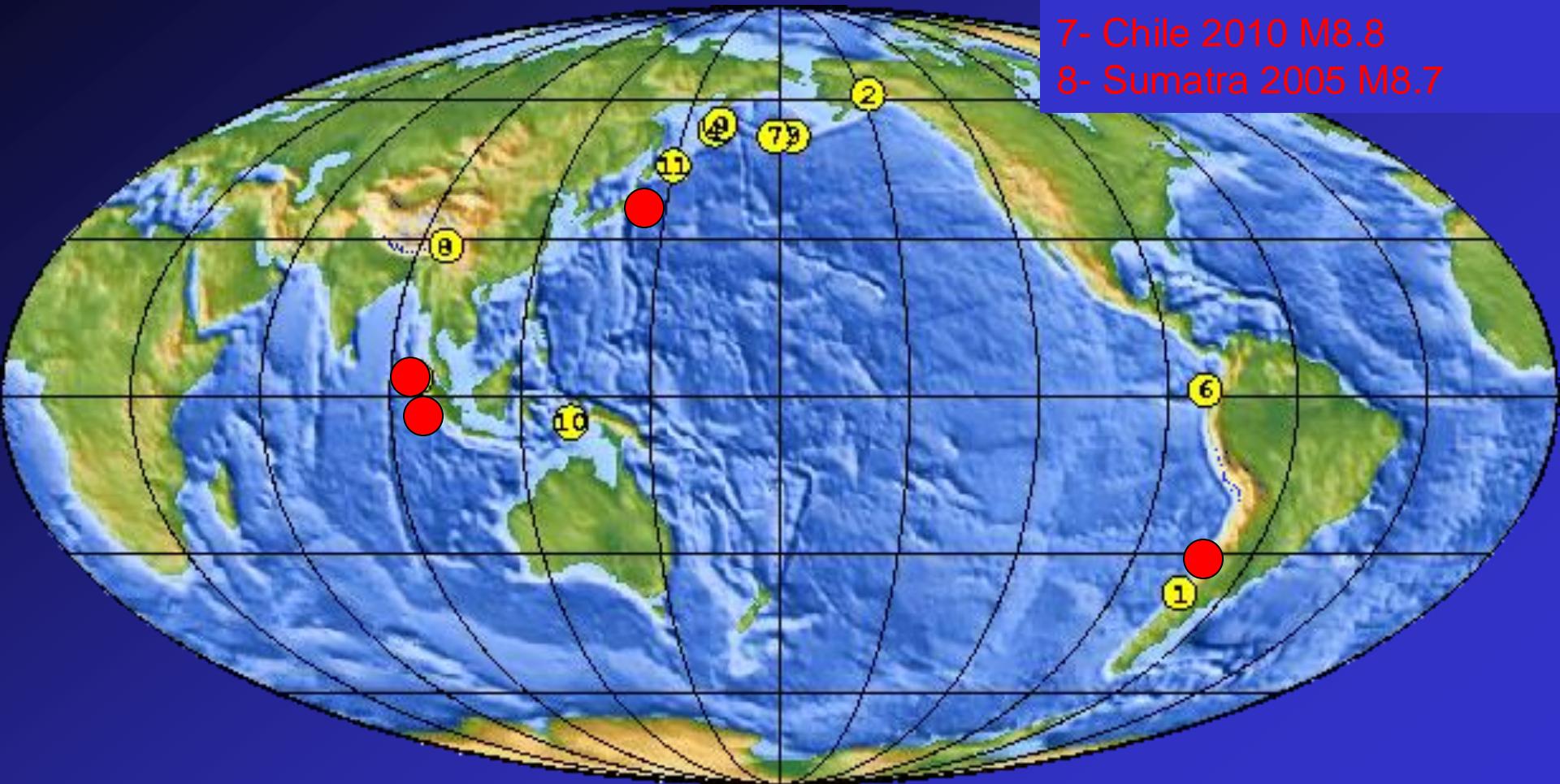
- SW Iberia region has generated historical M8 - M8.7 earthquakes and strong tsunamis
- the source of the 1755 earthquake & tsunami is still uncertain / debated
- but a big fault is necessary to produce such an earthquake (M8.7)
- the seismogenic and tsunamigenic potential of the slow subduction zones (Calabria, Gibraltar) is uncertain / debated

Thanks for your attention !



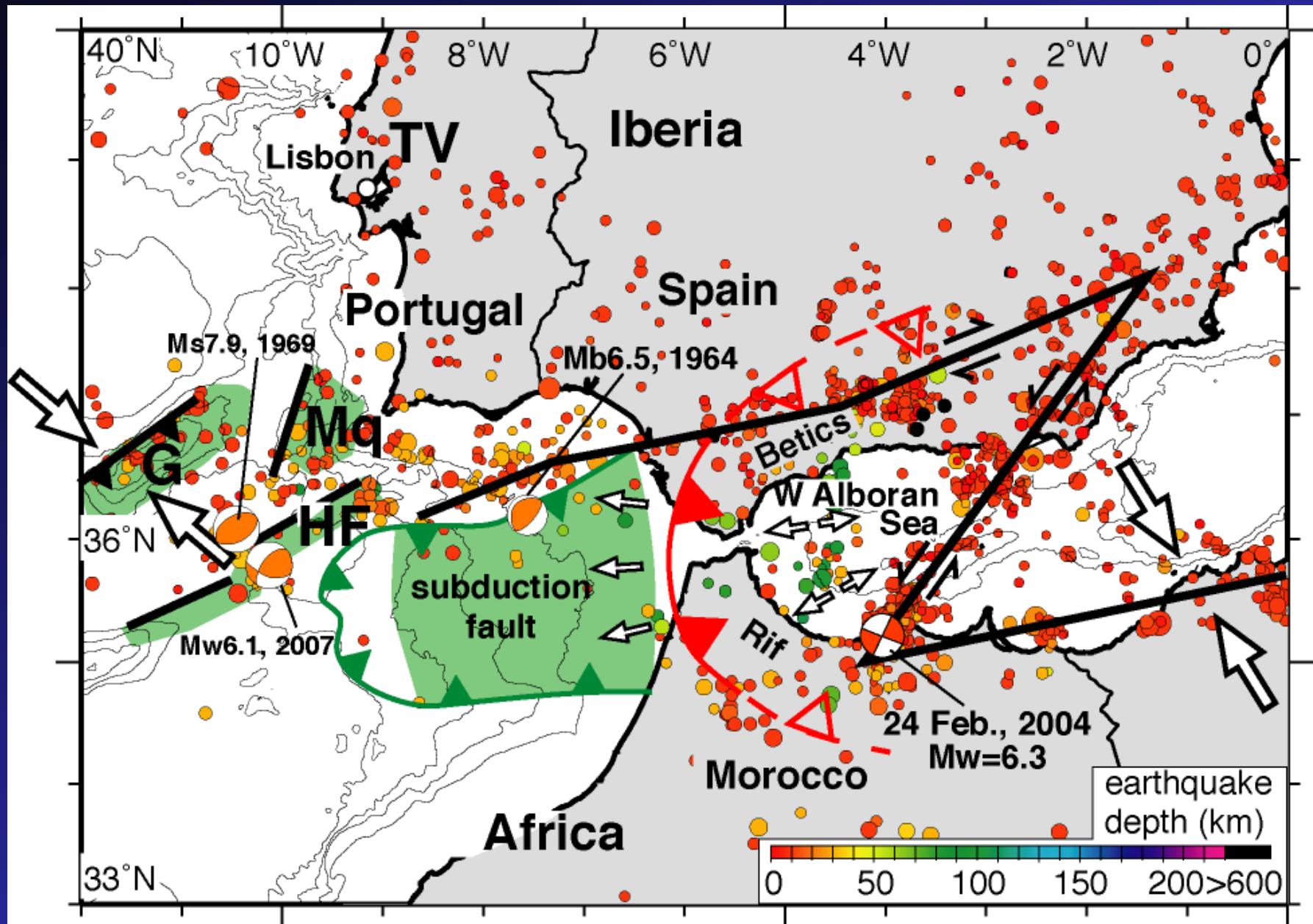
The strongest earthquakes ($M \geq 8.5$) in the world since 1900

- 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

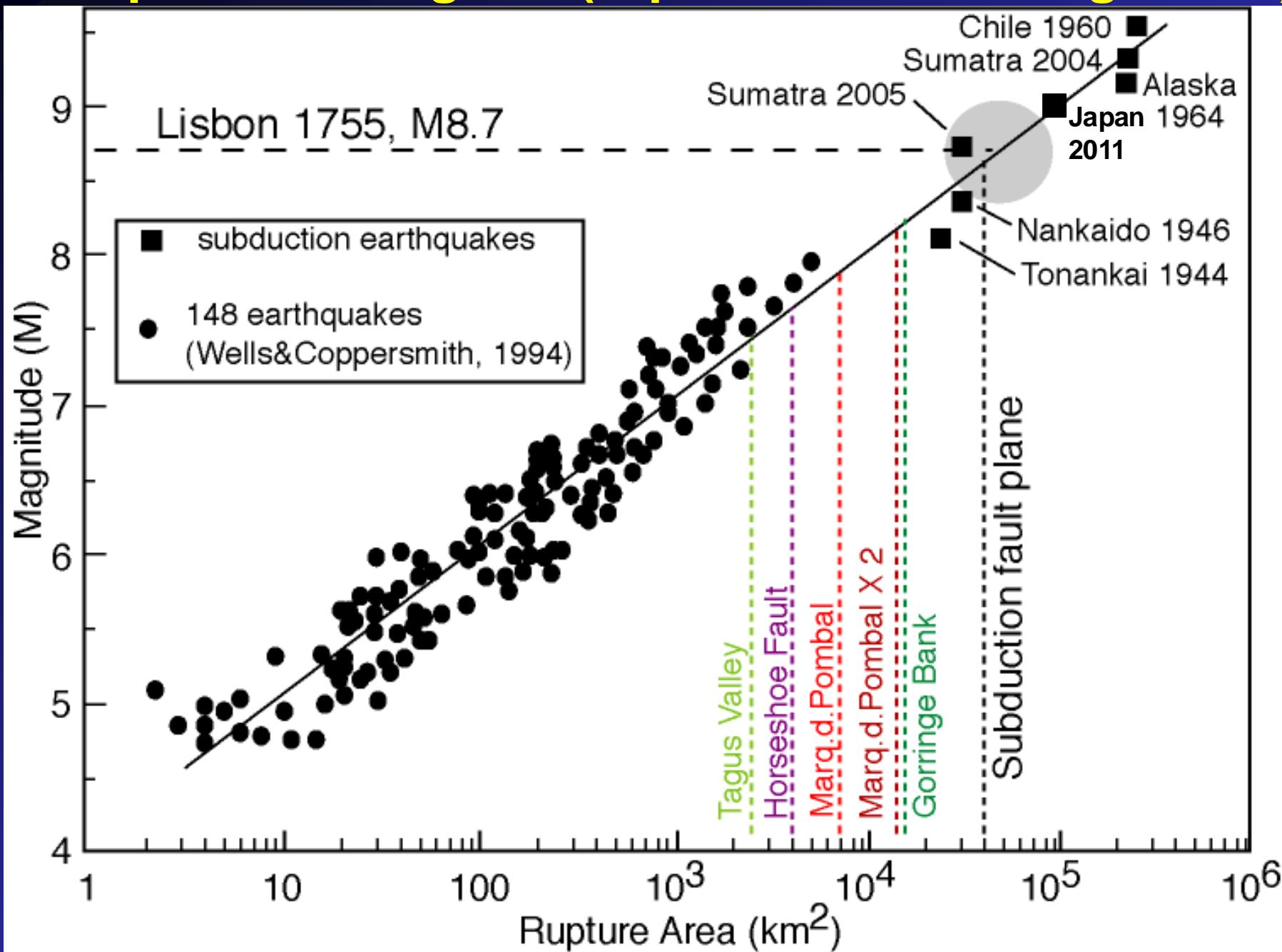


All (except Tibet) occur in subduction zones

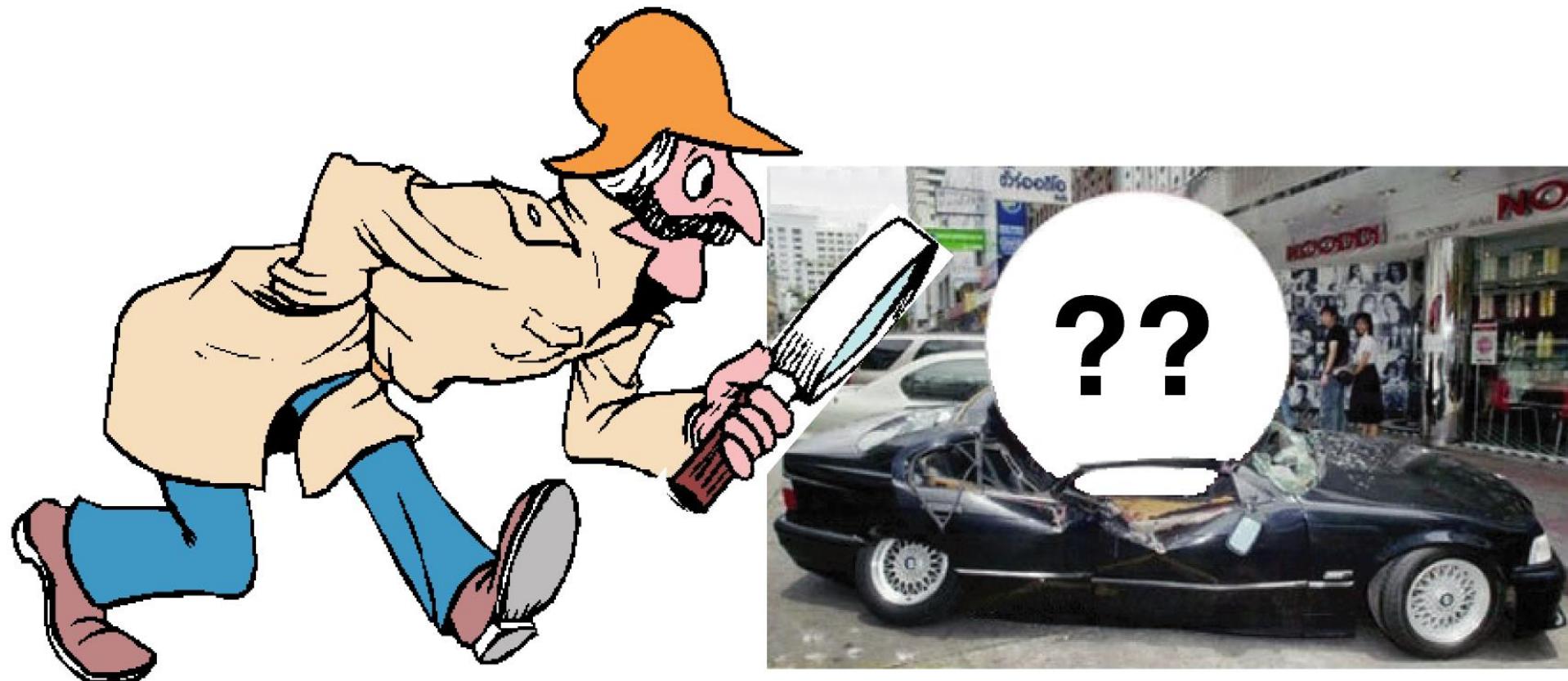
Recent seismicity and active faults in S. Iberia region



Earthquake scaling law (rupture area vs. magnitude)



Whodunnit?



the suspects



The scene of the crime



(Ad campaign for Nike)