ESTIMATION OF RADIATED ENERGY FOR DEEP EARTHQUAKES

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Objective

The occurrence of very deep earthquakes is characteristic of the subduction regions. However, Southern Spain, where very deep earthquakes have occurred, does not correspond to a classic subduction region. The objective of this study is to calculate the radiated seismic energy for South Spain earthquakes and to compare them with other classic subduction regions.The results obtained are interpreted based on different rupture processes.

1. Methodology

$$E_R = E^P + E^S = \frac{1}{15\pi\rho\alpha^5}\int_{-\infty}^{\infty}\ddot{M}_0^2(t)dt + \frac{1}{10\pi\rho\beta^5}\int_{-\infty}^{\infty}\ddot{M}_0^2(t)dt$$

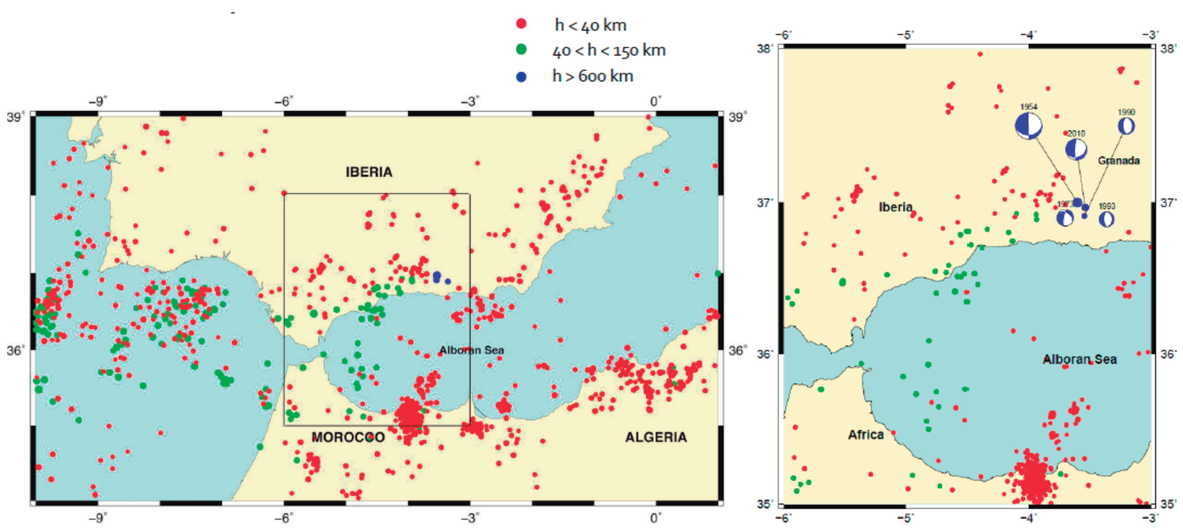
$$E_R = \left[1+\frac{3}{2}\left(\frac{\alpha}{\beta}\right)^5\right]\frac{8\pi}{15\rho\alpha^5}\left[\frac{4\pi\rho^3\alpha^3 R_T}{R(\theta,\phi)C_z g(\Delta)}\right]^2\int_0^{\infty} f^2\left[\frac{|u(f)|}{e^{-\pi f t^*}}\right]^2 df$$

$$E^S = \frac{3}{2}\left(\frac{\alpha}{\beta}\right)^5 E^P$$

Venkataraman (2002)

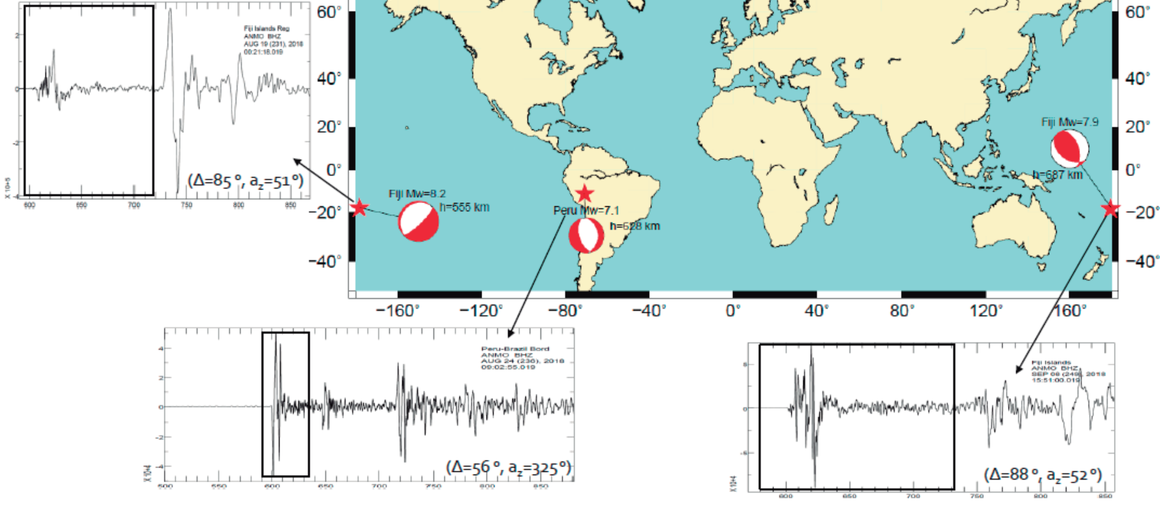
- $u(f)$ displacement (removed the instrument)
- $e^{-\pi f t^*} = e^{\frac{\pi f \tau}{Q}}$ correction by attenuation
- g(Δ) geometrical spreading
- C_z Free Surface effects
- R(θ,ϕ) Radiation pattern

2. The Spanish Very Deep Earthquakes



Overview of Seismicity in the Ibero-Maghrebian region (left, Buforn et al., 2019). Since 1954, ve deep earthquakes have occurred and their focal mechanisms and epicenters were studied (right).

3. Deep earthquakes 2018

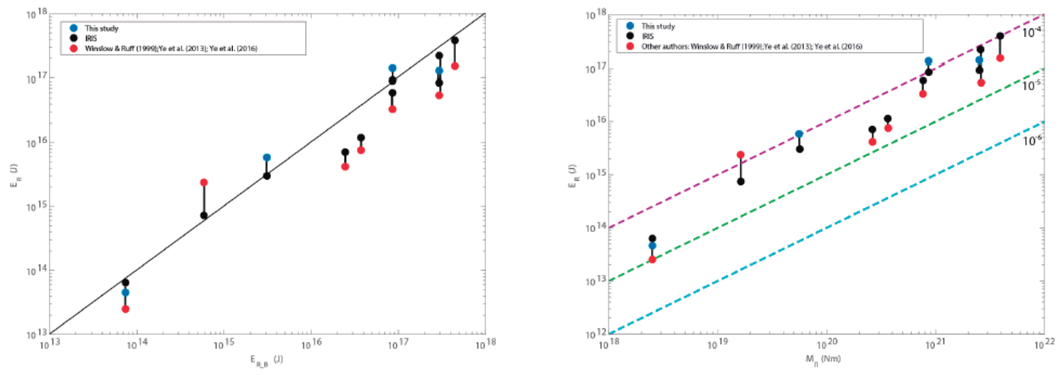


Other deep earthquakes that have occurred at Peru and Fiji. Shown are the focal mechanisms and selected time windows used to obtanied the radiated seismic energy.

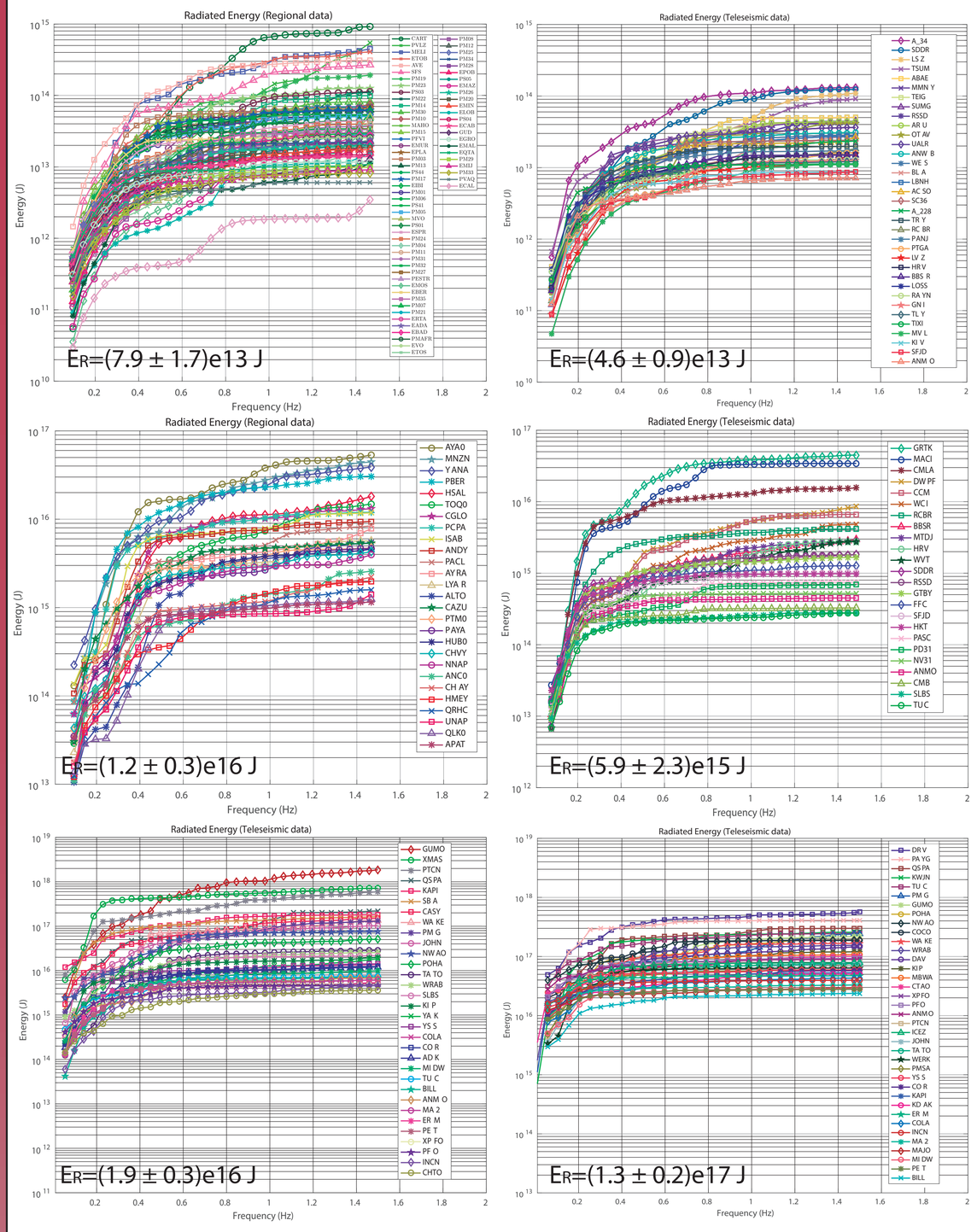
5. E_R for deep earthquakes

$$m_B = 0.75M_w + 1.63\ (Kanamori\ \&\ Ross, 2018)$$

$$\log_{10} E_{\{R-B\}} = 5.8 + 2.4m_B (Gutenberg\ \&\ Richter, 1955)$$



4. Estimation of radiated seismic energy



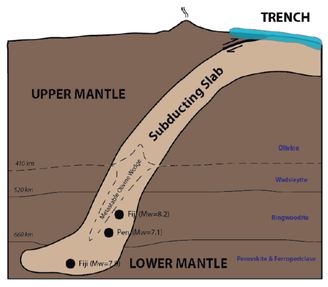
Estimation of the radiated seismic energy of 2010 Spanish earthquake from stations at regional distances and teleseismic distances (upper panel); 24th August, 2018 Peru earthquake (Mw=7.1) from regional and teleseismic distances (center); 6th September, 2018 Fiji earthquake (Mw=7.9, left) and 19th August, 2018 Fiji earthquake (Mw=8.2, right) from teleseismic distances (bottom panel). The radiated seismic energy has been corrected by the geometrical spreading, anelastic attenuation, free surface and radiation pattern (López-Sánchez et al., 2019).

Conclusions

- For deep earthquakes (Mw between 6.4 and 8.2) Er values range from 4e13 to 2e17. There are small differences between E_R from station at teleseismic distances (30<Δ<90) and E_R from station at regional distances (x<1000 km). A possible explanation to this diference can be explained by the lack of a reliable regional Earth's model.

- Estimation from Spanish deep earthquakes are compatible with other region.

- Open question: What is the origen of deep earrthquakes in South Spain?



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