Earthquake Research Institute, the University of Tokyo

Summary of Report on Research Activities at ERI from 2017/6/29 - 2017/8/5

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My first visit from ERI started with activities related to analyses of an important event and some minor events in South African Gold Mines. On 5 August 2014, the Orkney earthquake occurred near a gold mine in Orkney, South Africa. Data for the research were CGS continuous data in miniseed format at 200 Hz sample rate. Initial waveform and spectral studies for P and S phases showed that probability of a natural earthquake is higher than other possibilities for the mainshock. About 57 seismic stations of the Council for Geoscience networks (CGS network) recorded the mainshock. The signal to noise ratio studies performed for all the waveforms recorded by stations. The best waveforms belonged to 15 stations (Figure 1).

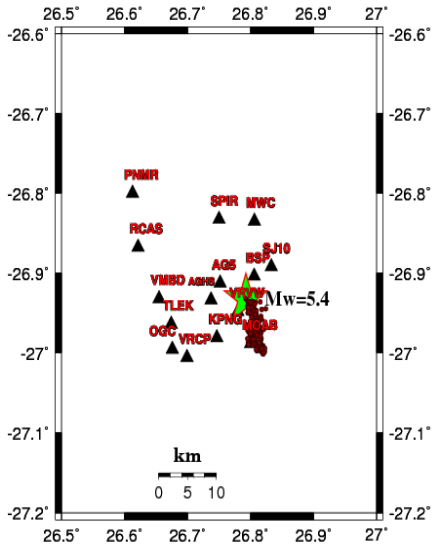


Figure 1: The epicenter location of the 5 August 2014 Orkney earthquake with Mw 5.4 (Green star) and some minor events

The signal-to-noise ratio less than 3 were not used for spectral study of P and S phases from 56 stations. Figure 2 shows an example of waveform for AG5 station for mainshock and signal to noise ratio for this station.

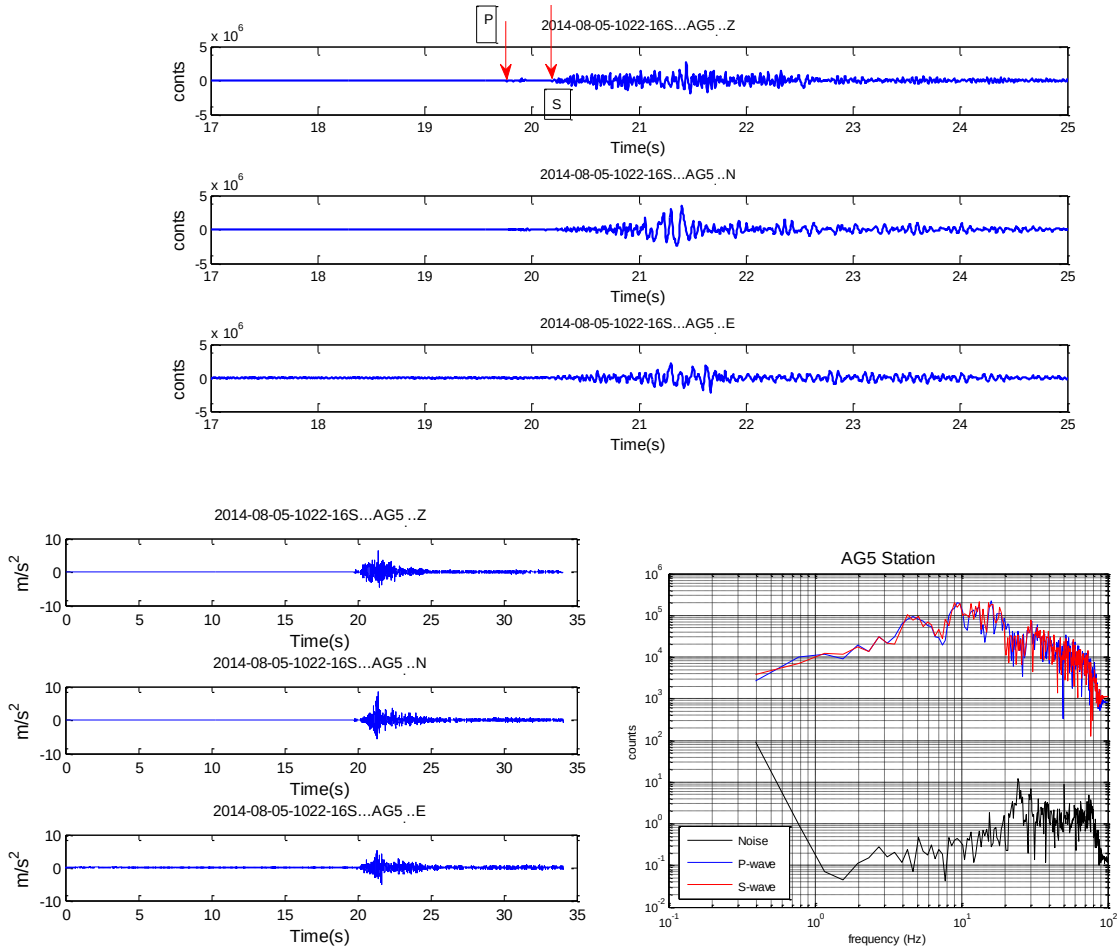


Figure 2: (left) Three component waveforms at AG5 station, (right) A sample of signal to noise ratio for AG5 station

An example of the spectral analysis for P and S phases for some stations are shown in Figure 3.

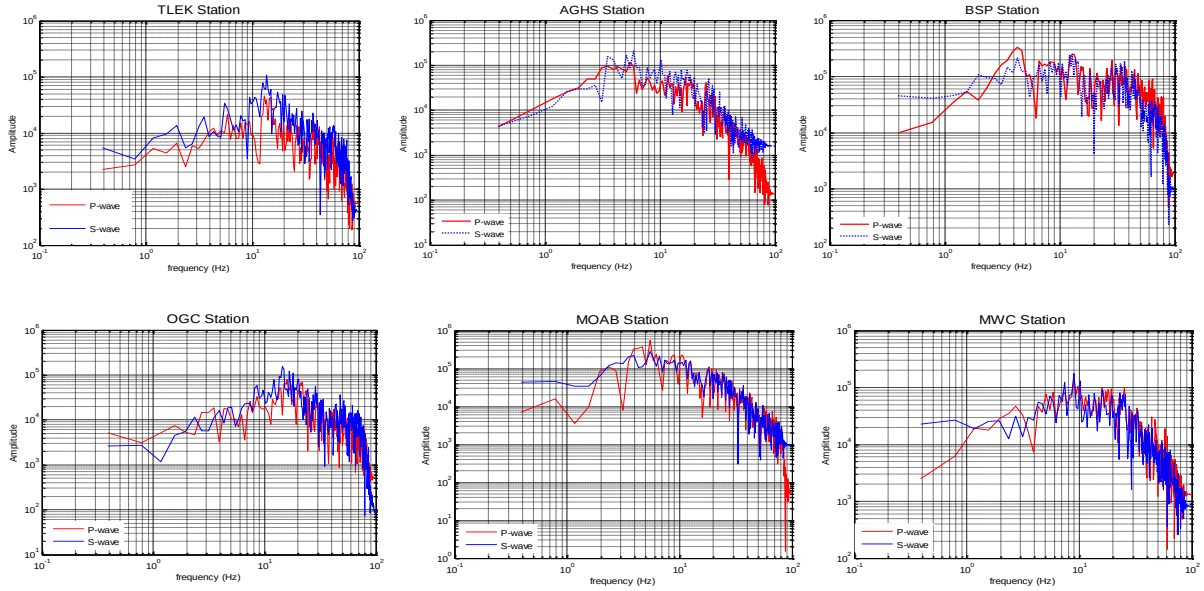
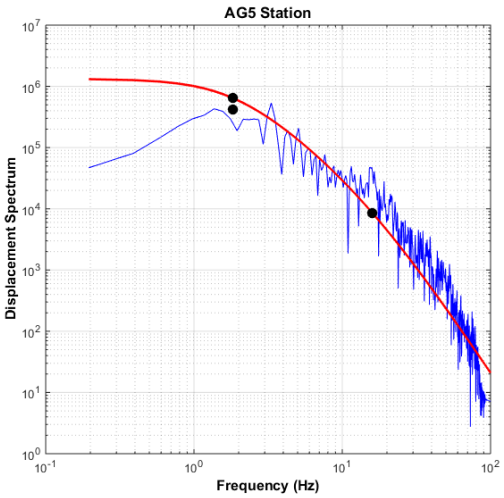


Figure 3: Spectra for P and S phases of the mainshock (5 August 2014, Orkney earthquake)

Moreover, we tried to estimate the seismic source spectral parameters for three stations like the seismic moment, corner frequency (fc), fmax, source radius, kappa, and the stress drop. Figure 4 shows results for AG5 station. The Brune's source model (1970, 1971) used for this study.



M0= 1.7e+17 Nm; fc= 1.8 Hz; fmax= 15.9 Hz; kappa = 0.080
Mw= 5.4; r = 632.2 m; Delta sigma=28.969 Mpa

Figure 4: spectral parameters for the mainshock; AG5 station

The attenuation of the P- and S-waves was estimated using the coda normalization method for the mainshock and 29 minor events in a hypocenter distance range of 2.5-26 km. The lapse time is measured from the source origin time. The seismograms were band pass filtered at the central frequencies from 3 to 24 Hz. Figure 5 presents two example of coda normalization method amplitude at 12 and 24 Hz against distance for S-waves.

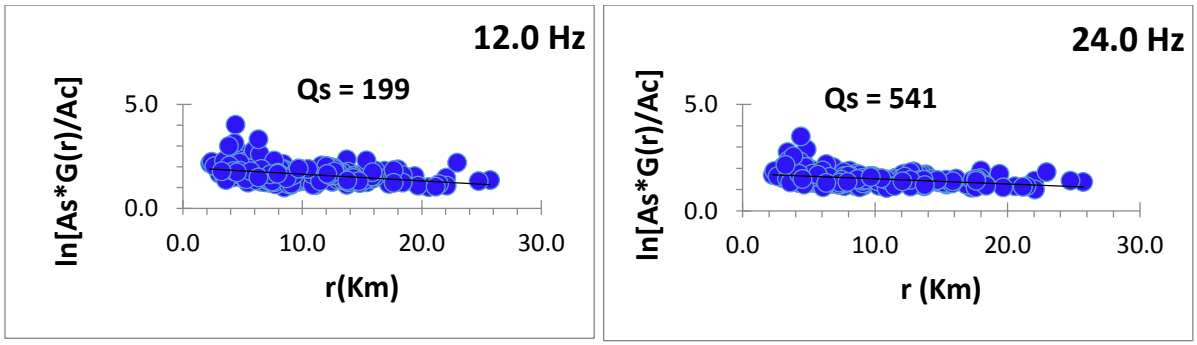


Figure 5: Coda normalization amplitude at 12 and 24 Hz plotted against distance for S-waves.

Also, a sample of the frequency dependent relationship for the P-wave is shown in Figure 6.

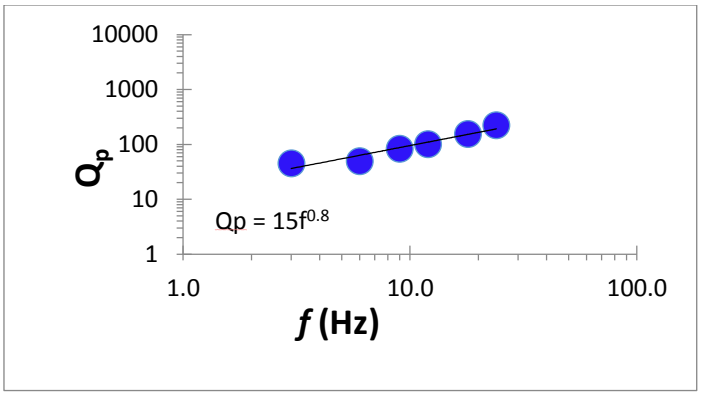


Figure 6: Qp^{-1} (f) frequency dependence

The results showed stronger attenuation for P-waves than for S-waves in the 3–24 Hz frequency band.

Extended data can answer problem for seismological characterization in the study region with less uncertainty.

I am glad to have the opportunity to work at Earthquake Research Institute, the University of Tokyo. I would like to express my gratitude to Dr. Hiroe Miyake for her support. Thank you for all her assistance.

Also, I would like to thank all the staffs of ERI who always tried to help me and made this stay enjoyable. I met fantastic new people from different countries at ERI. I totally enjoyed in Japan.

Related papers

Cichowicz, A. (2015). Estimation of Source Parameters of Local Earthquakes Using Strong Ground Motion Network Data from the Far West Rand (Phase 1). Report number 2015-0019.

Vasheghani-Farahani, J. (2015). Discrimination of quarry blasts and microearthquakes using adaptive neuro-fuzzy inference systems in the Tehran region. Episodes Journal; 38 (3): 162-168.

Vasheghani-Farahani, J., Zaré, M., and Lucas, C. (2012). Adaptive neuro-fuzzy inference systems for semi-automatic discrimination between seismic events: a study in Tehran region. Journal of Seismology; 16 (2):291-303.

Vasheghani-Farahani, J., Zaré, M., and Cichowicz, A. (2012). Attenuation of High- Frequency P and S waves in South and Southeast Tehran Using Blast Data. Soil Dynamics and Earthquake Engineering; 40: 99-108.

Vasheghani-Farahani, J., Zaré, M. (2014). Seismological aspect of Ahar-Varzeghan Twin Earthquakes on 11 August 2012 Mw 6.3 and Mw 6.1, in NW Iran, East Azerbaijan province. Episodes Journal; 37 (2): 96-104.