

Thesis Summary

Study on Relationship between Very Low-Frequency Earthquake and Non-Volcanic Tremor in the Nankai Subduction Zone

(南海沈み込み帯における超低周波地震と非火山性微動の関係に関する研究)

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The non-volcanic seismic tremor was discovered as well as very low-frequency earthquakes (VLFs) were observed in the Nankai Trough subduction zone southwest Japan. In this study, we detect very low-frequency earthquakes VLFs in tremor episodic using the new method in southwest Japan and then study the spatiotemporal relationship between the two phenomena. Our method showed high capability of detection and could detect new and small events that the conventional method could not detect, we used a dense virtual source grid and applied the new detection method of VLFs which depends on calculating the average cross-correlation (cc) between observed and Synthetic seismogram in order to increase the detection number and spatial distribution of VLFs in Shikoku region and as a first step to study and improve our understanding of the unknown relationship between VLFs and the tremor in southwest Japan.

We utilized seismic data from with 73 Hi-net seismic stations telemeter recorded in Shikoku area as the main study area and we tested the method in Kii and Tokai using 43 and 41 Hi-net stations respectively. Seismic data were filtered using 0.02–0.05 Hz band pass filter. In the observation periods, the tremor activity occurred in 6-22 September 2006, 10-21 March 2007, 7 - 31 August 2011, 1 - 16 June 2012, 21 - 31 May 2013, 1 - 11 November 2015, 1 - 31 May 2014, 1 - 30 June 2014 and from 1 to 31 July 2014 which expected to be VLFE activity periods. We used the new detection method to compare the observed and Synthetic seismogram for all the source grids by calculate average cross-correlation (cc) between them then analyzed the data for the final detection of (VLF), virtual source grid with 5 km intervals in horizontal was used for data from 2006 and 2007 to compare with the previous results in the same periods which used grid with 10 km because we wanted to check if we could increase the detection number and spatial distribution of VLFE by this amendment, then we used the new dense virtual source for 2011 and 2014 data analysis in order to study the relationship between VLFs and tremor. As well we tested our method in Kii and Tokai using dense virtual source grids. In addition, we divided Shikoku area for Eastern and Western parts to check if we could increase the spatial distribution and save the analytic time.

We can say that we could increase the detection number of VLFs as well as the spatial distribution using a dense grid of virtual sources. We chose to investigate our data because the data periods include episodic tremors. We find VLFE activity in wide range during our data periods, although the total tremor lasted for more time and more space, in most cases VLFs are located within and where tremor is located, even though we noticed some VLFE events that not correlated with tremor activity both in space and time but this suggestion needs more analysis and interpreting, if we could fix this event as a real VLFE events, this result may change our current understanding of the clear spatiotemporal relationship between tremor and VLFE as a result issued by the previous studies. we also noticed that at the same time as Rapid Tremor Reversal (RTR), VLFs also migrate rapidly back in the opposite direction of the source movement. Furthermore, we noticed that the detection number and moment values for activity after 2011 is low compared with activity in 2006 and 2007, so we need to do more analysis in the future to confirm these results because it will be very important discovery toward earthquakes prediction in the region if the reason natural phenomena.

Although this study still need more research work in the future to confirm the new suggestion about the possible occurrence of VLFE independently from NVT in space and time ,as well to confirm the reason of the low detection number in all results after 2011 , But the current results could give a clear understanding of the characteristics of VLFE and NVT in Nankai Trough which might be important for regular small and large earthquakes prediction in the region, and that might help the scientists to develop better earthquake prediction models in the future in Nankai and other subduction zones around the world.