Tremor asperities in the Bungo Channel region

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Non-volcanic tremors in southwest Japan occur at depths around 35 km along the strike of subducting Philippine Sea plate interface. Occurrences of tremor are not spatially uniform in the tremor belt, but they show several gaps and clusters. Occurrences of tremor are now considered to be stress relaxation process in the transition zone of subducting plate interface as well as the other slow earthquakes. The tremor clusters are the regions with high release of seismic moment in the transition zone, so that they can be regarded as analogues of asperity in the locked zone of subducting plate interface. In this study, we have investigated characteristics of the space and time variation in seismic moment release due to tremors in the Bungo Channel region.

We detected tremors and determined their hypocenters from analysis of records from seismic stations in and around the Bungo Channel region by using the software used in our automatic real-time tremor monitoring system (ATMOS). We also calculated reduced displacements (RDs) when tremor hypocenters could be determined. The RD is proportional to seismic moment rate and its time integral is proportional to seismic moment release. The detection and hypocenter determination is carried out for every two-minute records in our method. We calculated two-minute averages of displacement envelope amplitudes for each station, and then calculated their station average in which we culled the upper and lower 10 % data. Finally, we plotted the integrated RD values on grid cells of Bungo Channel region to create the integrated RD maps.

In the RD map for the whole tremor swarms, there are two local maxima of RD located at the northeast and southwest of about 10 km off Hiburi Island. Here we call them the northeast and southwest asperities, respectively. In the RD map for the whole swarm the latter is dominant to the former. In the RD maps for each swarm, either of two is dominant: there was almost no swarm showing comparable activities in the two asperities. The southwest asperity was always dominant in the swarms limited in the Bungo Channel region. On the other hand, either of two asperities was dominant in the swarms that were linked to those in western Shikoku. That is, the northeast asperity was dominant only in the case of linked swarm. In the cases that both of the asperities were active in one swarm, tremor sources migrated northeastward when the southwest asperity was dominant; they migrated southwestward when the northeast asperity was dominant.

Thus, the basic mode of tremor occurrences in the Bungo Channel region is the dominant activity in the southwest asperity with the northeastward migration. The observed relationship between dominant asperity and migration direction suggests that tremor sources migrate from the region with high stress energy to the low. The characteristics of tremor occurrences found in this study will be of importance in understanding mechanisms of ETS and properties of the subducting plate interface.