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Migrated activity of shallow very low-frequency earthquakes in and around Hyuga-nada, southwestern Japan

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We have investigated detailed spatiotemporal distribution of shallow very low-frequency earthquakes (SVLFEs) in Hyuga-nada and Ashizuri-misaki-oki regions, southwestern Japan. Three component seismograms observed in a period from 2002 to 2010 at the NIED F-net stations in Kyushu and Shikoku regions were analyzed by using a cross-correlation technique. In this method, we detected SVLFEs having similar waveforms to those of reference events (known SVLFEs) and estimated their epicenters from phase delays of the present detected SVLFEs to the reference events at each station. Centroid moment tensors (CMTs) of those SVLFEs were also estimated from the NIED F-net and Hi-net high sensitivity accelerometer data. Initial centroid locations and times of this analysis were selected to be those estimated by the cross-correlation analysis. Obtained CMTs show that seismograms of SVLFEs are explained by thrust faulting with larger dip angles than the plate boundary between the subducting Philippine Sea Plate and the overriding plate. Those SVLFEs occur at a depth range of 1-15 km close to this plate boundary. On the other hand, spatiotemporal distribution shows migration in each episodic burst activities of SVLFEs. In an episode in 2010, SVLFE activity started on January 24 in east off Tanegashima Island and migrated toward north along the strike of the subducting plate for a week. Travel distance of migration is at least 100 km; its front reached Hyuga-nada on January 31. After temporal reduction of seismicity, the SVLFE activity restarted on February 12, migrated toward east, and continued strong activity in Ahishizuri-misaki-oki until the end of February. After another temporal reduction of seismicity, restart of the SVLFE activity and backward migration from Ahishizuri-misaki-oki toward Hyuga-nada were observed in the middle of March. Such a large scale migration is quite similar to that of non-volcanic tremor and deep very low-frequency earthquakes coincident with slow slip events in the deeper extension of the seismogenic zone along Nankai trough. This suggests that possible slow slip events associated with SVLFEs can exist even in the shallower extension of the seismogenic zone.

Keywords: subduction zone, very low-frequency earthquakes, slow slip events, Hyuga-nada