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Correlation of activity of very low frequency earthquakes with tide in the Ryukyu Trench

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Recently, very low frequency earthquakes (VLFEs) were observed in the shallow part of the Ryukyu subduction zone (Ando *et al.*, 2012; Asano *et al.*, 2013, 2014, 2015; Nakamura and Sunagawa, 2015). Since the stress drop of the VLFEs are very small comparing with that of ordinary earthquake (Ito and Obara, 2005), the VLFEs would be activated by small stress change such as tidal stress. Then we investigated the activation of the VLFEs by earth tide.

We used the events (Mw>3.5) which occurred from January 1, 2002 to December 31, 2014. We employed the VLFE catalogue which is determined by manually-picking method (Nakamura and Sunagawa, 2015). We employed the ocean-tide data at Naha, Ishigaki, and Naze which is installed by Japan Meteorological Agency. Then we computed the theoretical horizontal strain by the earth tide and ocean loading using GOTIC2 (Matsumoto et al., 2001) to compare the theoretical strain and activity of the VLFEs.

First we selected five areas along the Ryukyu Trench where the VLFEs are clustered, then we counted the number of VLFEs as a function of the phase of ocean tide. The VLFEs had been activated at low tide, and they had been quieted at high tide in all areas excluding southwest of Ryukyu. Moreover, the activation occurred on the compressional stage by the earth tide and ocean loading, and quiescence occur on the tensional stage. The VLFEs were activated when the shear stress on the plate interface reached maximum.

Since the VLFEs in the Ryukyu Trench are thrust type or reverse fault type (Ando *et al*., 2012), the VLFEs would be activated in the compressional shear stress stage. This suggests that the activity of the VLFEs is triggered by stress change by the earth tide. The amplitude of the shear stress on the plate interface is large in the central and north Ryukyu Trench but it is small in the southwestern Ryukyu Trench because of the strain by the ocean loading and strike of the Ryukyu Trench. This generates the difference in activation of VLFE by the ocean tide along the north-central and southwestern Ryukyu Trench.

Keywords: very low frequency earthquake, tide, Ryukyu Trench