Seismic reflection profiling across deep low-frequency tremor zone in western Shikoku, southwestern Japan

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The Nankai trough region, where the Philippine Sea Plate (PHS) subducts beneath SW Japan arc, is a well-known seismogenic zone of interplate earthquakes. In recent years, various slip motions with different time scales, including episodic tremors and very low-frequency earthquakes have been recognized in neighboring regions of the seismogenic zone (e.g., Obara and Kato, 2016). A narrow zone of nonvolcanic tremor has been found in SW Japan fore-arc, along strike of the arc (Obara, 2002). The spatial distribution of the tremor is not homogeneous in a narrow belt but concentrated forming clusters. Revealing structural factors that control the fault slip behavior is important to understand the subduction dynamics. The fluid pressure on a plate interface is one of the key factors to understand the fault slip behavior (e.g., Saffer and Tobin, 2011). Seismic reflection characteristics can provide important information on the fluid-related heterogeneity of structure around plate interface. A series of active seismic experiments were undertaken in 2008 and 2014 to obtain a structural image beneath the western part of Shikoku, southwestern Japan (Takeda et al., 2008, 2015). Takeda et al. (2015) provided the geometry of the subducting PHS. To investigate the lateral variation of reflection characteristics along tremor zone, we conducted active seismic experiment in the western part of Shikoku in November 2019. Our seismic experiment had two survey lines. One was carried out along a 80-km-long seismic line between Seiyo and Kumakogen (S-K line) in the east-west direction and the other was carried out along a 50-km-long seismic line between Ozu and Shimanto (O-S line) in the north-south direction. Six hundred seismic stations were deployed with about 200 m spacing for the S-K line and about 250 m spacing for the O-S line. Six explosive shots with charge size of 200 kg were fired on our survey lines. We obtained high signal-to-noise ratio explosion data along the entire length of the profile. The most remarkable feature of the record sections is that high amplitude reflections, probably from the top of the subducting PHS, are recognized. To obtain the detailed structure image, we applied the seismic reflection technique to explosion data. The stacked image shows several features of the deeper part of the hanging wall and the northward dipping plate boundary at 8-10 sec in two-way travel time.

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