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Seismic basement structure estimated from seismic interferometry and microtremor analysis

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Recently, seismic interferometry has been considered to be a powerful tool for subsurface structure survey. Seismic interferometry is a method that produces pseudo reflected waveform data by computing the autocorrelation function (ACF) of seismic waveform record. In this study, we estimate the seismic basement structure beneath the northwestern Noto Peninsula from seismic interferometry and microtremor analysis. We examine the reliability of seismic interferometry and microtremor analysis by comparing those results with the results from gravity anomalies and a reflection seismic survey (Sato et al., 2007) in this area.

For seismic interferometry, we use waveform data of the aftershocks of the 2007 Noto Hanto earthquake at 44 seismic stations which are located in the northwestern Noto Peninsula. We apply high-pass filter of 2 Hz to SH component of displacement waveform and set a time window of 10 s after the arrival of S wave to calculate ACF. We make the average ACF by stacking all ACFs at each station. For microtremor analysis, we performed microtremors observation at 44 points where the stations for the aftershock observation were located and calculate H/V spectrum at each station. We estimate the basement structure in the analyzed area by assuming two-layer structure from ACF and H/V spectrum.

For the ACF analysis, it is difficult to identify the dominant peak of ACF for most stations. Especially, we cannot estimate the basement depths where the basement depths estimated from the reflection seismic survey (Sato et al., 2007) are shallower than 100 m. Finally, we obtain the basement depths at 14 of 44 stations. On the other hand, for the microtremor analysis, we can estimate the basement depths at 35 of 44 points. This indicates that the seismic interferometry with ACF is not an effective approach to estimate the basement depths in the northwestern Noto Peninsula.

We compare the basement depths estimated from ACF, H/V spectrum and gravity anomaly each other. These estimates are approximately coincident each other and shows that the basement depth of the Kuwatsuka block is shallower than that of the Saruyama block. Coseismic uplift was observed in the Kuwatsuka block at the 2007 Noto Hanto earthquake. Therefore, the results of this study is coincident with the hypothesis that the activity of active faults on seafloor near the coast causes the uplift of the Kuwatsuka block and makes its basement depth shallower (Hiramatsu et al., 2008).

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Keywords: auto correlation function, H/V spectrum, gravity anomaly, geological block structure, the Noto Peninsula