実観測に基づく傾斜構造が微動探査に与える影響の検討

Investigation of influence of dipping structures on microtremor exploration from case study research

*岡本 京祐[1]、津野 靖士[1]
*Kyosuke Okamoto[1], Seiji Tsuno[1]

1.鉄道総合技術研究所
1.Railway Technical Research Institute

S-wave velocity structures have been estimated from dispersion curves of phase velocity, H/V spectral ratios, etc., using microtremor exploration technique. However the estimations are originally based on the assumption that underground structures have stratified horizontally. So, if structures have irregular, e.g., layers incline or discontinue, the structures estimated under the assumption of horizontal stratification have errors to some extent due to perturbation of wave filed at the irregular. On the other hand, it has been known that seismic waves are likely to be amplified at the irregular structures since the various seismic waves interfere with each other. So, accurate estimation of the irregular structures is needed for disaster prevention. Seismic reflection and boring surveys are powerful tools to estimate the irregular structures since boundaries of the structure are directly imaged or excavated. However sometimes they have difficulties in cost and space for their application, especially surveys of a wide range of areas are limited. Here, we focus on H/V spectral ratios, which are relatively easy to measure a wide range of areas with a small budget, to estimate a dipping structure.
In this study, we applied microtremor explorations to an anonymous site, where a shallow dipping layer has been found by preceding boring surveys. The fall of the dip is several 10m while the horizontal length is several 100m. We conducted spatially dense microtremor observations to observe H/V (Horizontal/Vertical) spectral ratios along the dipping structure. We attempted to image the dipping structure by the H/V spectral ratios. It is known that velocity structures are difficult to be determined only by H/V spectral ratios since they have a trade-off between S-wave velocity and layer thickness. So, reference structures were determined by the SPAC (SPatial Auto Correlation) method apart from the dipping structure. Using the information of the references, the dipping structure was successfully illuminated by the H/V spectral ratios. The estimated structure agrees with that of the preceding boring surveys. However the H/V spectral ratios become complex especially around the edges of the dipping structure (e.g., multiple peaks, obscure peaks, reclamation of valleys) due to the reflection, refraction, scattering waves, etc. The H/V spectral ratios are largely different from that of horizontally stratified medium. In this condition, the analysis of them is difficult since it is based on the assumption of horizontal stratification. Here, a question arises; how far (in terms of space) the dipping structure gives the effect on the wave field. To examine it, we synthesized the wave field using a numerical simulation using the estimated structure model. We divided the synthesized wave at the edges of the dipping structure into surface wave and the others (reflections, refractions and etc.), then, we calculated the original locations of the latter waves based on the method of back propagation. As a result, it was revealed that part of the dipping structure within one-wavelength from the edges gives major effect on the wave filed. It could disturb the H/V spectral ratio.
When we apply the microtremor explorations based on the assumption of horizontal stratification to dipping structures, it is important to note that the wave filed within one wavelength from the edges of the dipping structure is likely to be fluctuated. The estimated result may have errors to some extent.

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