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Seismic Imaging and Inversion of Lithospheric Structures beneath the Korean Peninsula

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1. Abstract

Modern seismic imaging and inversion methods play an important role in understanding the Earth’s interior and its behavior by establishing more accurate subsurface velocity models. This study presents the results of the model update and interpretation of lithospheric structures beneath the Korean Peninsula. Tao et al. (2018) conducted a full waveform inversion to determine a seismic model of the upper mantle beneath eastern Asia, FWEA18 (Full-Waveform Inversion of Eastern Asia). This model gives large-scale structures and physical properties of them beneath this extensive area. However, there is a limit to show smaller-scale seismic structures of the Korean peninsula due to the sparse data in that region.

Song et al. (2018) recorded seismic noise data in 2014 and applied seismic interferometry and reflection processing methods to image them. In this study, we enhanced the three 2D seismic images and determined the seismic models with small geological features not shown in the FWEA18 model. First of all, the main problem of this seismic imaging was its low signal-to-noise ratio (SNR) of recorded noise data. By applying the same seismic acquisition geometry to the FWEA18 model, we generated noise-free synthetic seismic traces and improved the SNR of existing data. Since the data distribution of the FWEA18 model was less dense than the receiver distribution, we applied the interpolation method based on seismic trace regularization using Delaunay triangulation to this model (Yeoh et al., 2018) in this imaging process. After we obtained the better post-stack seismic images, we conducted the L2-norm model-based impedance inversion from these images and obtained the P-impedance model, the product of Vs (P-wave velocity) and density. From our model, we estimated more accurate Vp, Vs (S-wave velocity), and density values of the crust and mantle of the peninsula using the linear relationships among three physical properties shown in FWEA18. Furthermore, we were able to observe geological features and their local depth changes such as Moho and mid-crust low-velocity zones. In conclusion, we improved the resolution of the seismic model and this model allows us to interpret more intense structures and understand their tectonic behavior.

2. Study Area

3. Seismic Data Processing

4. Post-stack Seismic Inversion

5. Results

6. Conclusions

7. References

8. Acknowledgement

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