Donnerstag, 29. Februar 2024, 14.50 Uhr
Baden Arena Kongress 1 – Tiefe Geothermie

Thursday, 29 February 2024, 2.50 pm
Baden Arena Congress 1 – Deep Geothermal Energy

Seismic monitoring network evaluation using an interferometry derived velocity model

Bewertung des seismischen Überwachungsnetzes anhand eines interferometrisch abgeleiteten Geschwindigkeitsmodells

Leo Eisner* (Seismik), Toufik Chtouki (Seismik), Barbara Cox (Aardyn), Petr Kolínský (Institute of Geophysics), Tijmen Jan Moser (Seismik)

Seismic monitoring is essential for safe development of the geothermal resources. In the absence of large number of pre-existing seismicity, the monitoring performance of a network must be determined by network design modeling. Such modeling is dependent on both P-wave and S-wave velocity and P-wave and S-wave attenuation models. While P-waves are usually known (reflection surveys or sonic logs), S-wave models need additional constrains, especially in the shallow part of the model where there are no constrains from sonic logs.

We use seismic noise interferometry to obtain Rayleigh surface waves between receivers of the sparse array. We invert the Rayleigh wave dispersion curves for the S-wave velocity structure beneath the array with additional constrains on layer boundaries derived from the P-wave model. We show that this approach leads to a significantly different velocity and attenuation model than the starting model. The network performance in the new model results in lower magnitude detection than in the starting model, because the near surface low velocity layers result in higher impedance contrast. If we assume an attenuation-velocity relation, such difference is even more significant.

The presented methodology and data example illustrate the need of good knowledge of the near-surface structure in the geothermal areas to correctly apprise the seismic monitoring network performance. Besides, it illustrates the possibility that our networks may perform better than we thought.

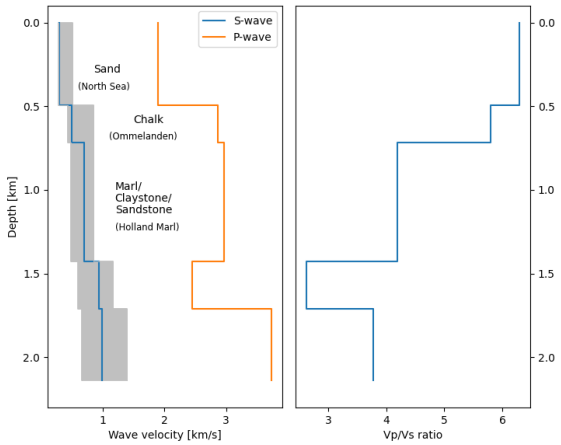

Figure 1: Left: Inverted S-wave velocity depth profile (blue line) together with publicly available P-wave velocity model. Grey area shows the range of minimum to maximum velocity value at each layer during inversion iterations. Right: Vp/Vs ratio calculated using known P-wave and inverted S-wave velocity.