Passive seismic methods for geothermal exploration:  
A case study from the Jinqu Basin (China)

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Geothermal resources are considered as underutilized contributors to diversification of the growing 
energy needs worldwide. Like several other nations, China embarked on a program to explore potential 
geothermal reservoirs. We present a case study from the Jinqu Basin in southeastern China where 
ambient seismic noise tomography was applied to investigate the geologic structure in regard to its 
probability for hosting temperate ground water in large depths. The Jinqu Basin is located ca. 300 km 
southwest of Shanghai and comprises sandstones and conglomerates on top of volcanic units. Heatflow 
is around 75–80 mW/m², and temperate surface water is characteristic for the region. A passive seismic 
survey was conducted to identify potential zones with increased fracture density. The passive method 
allows to cover large areas in short time at minimal costs, while it provides low-resolution velocity models 
only. Nonetheless, in the initial stage of exploration low-resolution and spatially extended 3D models 
are required to plan detailed reflection seismic acquisition and drilling locations in later phases. The 
passive seismic survey comprised 192 recorders, which were deployed for 5 days in a 20 km² wide area. 
Continuous recording of ambient seismic energy (e.g., traffic noise, cultural noise) allowed for the 
application of interferometric analysis and tomographic inversion. The main result is a 3D shear-wave 
velocity model, which extends to a depth of ca. 2 km. The model shows a low-velocity anomaly which 
correlates with low electrical resistivity from a previous 2D magneto-telluric campaign. This anomaly is 
interpreted for a zone of increased fracture density and will be considered for future active seismic 
acquisition. It is concluded that passive seismic methods are useful for large scale geologic exploration 
in the context of geothermal reservoirs because of their low costs and short acquisition time. The 
obtained shear-wave velocities are sensitive to fracture density, which is an important property of 
potential reservoirs. Depending on the type and availability of ambient seismic noise, the method can 
be scaled from a depth of few tens of meters to several kilometers.