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New seismological constraints on rifting of the Upper Rhine Graben, Germany

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The lower lithospheric and asthenospheric structure of the Upper Rhine Graben (URG), which is part of the European Cenozoic Rift System, is poorly known. To improve the knowledge on the subcrustal structure of the URG the TIMO project (TIefenstruktur des Mittleren Oberrheingrabens) is conducted. 32 mobile seismic broadband stations of the KArlsruhe BroadBand Array recorded continuously from December 2004 until May 2006. To expand the dataset recordings of 4 permanent broadband stations and 4 permanent short period stations are added.
The heterogeneous structure of the URG deforms the teleseismic wavefront what leads to measurable perturbations in travel time, backazimuth and slowness. Since we are interested in the deep, subcrustal structure of the URG, we eliminate travel time effects due to the known crustal structure by using 1D crustal velocity models for each station. These crustal velocity models are determined by collecting all available geophysical and geological information of the study area. The network is divided into three subarrays to measure the backazimuth and slowness with array techniques. In the measured dataset we find no significant seismic P-wave velocity anomaly related to the upper mantle underneath the URG. These results are compared to expected values of slowness, backazimuth and travel time perturbation due to a synthetic seismic velocity reduction underneath the URG. The effect of the synthetic velocity reduction (-3% to -5%) is clearly visible in contrast to the measured data. Thus the travel time and array analyses indicate that there is no seismic anomaly in the subcrustal lithosphere that is related to the URG. This is consistent with previous SKS-splitting results. As consequence we assume that the rifting processes and rupturing of the lithosphere did not alter the deep lithospheric structure and did possibly not even lead to lithospheric thinning in the region.