A 3-D crustal model of the eastern Arabian plate margin below the Oman Ophiolite

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The Oman ophiolite is one of the best preserved and studied ophiolites, where oceanic lithosphere was obducted on top of a continent. It covers an area of about 700 x 140 km² but its 3D geometry, as well as the properties of the underlying continental lithosphere are largely unknown. We operated a temporary broadband seismic network with 40 instruments for continuous, passive seismic registration for 27 months, complemented by 18 permanent stations in the study region. Ambient noise cross-correlation functions are calculated for vertical and transverse components for all station pairs. We derive azimuthally anisotropic phase velocity maps for Rayleigh- and Love waves in the period range 2 – 40s which show velocity anomalies that are very consistent with geological features at the shortest periods (<10s). At longer periods (>15s) the velocity pattern subdivides the study region into a faster eastern and slower northwestern part below the Oman Mountains.

We then invert local dispersion curves to shear wave velocity profiles using a novel implementation of a radially anisotropic, probabilistic inversion. Combination of the obtained 1D models to a 3D model provides the first three-dimensional view of shear wave velocity variations along the Eastern Arabian Plate margin. The model highlights at shallow levels strong lateral velocity contrasts between unconsolidated young sediments south of the Oman Mountains (slow) and areas covered by ophiolite and where autochtonous shelf sediments are exposed (fast).

At middle to lower crustal levels, we image linearly northeast trending velocity contrasts that we attribute to assembly of the Arabian plate in late Proterozoic. These features are overprinted by obduction-related convergence in late Cretaceous with thickening of the middle to lower crust below the Oman mountains. Moho depth is around 40-45km northwest of Semail Gap but shallows significantly east of it to 20km at the eastern coast. This is largely in consistency with independent estimates from Receiver Functions calculated with the same data.