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Upper mantle imaging with surface wave diffraction: AlpArray seismic network and the Cameroon Volcanic Line

The AlpArray seismic network stretches hundreds of kilometers in width and more than thousand kilometers in length over the greater Alpine region (Europe) consisting of around 250 temporary and 400 permanent broadband stations. We utilize an array beamforming technique identifying the frequency dependence (40-150 s) of the surface-wave phase-velocity vector. We observe deviations of backazimuths with respect to the great circles, which form intriguing stripe-like patterns throughout the region. These stripe-like arrival-angle deviation patterns can be caused by interference of diffracted wavefield after passing a single small-scaled velocity anomaly. Using Rayleigh waves from two earthquakes under the Southern Atlantic Ocean and a grid search inversion scheme, we located the anomaly at 10.5°N/15.0°E. Its width is 320 – 420 km, and its length matches the 2500 km long upper mantle low-velocity region under the Cameroon Volcanic Line. The observation serves not only as a detector of upper mantle heterogeneities, but it also allows to determine how phase and group travel time delays and wavefront healing can affect global and regional tomographic studies. This has important consequences for the local phase-velocity measurements as well.

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