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Evidence for the Mesozoic and Cenozoic Evolution of the Lithosphere in the Trans-European Suture Zone from Surface Wave Tomography

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The Trans-European Suture Zone marks the transition between the East European Craton and Phanerozoic central Europe. Subduction of the Thor ocean and collision of Avalonia resulted in a Caledonian terrane assemblage that has been strongly affected by Permian volcanism, sedimentation in Post-Permian basins and recently by Cenozoic inversion tectonics. Whereas the structure of the crust in the area has been extensively studied by Deep Seismic Soundings, properties of the subcontinental mantle lithosphere are less well known. Surface waves are well suited to study the structure of the lithosphere and the sublithospheric mantle being mainly sensitive to the S-wave velocity structure at those depths. It has been shown before that the Tornquist-Teisseyre Zone representing the boundary to the East-European Craton in the southwest of the Trans-European Suture Zone is associated with a sharp transition between thick cratonic lithosphere in the northeast and thinner lithosphere to the southwest. Here we present results of a tomographic surface wave study based on automated broad-band measurements of average inter-station Rayleigh wave phase velocities providing higher resolution especially at lithospheric depths. All available broad-band recordings including data of temporary deployments like the TOR and PASSEQ experiments have been processed.

At shorter periods phase velocities are sensitive to the sedimentary basins providing a 3D image of average shear-wave velocities. At intermediate periods differences in the crustal thickness and the structure of the uppermost mantle in the regions of the North German Basin and the Polish Basin become obvious. The latter is characterized by larger crustal thickness and rather low sub-Moho S-wave velocities. Also, lithospheric thickness varies along the Trans-European Suture Zone. In the region of the Sorgenfrei-Tornquist Zone a rather gradual decrease of lithospheric thickness towards central Europe is observed, whereas a shallow asthenosphere is present beneath the Tornquist-Teisseyre Zone. Furthermore, there are indications for temporal changes in the lithospheric thickness across the Trans-European Suture Zone: for the North-German Basin a shallow asthenosphere has to be assumed in the Permian because of extensive volcanism. Subsequent Post-Permian sedimentation mainly caused by cooling of the lithosphere was accompanied by thickening of the continental lithosphere. Cenozoic volcanic activity to the northeast of the Bohemian Massif hints at emplacement of the shallow asthenosphere in the area of the Tornquist-Teisseyre Zone at that time.