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Strength and elastic thickness of the European lithophere

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Rheology and strength of the Earth's lithosphere have been debated since the beginning of the last century, when the concept of a strong lithosphere overlying viscous astenosphere was introduced. The issue of strength of the lithospheric plates and their spatial and temporal variations is important for many geodynamic applications. For rocks with given mineralogical composition and microstructure, temperature is one of the most important parameters controlling rheology. Temperature estimates for the deeper horizons of the lithosphere, where the heat transport is mostly conductive, require a precise knowledge of many crustal parameters (mainly thermal conductivity and heat production) and are extremely uncertain. Therefore, indirect approaches, such as seismic tomography are commonly used to determine temperature distribution within the lithosphere. We have recently inverted for temperature a new tomography model, which is principally improved by correcting before-hand for the crustal effect. For the correction we use EuCRUST-07, a new digital model of the European crust. Although the inversion approach is similar to those used in previous studies, the employment of a more robust tomography model essentially improves the result. EuCRUST-07 and the new thermal model are employed to calculate the strength distribution within the European lithosphere. Differently from previous studies, the new model adopts lateral variations of lithology and density, which are derived from the crustal model. The lithosheric rheology is employed to calculate variations of the elastic thickness of the lithosphere. According to these estimates, in Western Europe the lithosphere is more heterogeneous than that one of Eastern Europe. Western Europe with predominant crust-mantle decoupling is mostly characterized by lower values of the strength and elastic thickness. High strength values are found in the areas having the average/low thermal regime and strong crustal rheology (the EEP, the North German Basin and the Bohemian Massif). Weak zones correspond to the areas affected by the tertiary volcanism and mantle plumes, such as the European Cenozoic Rift System (ECRIS) and the Massif Central. Both the integrated strength of the lithosphere and of the crust demonstrate similar trend in most parts of the study area. One of the most interesting result is the high contribution provided by the crustal strength ($\tilde{5}0\%$ of the integrated strength for the whole lithosphere) in the most part of the study area ($\tilde{6}0\%$). The contribution of the thickness of the mechanical strong lithosphere to Te is low (<10 km) in the most part of Western Europe. No clear relationship between Te and the thermal age is found in the continental part of the study area: in the tectonic provinces older than 85 Ma the Te values are significantly smaller than that ones theoretically predicted as a function of the age and crustal thickness, while the opposite is true for the younger provinces.