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Tectonic fragmentation of the Antarctic lithosphere as revealed by the analysis of effective elastic thickness variations

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In this study, we derive the effective elastic thickness T_e as a proxy for the lithospheric strength and thermal state by using ice thickness, bedrock topography and a combination of new satellite and high resolution terrestrial gravity data. Cross-spectral analysis methods based on the fan wavelet technique were employed to calculate both admittance and coherence based values of T_e. To this day, little is known about the thermal and rheological properties of the Antarctic lithosphere. Those properties are important to understand ongoing tectonic processes and the behaviour of the Antarctic ice shield. T_e variation shows, that Antarctica can be divided into two distinct provinces, with high values in EANT (T_e ~60-80 km) and low values in WANT (T_e ~5-20 km). For the Transantarctic Mountains separating these provinces, we found T_e to be around 10 km and thus comparable to western Antarctic values. Apart from this general division, we found fragmentation of the lithosphere within these provinces. Especially EANT is not homogeneous in lithospheric strength but shows strong variations. The highest T_e values are found around the Aurora Subglacial Basin (up to ~90 km) and in Dronning Maud Land (up to ~80 km). Dividing these provinces is a zone of relatively low T_e with its minimum of ~15 km in the Lambert Graben. According to coherence based calculations, this weak zone extends into the Gamburtsev Subglacial Mountains showing a distinct decrease of T_e to 25-30 km. The admittance analysis gives relatively high values (~70 km) for this region. Based on the wavelength-dependent admittance and coherence results and misfits for several principal locations and since the admittance estimations could be significantly biased by internal density heterogeneity of the lithosphere, as already pointed out in several previous studies, we give some preference to the coherence method predicting reduced T_e.