Lithosphere structure of the North China Craton: high resolution seismic crustal structure and lithospheric mantle density

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We present a new digital model (NCcrust) of the seismic crustal structure of the Neoarchean North China Craton (NCC) and its surrounding Paleozoic-Mesozoic orogenic belts (30^{O}– 45^{O}N, 100^{O}- 130^{O}E). All available seismic profiles, complemented by receiver function interpretations of crustal thickness, are used to constrain a new comprehensive crustal model NCcrust. The model, presented on a $0.25^{O} * 0.25^{O}$ grid, includes the Moho depth, and the internal structure (thickness and velocity) of the crust specified for four layers (the sedimentary cover, upper, middle and lower crust), and the Pn velocity in the uppermost mantle. The crust is thin (30 - 32 km) in the east while the Moho depth in the western part of the NCC is 38 - 44 km. The Moho depth of the Sulu-Dabie-Qinling-Qilian orogenic belt ranges from 31 km to 51 km, with a general westward increase in crustal thickness. The sedimentary cover is 2 - 5 km thick in most of the region and typical thicknesses of the upper, middle, and lower crust are 16 - 24 km, 6 - 24 km, and 0 - 6 km, respectively. We document a general trend of westward increase in the thickness of all crustal layers of the crystalline basement and as an consequence, the depth to the Moho. There is no systematic regional pattern in the average crustal Vp velocity and the Pn velocity. We examine correlation between the Moho depth and topography for seven tectonic provinces in the North China Craton and speculate on mechanisms of isostatic compensation.

Based on gravity, seismic and thermal data we constrain the lithospheric mantle density at in-situ and Standard Temperature and Pressure (STP) conditions by removing the effect of the crust and the Lithosphere-Asthenosphere Boundary (LAB) from the free-air gravity anomaly. Our new thermal model suggests that the average surface heat flow in the North China Block, including the western block, is > 60 mW/m^2. Low surface heat flow (30 - 40 mW/m^2) is observed in the northern and southern parts of the Trans-North China Orogen and the western part of the Western block. The thermal lithosphere is 100 -140 km thick where the surface heat flow is 60 - 70 mW/m^2. The gravity effect of surface topography, sedimentary cover, and Moho depth are 0 to +150 mGal, - 20 to -120 mGal and -200 to +50 mGal, respectively. The gravity effect of both the thermal and seismic LAB ranges from +20 to +200 mGal. The lithospheric mantle residual gravity ranges from -250 to +100 mGal. The lithospheric mantle density ranges from 3.20 to 3.26 g/cm^3 at in-situ condition and 3.31 – 3.41 g/cm^3 at STP condition. Thin lithosphere with relatively high lithospheric densities and normal heat flow (30 - 40 mW/m^2) characterises the Archean lithosphere in the southwestern part of the Eastern Block. Similar high densities and high heat flow (50 - 60 mW/m^2) are observed in the major part of the Trans-North China Orogen and the Western Block which indicates that the lithospheric mantle has experienced modification.