Multi-stage evolution of the Ordos lithosphere from stochastic inversion of elevation, geoid, surface heat flow, Rayleigh wave dispersion data and magnetotelluric data

A.G. Jones[1*,2,3,4], DONG Hao[1], J.C. Afonso[2] WEI Wenbo[1], S.L. Klemperer[3], and LIU Tianze[3]

[1]China University of Geosciences, Beijing, China, *email: alan.jones.geophysics@gmail.com

[2]Macquarie University, North Ryde, New South Wales, Australia

[3]Stanford University, Stanford, California, USA.

[4]Dublin Institute for Advanced Studies, Dublin, Ireland

The North China Craton, constructed in the Archean and Proterozoic, underwent Mesozoic lithospheric delamination and crustal thinning in its eastern part whereas it exhibits thick lithosphere in its western part beneath the Ordos Block. The cause of the enigmatic present-day ~1300 m elevation of the Ordos Block, highly unusual for a Precambrian craton, remains debated, with highly variable estimates proposed of both crustal thickness (40–65 km) and lithospheric thickness (150–280 km). We use multi-observable thermochemical inverse modeling of available geophysical datasets to show that the crust of the Ordos block cannot be unusually thick, nor can the lithosphere be unusually thin, and both are comparable to other Precambrian cratons. Instead, the unusual elevation of the Ordos Block must arise in the composition of its lower lithosphere, which we show to be atypical of Archean upper mantle by being both unusually fertile, i.e., dense, and by incorporating a wet layer. We surmise that the Ordos Block must have either grown by secular downwards thickening and/or extensive lower lithosphere modification to produce a structure in which tectonothermal ages become younger with increasing lithospheric depth. We further speculate that the spatial correlation of the observed compositional depth variation of the Ordos Block with extrusives on the eastern and western boundaries of the so-called “Eastern Block” give support to the newly developing notion that the NCC was formed as a single entity and not by two distinct blocks amalgamated during Paleoproterozoic collisional orogeny along the putative “Trans North China Orogen”.