Geophysical Research Abstracts, Vol. 9, 02121, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02121

Thermal regime and rheological structure of Precambrian continental lithosphere in China: implications for Cenozoic diffuse boundary deformation

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The Continent of China mainly constitutes of three Precambrian Cartons as the Tarim, Sino-Korea (or North China) and Yangtze, respectively, along with the intervening deformation zones. The thermal regime and associated rheological structure of the Precambrian continental lithosphere in China is vital for deciphering the Cenozoic diffuse plate boundary deformation there, but is still not understood well. Combined the new updated heat flow data with the deep seismic sounding results, here we present the thermal state, rheological structure and mechanical strength of the Precambrian lithosphere of these three Cratons, as well as the implications for tectonics.

Our results show that differences in thermal regime exist for Cratons in China. The Tarim Craton is featured by relatively low heat flow with 45 mW/m^2, and relatively thick lithosphere with more than 160 km, and the temperature at Moho is really low as 500 degrees. The Yangtze Craton shares the similar thermal characteristics with the Tarim, along with low heat flow and Moho temperature and great lithospheric thickness with 140 km. However, The Sino-Korea Craton is of distinct thermal regime, and its eastern part is characterized by high heat flow of 70 mW/m^2 and Moho temperature of 700 degrees, as well as thin lithosphere less than 80 km; while the western one, bounded by the Taihang Mountain, has the similar thermal regime with those of the Yangtze and Tarim Cratons, suggesting the existence of transformation in thermal regime of the Sino-Korea Craton. Generally, the Yangtze and Tarim Craton are still of Precambrian lithosphere, featured by low heat flow and thick lithosphere; and the late

stage intensive tectonic alteration makes the Sino-Korea Craton more representative of Meso-Cenozoic lithosphere.

The rheology of the lithosphere beneath the Tarim and Yangtze Craton where the heat flow is really low is characterized by a relatively strong upper crust and upper mantle sandwiched by a relatively weak lower crust, and the effective elastic thickness of the lithosphere is greater than that of the crust, indicating the more contribution from the upper mantle. However, the rheology of the lithosphere beneath the eastern Sino-Korea Craton is of strong upper crust and weak upper mantle, contrasting with that of the western part and the Tarim and Yangtze Craton as well, and the effective elastic thickness of the lithosphere is less than that of the crust, suggesting the more contribution from the upper crust. It is obvious that the rheology of the lithosphere beneath the Cratons in China is strongly controlled by its thermal state. Thermal-rheological heterogeneities of the Precambrian lithosphere account for the puzzling Cenozoic diffuse boundary deformation within the continent of China associated with the specific geodynamic settings.

The pre-existing weak zones around these Precambrian Cratons, as the thermal-rheological gradient zones, rework again due to the juxtaposed impacts of the Indo-Asia collision and the western Pacific plate subduction during the Cenozoic in the western and eastern China, respectively. The Late Mesozoic intensive lithospheric thinning well documented by petrological and geochemical studies in North China, are responsible for the transformation the thermal regime and associated rheological structure in the eastern Sino-Korea Craton.