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Non-rigid Eurasian plate during the Tertiary evidenced by paleomagnetic data from effusive and sedimentary rocks from Central Asia, and clues on the Inclination anomaly

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Squashed between China and Siberia, and far from the India-Asia collision front, Mongolia occupies a central position within the Asian continent. Understanding the deformation processes of this area during the Tertiary is crucial to unraveling the complex tectonic history of the Eurasian plate at that period. This study reports four Tertiary paleomagnetic poles at 13, 20, 30 and 40 Ma from Mongolia and Siberia. Whereas the poles at 13 and 20 Ma are fairly consistent with the reference APWP poles for Europe (B&C, 2002), the 30 and 40 Ma poles are far-sided with respect to the corresponding reference poles. The discrepancy between each pole and the corresponding reference amounts to $\Delta\lambda$=12.6°$\pm$3.9° and $\Delta\lambda$=9.6°$\pm$5.7° in paleolatitude for 30 and 40 Ma poles respectively. When compared to previously published coeval Asian poles obtained on igneous and sedimentary rocks, we note that most of them display offsets with respect to the reference poles at 10, 20, 30 and 40 Ma. We therefore draw two small circles, in each case, one passing through igneous poles, including our poles, and the other through sedimentary poles. Discrepancies between each small circle and the reference poles amount to 13.9°$\pm$3.8° and 20.9°$\pm$3.4° (difference: $\Delta\lambda$=7.0°$\pm$4.1°) at 40 Ma for igneous and sedimentary poles respectively; to

11.3°±4.4° and 21.0°±3.7° (difference: $\Delta\lambda$=9.7°±4.6°) at 30 Ma for igneous and sedimentary poles respectively; to 8.6°±5.0° and 17.6°±4.0° (difference: $\Delta\lambda$=9.0°±5.1°) at 20 Ma for igneous and sedimentary poles respectively. In contrast, the 13 Ma igneous poles are consistent with the European reference pole, whereas sedimentary poles exhibit a 15.2°±2.3° offset. These values lead us to the following conclusions. 1) The European reference APWP is not a valid reference for Siberia during the Tertiary. This invalidity could be due to (i) a magnetic field anomaly in Central Asia or long lasting non-dipole field contributions to the magnetic field. However, there is no supporting evidence; (ii) a non-rigidity of the Eurasian plate since the Cretaceous; and/or (iii) tectonic deformation due to ongoing penetration of India. Moreover, almost all poles are obtained from mobile blocks. 2) The commonly observed ∼20° offset of the Tertiary sedimentary poles from Central Asia is partly due to a ∼7-10° offset of the reference poles, as evidenced by the offset of igneous poles. The remaining ∼10° offset probably results in part from inclination shallowing due to sedimentary processes and in part from the northward movement of mobile blocks due to the ongoing penetration of India into Eurasia. This study suggests that the Tertiary inclination shallowing problem in Central Asia may be due to the superimposition of two contributing phenomena: sedimentary processes and tectonic movements.