Neogene Rotations in the Northeast Tibetan Plateau

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Vertical-axis rotations of blocks in and around the Tibetan Plateau can be attributed to the ongoing India-Asia collision and convergence since 55 Ma. Study of these vertical-axis rotations will increase our understanding of the mechanisms and kinematics of continent-continent collisions, and it is paleomagnetism that is most useful in quantifying the rotations experienced since the rocks became magnetized.

The uplift of the northeastern Tibetan Plateau has attracted wide attention recently. The ongoing sequence of uplift phases of the plateau has been suggested to be a young continuous outgrowth of the Tibetan Plateau. Hence, the research of the deformation and evolution of this part of the plateau will lead to the further understanding of the kinematics and mechanisms during the evolution of the entire Tibetan Plateau. However, Neogene paleomagnetic results in the northeast Tibetan Plateau are disparate, and no definitive understanding of the rotation patterns has yet been reached. Recent paleomagnetic data within the Qaidam-Alty Tagh region are contradictory, in that they are being used as arguments for significant (clockwise or counterclockwise) as well as insignificant rotations in the region. In addition, paleomagnetic studies in the Gonghe-Guide and Longzhong basins are marred by a lack of comprehensive understanding as to whether significant clockwise rotations of the region were diachronous or whether they all occurred before 29 Ma.

Recent magnetostratigraphic based rotation study of the Jiuquan Basin, a foreland basin of the North Qilianshan, revealed that the studied four localities have had similar sequential patterns of rotations during the last 13 Ma, significant continuous counterclockwise before c.a. 8.0 Ma, insignificant rotations between 8.0–4.0 Ma, and slight clockwise rotation after 4.0 Ma; while the mean declinations of the four localities are different from each other. The work indicates that significant basin-wide rotations have occurred in the Jiuquan Basin during the late Neogene, whereas the discordant paleomagnetic declination means of the four localities are results of averaging of different rotation angles and senses during different time intervals, which may be the similar case throughout the northeast Tibetan Plateau.

Given the possible existence of multiple changes in the sense and magnitude of rotation of the northeast Tibetan Plateau during Neogene, average declinations were calculated for every 100 m of well dated magnetostratigraphy sections from the Kunlun, Qaidam, Chaka, Linxia, Tianshui and Liupanshan basins, combined with the published results of the Jiuquan and Guide basins, to discuss the Neogene rotations of the northeast Tibetan Plateau. The analyses indicate that significant rotations did exist around the northeast Tibetan Plateau: (1) an overall pattern of clockwise rotation within the northeast Tibetan Plateau, but more or less counterclockwise rotation outside of the plateau; (2) significant rotations since ~11-8 Ma, and with accelerated rotations or switch of rotation patterns since ~5-3 Ma; and (3) the magnitude of clockwise rotations decreases from the west (Qaidam and Guide Basins) of ~25o to the east (Linxia and Tianshui Basins) of ~10o, while those outside of the NE Tibetan Plateau or close to the major faults the magnitude is generally large (>20o-30o) and with some complicated rotation history.

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