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The importance of basement structure reactivation during Mesozoic extension and Cenozoic transpression in the Gobi Altai (Mongolia)

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The Phanerozoic geological history of Mongolia includes Palaeozoic to early Mesozoic accretion of arcs, ophiolitic assemblages and continental terranes that amalgamated as part of the Asian continent. This was followed by Mesozoic intracontinental extension, basin formation and widespread mafic volcanism. Late Cenozoic transpressional mountain building formed the Mongolian Altai and Gobi Altai, induced by stresses associated with the India-Asia collision. Palaeozoic amagamation of the central Asian continent resulted in a structural grain in western and southern Mongolia that curves around the Precambrian Hangay terrane. In western Mongolia the orientation of Mesozoic and Cenozoic structures is strongly influenced by this older grain.

To assess the influence of Palaeozoic basement structures on the Mesozoic and Cenozoic tectonic evolution of southern Mongolia, we carried out detailed geological and palaeomagnetic fieldwork in the northeastern Gobi Altai. Detailed sedimentological and stratigraphic analysis of selected regions north and east of Ih Bogd has for the first time, documented evidence for Jurassic-Cretaceous intracontinental rifting in the Gobi Altai, with the rift-bounding normal faults striking parallel to the basement grain. The available information is consistent with at least partial reactivation of pre-existing basement structures.

Transpressional mountain building in the Gobi Altai developed largely since approximately 8 Ma. Two scenarios explain why the strike-slip systems are transpressional:

(1) strike-slip and oblique-slip faults reactivate Paleozoic or Mesozoic faults and metamorphic fabrics that are oblique to SHmax or, (2) original strike-slip faults become transpressional due to vertical axis rotations. To test these competing hypotheses, we carried out a palaeomagnetic investigation in the northeastern Gobi Altai. We sampled lower Cretaceous stratigraphy in rift basins flanking the modern Ih Bogd, Baga Bogd and Artsa Bogd mountains and younger lavas and basalt plugs. Approximately 900 samples were drilled in 10 localities in lower Cretaceous lavas, each subdivided into 7-15 sites of 7 samples each. These were then AF and thermally demagnetized. Curie temperatures around 560-600°C indicate magnetite as the principal carrier of the magnetic signal. The results show a mean direction of D/I = 10.2/66.8 (α95=3.6; k=177.5), which does not significantly deviate from the published average Eurasian palaeomagnetic direction for this time window (D/I = 13.6/62.4; α95 = 1.7). We thus conclude that Neogene transpressional mountain building was not associated with vertical axis rotation of strike-slip faults into orientations that would favour components of crustal contraction driving uplift. Instead, oblique-slip thrust reactivation of the basement grain between strike-slip fault segments is a more likely mechanism for transpressional deformation and restraining bend uplift in the northeastern Gobi Altai.