Maximum Effective Moment Criterion and Formation of Extensional Crenulation Cleavage and Low Angle Normal Faults

Zheng, Y., Department of Geology, Peking University, Beijing, China

Low-angle normal fault is precluded by standard mechanics theory which predicts normal faults formed at the steeper dip of 60°. Consequently, whether low-angle normal faulting is mechanically feasible is controversial for years. Many field studies, however, have provided examples of low-angle normal faults with clear evidence. Most cases are involved ductile shear zones and often contain minor shear bands that transected at a small angle and displaced the penetrative mylonitic foliation. These shear bands are termed as extensional crenulation cleavage (ecc). Using a moment approach, the initial angle between conjugate extensional crenulation cleavages (eccs) is found to be 109°28' in co-axial deformation cases. The ecc sets follow the maximum moment orientations. Although conjugate sets of ecc occasionally occur in shear zones, usually the synthetic ecc set is normally the better developed, which implies that natural shear zones are usually of non-coaxial deformation. The detachment fault of the Yagan-Onch Hayrhan metamorphic core complex in southern Gobi area generally dips to SSE at ca 25° and is statistically parallel to the synthetic ecc set, while antithetic ecc set and low-angle normal faults in the lower plate dip to NNW at ca 35°. The propagation of the synthetic ecc set is suggested to be a mechanism by which low-angle normal faults are developed. The high angle part of the detachment fault above the brittle-ductile transition zone is progressively removed off by erosion during the footwall exhumed along the detachment fault, whereas its low-angle part gradually is flattened into lower-crustal flow below the brittle-ductile transition. The low-angle part may retain its attitude or be warped upward and flattened as the isostatic response to unloading of the footwall when it is exhumed. The low-angle part may form a restraint boundary of the brittle hangingwall as observed today.