



Large-scale thrusting along the northern margin of the Tibetan Plateau and the southwest Tarim basin: 230 km long active Hotian thrust sheet

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We present the geometry, kinematics and mechanics of large-scale thrusting in the West Kunlun Shan and the southwest Tarim Basin, which is associated with the northward motion of Tibet. The great frontal structure is the ~230km long intact bedding parallel Hotian thrust sheet composed of strata of the Tarim Basin lying above a regional gypsum horizon at the base of the Cenozoic sequence. The toe of the Hotian thrust sheet steps steeply to the surface two thirds of the way across the basin forming the Selibuya-Mazartag hills in the sand desert. The Hotian thrust constitutes one of the longest active intact thrust sheets in the world, showing little internal deformation, however at its back it steps down to a Cambrian detachment at the base of the Paleozoic below a belt of complex high-amplitude anticlines near the front of the West Kunlun Shan, which display break-forward imbricate and wedge structure. More interior, steep reverse faults such as the Tieklik thrust bring older strata to the surface, including Paleozoic basement. The Cambrian detachment also extends northward under the Tarim basin with minor hanging-wall deformation that warps the Hotian Thrust sheet locally, causing the development of growth strata in the Hotian thrust sheet that provides a quantitative record of its motion over these warps. Seismic profiles in the southwest Tarim basin reveal widespread growth strata that record much of the structural history beginning in the early Pliocene Atushi Formation. Ages of seismic reflectors are calibrated to a surface magnetostratigraphic sequence (from Zheng et al., 2000) and traced throughout the seismic grid. The bottom of the growth strata is dated at 3.6 Ma indicating a Pliocene and younger age of thrusting and folding in the southwest Tarim Basin. Structural restoration suggests minimum shortening greater than 35km. The Tieklik thrust consumed at least 10 km in early Pliocene. The fold-and-thrust belts of the southwest Tarim basin shortened >25km in late Pliocene and Pleistocene. Some slip propagated northward into the inland of Tarim basin and developed the thrust surface rupture zone at Selibuya-Mazartag. The overall shortening rate is ~10 mm/yr in the fold-and-thrust belt of the southwest Tarim basin since Pliocene. The strength of the gypsum detachment of the 240 km long Hotian thrust sheet can be estimated from the tapered geometry. Using wedge theory (Suppe 2007) we find that the ratio of critical wedge strength W to detachment strength F is equal to the detachment dip in radians for a wedge of zero surface slope. The current dip of the Hotian detachment is 0.08° or 0.014. Typical wedge strengths are in the range 0.5-1, therefore based on the lack of internal deformation we estimate an upper bound on the strength of the gypsum detachment, expressed as an exceedingly weak effective friction coefficient of less than ~0.0005-0.0015.