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Major Fault Systems and Mountain Building Processes in the Tibetan Foreland and Beishan Region, NW China

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In regions north of Tibet, active deformation associated with the Indo-Eurasia collision is diffusely distributed within large areas of NW China, Mongolia and S and SE Siberia. These regions are dominated by intraplate strike-slip and transpressional reactivation of Palaeozoic terrane collages. Because of relatively low historical seismicity, the Beishan region immediately north of Tibet is generally regarded as tectonically uninteresting from a neotectonic standpoint. However, our preliminary work in the region coupled with satellite image analysis indicates that the region is cut by at least five major sinistral strike-slip fault systems that are potentially active and which parallel the Altyn Tagh fault which bounds northern Tibet directly to the south. These fault systems generate localised uplifts within the Beishan and show typical geomorphological characteristics of active intracontinental deforming belts such as sharply defined mountain fronts, Quaternary alluvial fan complexes and tilted Cretaceous peneplain remnants. Specifically, the Yushi Shan and Mazong Shan are Late Cenozoic restraining bends that show clear evidence for Quaternary thrusting and uplift. Other minor localised uplifts also appear fault-controlled. However, at first-order, regional Beishan topography is difficult to explain by Late Cenozoic upper crustal faulting, unlike Tibet to the south and the Gobi Altai to the north.

Directly adjacent to Tibet's northern margin, the Sanweishan and Nanjieshan blocks are thrust-bound basement-cored uplifts that interrupt the Tibetan sedimentary foreland in the Dunhuang-Anxi region. The faults that cut and bound these minor ranges appear to define an evolving transpressional duplex with north-directed thrusting, but perhaps surprisingly, also south-directed thrusting back towards the high Plateau. As noted by others, the Altyn Tagh Fault defines a profound topographic and structural boundary in Central Asia with significant differences in contractional strain on either side. The rigid Tarim block appears to be the major rheological control on the limited northward growth of the plateau in the Sanweishan-Nanjieshan region.

Basement rocks in the Beishan region record several major collisional suturing events associated with amalgamation of the Central Asian Orogenic belt. These events are expressed in a remote region north of Liuyuan by kilometre-scale refolded folds of Permian clastic sediments that are spectacular when seen on satellite imagery. The folds were ground-verified during summer, 2009 and sedimentary way-up criteria, cleavage-bedding relations and folded quartz veins were also documented to further constrain the fold geometries and deformational history. Detailed mapping of key areas and structural data analysis reveal that the folds initially formed by Late Permian NNE-SSW directed shortening associated with collisional suturing along the western extent of the Solonker Suture. Subsequent dextral transpression along a major terrane boundary immediately south of the Permian basin generated NW-SE shortening and km-scale type-2 refolds.

During all Palaeozoic terrane amalgamation events, the Beishan crustal block was located between the rigid Tarim and North China Precambrian cratons, and more recently between the modern intracontinental deforming belts in northern Tibet and the Gobi Altai. Thus the Beishan's unique position within Asia has led to a particularly complex polydeformational history involving repeated crustal reactivation by both near-field and far-field stresses associated with Late Palaeozoic-Recent collisional events.