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Crustal Structure Deformation in the Eastern Margin of the Tibetan Plateau constraints from Deep Seismic Reflection Profiles

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The Minshan block, located along the eastern margin of the Tibetan Plateau north of the Sichuan Basin, provides an important natural laboratory in which to study the patterns of deformation and their relationship to mountain building at the margin of the plateau. The Minshan range is bounded by the Minjiang fault to the west and Huya fault to the east. Evidence from the Neotectonics sediments suggests that deformation along the western Min Shan may reflect the surface response to thickening of a weak lower crust at the margin of the Tibetan Plateau [1].

In 2014, two deep seismic profiles was carried out across the Minjiang fault (55 km long) and Huya fault (45 km long) respectively, supported by China geological survey project (No.1212011220260) and Crust Probe Project of China (SinoProbe-02-01). The recording of seismic waves from 4 big shots (500kg), 100 middle shots (120 kg) and 400 small shots (36 kg) were employed. The geophones spacing is 50 m.

The seismic data processing was performed with a combination of the advantages of the CGG, ProMAX, GeoTomo, GeoRest and GeoDenoise systems. The data processing was performed by conducting tomographic static correction, true-amplitude recovery, frequency analysis, filter-parameter tests, surface-consistent-amplitude corrections, surface-consistent de-convolution, coherent noise suppression, random noise attenuation, human–computer interactive velocity analysis, residual statics correction, Kirchhoff pre-stack time migration from rugged topography and post-stack polynomial fitting for removing noise. An iterative procedure was adopted to obtain the optimal parameters for stacking and post-stack noise attenuation. These processing steps were designed to preserve the relative true amplitudes.

The stacked sections distinctly reveal the faults characteristic for the first time and provide us a detailed deformation mechanism of the Minshan block: 1) The Minjiang fault zone are composed of a series of thrust nappe in the upper crust. A strong reflector appears in the middle crust of the Minjiang section at 8-9 s two-way times, and it dips down to the lower crust from west to east. Similarly, the reflectors from Moho in Minjiang profile appears at 14-15s beneath the Ruoergai basin and 16-17s beneath the Minshan block. It may suggests that the Ruoergai lower crust was pushed into the Minshan lower crust with effect of the Eastward compression, while the upper crust thrust to the top along the Minjiang fault zone. 2) The reflectors on the Huya section have completely different trend on the west and east flank of the Huya fault. The Huya fault shows as a typical flower-structure which means it should be a left-lateral strike-slip fault [2]. It is worth noting that the Moho is also dislocated by the Huya fault, which produced two >Ms 7.0 earthquakes in 1976.

References:

[1] Eric Kirby et al. (2000) Geological Society of America Bulletin 112(3): 375-393

[2] Tang Wenqing et al. (2004) Sedimentary Geology and Tethyan Geology 24(4): 31-34.