The lower crust and Moho structures in the southern Lhasa terrane ——revealed from near-vertical reflection of the large dynamite shots

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As the consequence of the collision between Asian and Indian Plates, the Tibetan plateau is optimal for studying the collision and convergence of the continental lithosphere. Lhasa Terrane is the southernmost part of Tibetan Plateau, which is the front of ongoing collision. Thus revealing the deep crustal structure and Moho of Lhasa Terrane is the key to understand the processes of uplifting and crustal thickening mechanism of the Lhasa terrane.

Using near vertical single fold profile technology, an N-S trend 125.2 km-long deep seismic reflection profile (Xietongmen County – Xainza) was deployed in summer, 2016. In this study, authors collected four near vertical incident large dynamite shots data (FFID of four shots from south to north: 6055,6996,7805,8678) from the deep seismic profile crossing middle Lhasa terrane, in order to control the detailed deep structure beneath the Lhasa Terrane. Static, pre-stack comprehensive denoising, normal moveout, random noise attenuation and other data processing are applied to obtain crustal and Moho reflection.

The results highly constrain the deep crustal structure and provide highest-resolution information of Moho discontinuity beneath Lhasa terrane. South-dipping reflectors with large amplitudes, considered as bright spots, are clearly represented at shots 6055 and 6996 ~6s (two ways travel time, TWT) both in the raw single shot data and preliminary seismic profile. These reflections, appearing at the bottom of Gangdise batholithe, are speculatively supposed to be an evidence of partial melting beneath the Gangdise batholithe in the upper crust. Meanwhile, results show that the lower curst is characterized by a series of north-dipping and strong reflectors from ~8s TWT to ~18s TWT. These notable reflectors extending across the whole lower curst indicate that the crustal-scale duplexing is the prominent way to shorten and thicken crust of Lhasa terrane caused by the convergence of Asian and Indian Plates. At the bottom of crustal reflections, the seismic image reveals a clear, smooth and discontinuous crust-mantle

boundary (it is more prominent in the north), at TWT ~22.5s, depth ~70.8km (if average crustal velocity 6.3km/s is assumed) without distinct fabric and additional secondary Moho.

References:

[1] Gao, R., Lu, Z., Klemperer, S. L., et al. Crustal-scale duplexing beneath the Yarlung Zangbo suture in the western Himalaya[J]. Nature Geoscience, 2016, 9(7).

[2]Guo, X., Li, W., Gao, R., et al. Nonuniform subduction of the Indian crust beneath the Himalayas[J]. Sci Rep, 2017, 7(1): 12497