Acta Geologica Sinica (English Edition), 2019, 93(supp.2): 219–220

Crustal Velocity Structure in the Northeastern Margin of the Tibetan Plateau and Insights into Crustal Deformation

WANG Shuaijun[1, *], LIU Baojin[1], SONG Xianghui[1], LI Yiqing[1] DENG Xiaoguo[1] and BAO Xiumin[2]

[1] *Geophysical Exploration Center, China Earthquake Administration, Zhengzhou, 450002*
[2] *Shengyang Seismic Station, Earthquake Administration of Liaoning Province, Shenyang, 110161*

Citation: Wang et al., 2019. Crustal Velocity Structure in the Northeastern Margin of the Tibetan Plateau and Insights into Crustal Deformation. *Acta Geologica Sinica* (English Edition), 93(supp.2): 219–220.

Abstract: The transitional area between the northeastern margin of the Tibetan Plateau, Ordos Block and Alxa Block, also being the northern segment of the North-South Seismic Belt, is characterized by considerably high seismicity level and high risk of strong earthquakes. In view of the special tectonic environment and deep tectonic setting in this area, this study used two seismic wide-angle reflection/refraction cross profiles for double constraining, so as to more reliably obtain the fine-scale velocity structure characteristics in both the shallow and deep crust of individual blocks and their boundaries in the study area, and further discuss the seismogenic environment in seismic zones with strong historical earthquakes. In this paper, the P-wave data from the two profiles are processed and interpreted, and two-dimensional crustal velocity structure models along the two profiles are constructed by travel time forward modeling. The results show that there are great differences in velocity structure, shape of intra-crustal interfaces and crustal thickness among different blocks sampled by the two seismic profiles. The crustal thickness along the Lanzhou-Huianbu-Yulin Seismic Sounding Profile (L1) increases from ~43 km in the western margin of Ordos Block to ~56 km in the Qilian Block to the west. In the Ordos Block, the velocity contours vary gently, and the average velocity of the crust is about 6.30 km s^{-1}; On the other hand, the velocity structures in the crust of the Qilian Block

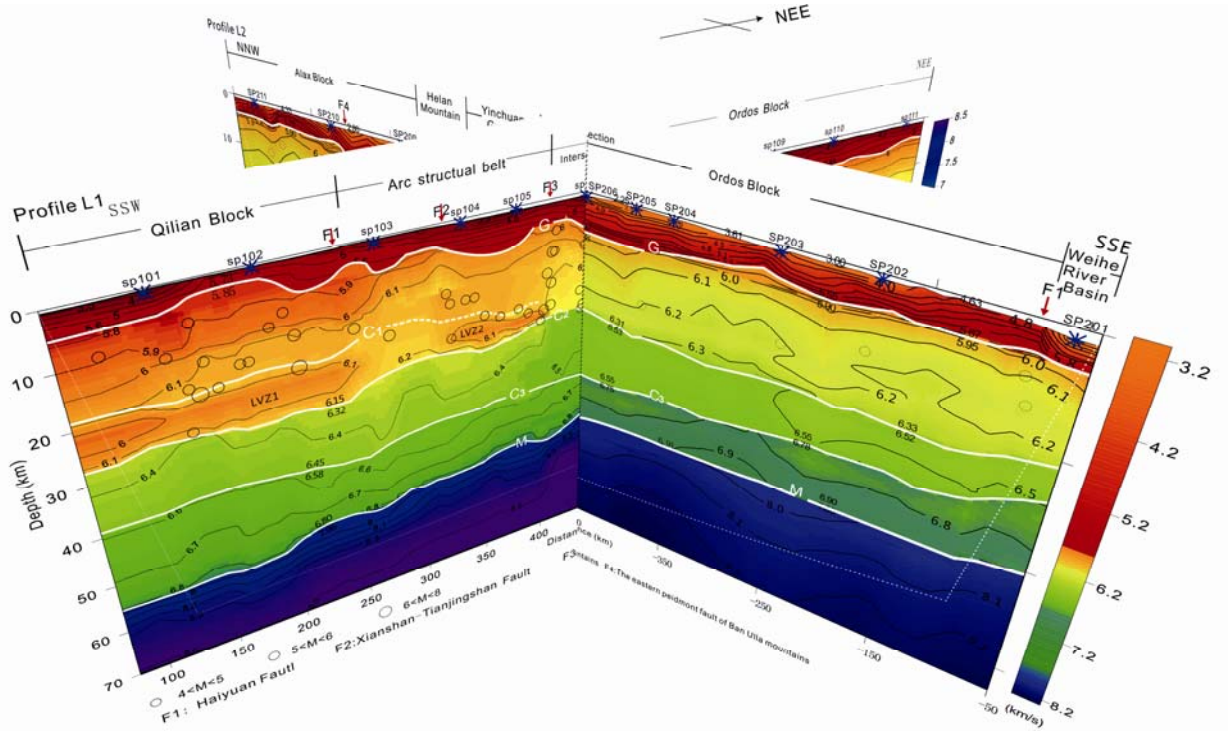

Fig. 1. 2D velocity structure of cross profile.
(a) Profile L1 is the northeast-east section. (b) Profile L2 is the southwesterly section.The intersection point of the two sections is near the shot point SP6.1,The white lines in the two-dimensional velocity structure diagram are the inner interface of the crust. 2,The black lines are the velocity contour.3,The black circle in the figure is the seismic source depth above M6.4,The red downward arrow is the fault position.5,Symbol * is the position of the shot.

* Corresponding author. E-mail: wsjdzj@126.com

and the arc-like tectonic zone vary dramatically, and the average crustal velocities in these areas are about 0.10 km s^{-1} lower than that of the Ordos Block. In addition, discontinuous low-velocity bodies (LVZ1 and LVZ2) are identified in the crust of the Qilian Block and the arc-like tectonic zone, the velocity of which is 0.10～0.20 km s^{-1} lower than that of the surroundings. The average crustal thickness of the Ordos Block is consistently estimated to be around 43 km along both Profile L2 (Tongchuan-Huianbu-Alashan Left Banner Seismic Sounding Profile) and Profile L1. In contrast to the gently varying intra-crustal interfaces and velocity contours in the Ordos Block along Profile L1, which is a typical structure characteristic of stable cratons, the crustal structure in the Ordos Block along Profile L2 exhibits rather complex variations. This indicates the presence of significant structural differences in the crust within the Ordos Block. The crustal structure of the Helan Mountain Orogenic Belt and the Yinchuan Basin is featured by "uplift and depression" undulations, showing the characteristics of localized compressional deformation. Moreover, there are low-velocity zones with alternative high and low velocities in the middle and lower crust beneath the Helan Mountain, where the velocity is about 0.15～0.25km s^{-1} lower than that of the surrounding areas. The crustal thickness of the Alxa Block is about 49 km, and the velocity contours in the upper and middle-lower crust of the block vary significantly. The complex crustal velocity structure images along the two seismic sounding profiles L1 and L2 reveal considerable structural differences among different tectonic blocks, their coupling relationships and velocity structural features in the seismic zones where strong historical earthquakes occurred. The imaging result of this study provides fine-scale crustal structure information for further understanding the seismogenic environment and mechanism in the study area.

Keywords: Northeastern margin of the Tibetan Plateau, the Ordos Block, Crustal velocity structure,Deep seismic sounding

Acknowledgments: This work is granted by the National Natural Science Foundation Project of China (No. 41474076) and jointly funded by Special Projects of Scientific Research of the Earthquake Industry (No. 201408023) .

References

Deng, Q.D., Zhang, P.Z., Ran, Y.K., Yang, X.P., Min, W., and Chu, Q.Z., 2002. Basic features of active tectonics in China. *Sci China Ser D* (Geosci.), 32: 1020–1030.

Tapponnier, P., Xu, Z.Q., Roger, F., Meyer, B., Arnaud, N., Wittlinger, C., and Yang, J.S., 2001. Oblique stepwise rise and growth of the Qinghai-Tibetan Plateau. *Science*, 294: 1671–1677.

Wang, C.Y., Yang, W.C., Wu, J.P., and Ding, Z.F., 2015. Study on lithospheric structure and earthquakes of North-South tectonic region. *Chin J Geophys*, 58: 3867–3901.

Zhang, P.Z., 2008. The present tectonic deformation in the Western Sichuan Area in the east margin of the Qinghai-Tibetan Plateau. *Sci China Ser D* (Geosci.), 38: 1041–1056.

Zhu, R.X., Chen, L., Wu, F.Y., and Liu, J.L., 2011. Time, scope and mechanism of craton destruction in North China. *Science China* (Geosci.), 41: 583–592.

About the first author

WANG Shuaijun, male; born in 1978 in Puyang City, Henan Province; master; research assistant of Geophysical Exploration Center, China Earthquake Administration; He is now interested in the study on deep geophysical detection and data interpretation. Email:wsjdzj@126.com; phone: 0371-63723029, 13838020861.