Experiment name* North China Interior Structure Project-Experiment 2 (NCISP2)
Names of Principal Investigators and their institutions* Tianyu Zheng, Institute of Geology and Geophysics, Chinese Academy of Sciences (IGGCAS)

Mobilization date* 2001-08-28
Demobilization date* 2003-03-10
Number of stations: 41
Network Code and Years: ZQ 2001-2003

A brief summary of the experiment:
The North China Craton (NCC) is one of the world's oldest, preserving continental rocks as old as 3.8 Ga; the basement consists of variably exposed Archean–Paleoproterozoic rocks. The craton is composed of two major Archean blocks, the eastern and western NCC, that was sutured along the Trans-North China orogeny (TNCO) in the Paleoproterozoic. After cratonization, the NCC remained relatively stable with a thick Archean lithospheric keel until the early Mesozoic. The NCC settled into the East Asia continent by amalgamating with the surrounding continental blocks. To the north, amalgamations of the NCC with the accretion terranes of the Central Asian Orogen occurred during the Late Permian to Early Triassic. To the south, the continent-continent collision between the NCC and the Yangtze craton was one of the most important accretion events in the Triassic. Since the Late Mesozoic, the craton has become unstable and marked by large-scale structural deformation and magmatic activity occurred in the eastern NCC.
The NCC is a classic example of ancient destroyed cratons. For understanding the interior structure and the tectonic evolution of the NCC, the North China Interior Structure Project (NCISP) had been carried out in 2000-2009. This seismic experiment had deployed 478 portable broadband seismometers with an average spacing of about 10–17 km in eight profiles and covered several major tectonic units. Seismic results based on such observations had revealed many interesting features of the crust and upper mantle of the NCC.
The stations in the NCISP-2 oriented in an NE-SW direction crossed the eastern and central NCC from Bohaiwan Basin (BB) to Taihangshan Mountain Range (TMR) over a distance of ~470 km.

Preliminary scientific results, if any:
The velocity structure information, including crust, lithospheric mantle, upper mantle and mantle transition zone, as well as the seismic anisotropiy in the observation area and NCC have been extracted based on these observations.
The seismological imaging result reveals distinct structural features between the mountain range and the basin area, and presents a picture of uneven crust thinning within the study region. In the east BB the crust is significantly thinned due mainly to the reduction in the thickness of the lower crust. The west TMR, in contrast, is characterized by a relatively thick lower crust of ～20 km. The teleseismic waveform

data and the gravity observation suggest a thicker crust and a buoyant mantle lithosphere beneath the TMR compared with the BB. The contrasting crustal structural features appear coupled with the lithospheric processes and possibly reflect that different tectonic mechanisms and deformation regimes dominated the evolution of the two regions. The North-South Gravity Lineament, lying between the TMR and BB, might represent a deep intra-continental boundary separating the NCC into topographically and tectonically different regions. (Zheng et al., 2006)
The receiver function images show that the lithospheric thickness of the study region is highly variable. The imaged LAB is on average ～80km beneath the BB, and displays obvious undulations from ～120 km under the TMR to <90 km further west in the central NCC. A rapid change of ～30km in the LAB depth was detected at around the boundary between the BB and the TMR, roughly coincident with North–South Gravity Lineament in the region. (Chen, 2009)
The results of shear wave splitting measurements reveal the presence of small to large seismic anisotropy in the mantle beneath the NCC. The most striking result is the distinct difference of fast polarization directions between the Eastern Block (EB) and the TNCO of the NCC. The fast polarization directions trend SE beneath the EB, which implies that northwestward mantle flow has played a significant role in the reactivating of the EB during Late Mesozoic to Early Cenozoic, and the boundary between the TNCO and the EB was possibly a west limit where the mantle flow was deflected. (Zhan and Zheng, 2005)
The tomography result shows that an obvious N–S trending narrow low-velocity region is located at the base of the lithosphere beneath the TNCO, which extends to more than 500 km depth. The imaged low velocities suggest that warm mantle material with a source at least as deep as the transition zone, possibly a mantle plume, may be responsible for the reactivation of the NCC. (Zhao et al., 2009)

Approximate amount of data (in MB): 853000

Describe any known problems with the data or particular problems encountered during the experiment:

List of publications submitted:

1. Zhao, L., Zheng, T. Y., & Xu, W. W. Modeling the Jiyang Depression, Northern China, Using a Wave-Field Extrapolation Finite-Difference Method and Waveform inversion. *Bull. Seis. Soc. Am. 94*, 988-1001, (2004).
2. Zhao, L., & Zheng, T.Y. Seismic structure of the Bohai Bay Basin, northern China: Implications for basin evolution, *Earth Planet. Sci. Lett., 231*, 9-22, (2005).
3. Zhao, L. & Zheng, T. Y. Using shear wave splitting measurements to inversion the upper mantle anisotropy beneath the North China Craton: Distinct variation from east to west, *Geophys. Res. Lett., 32*, L10309, doi:10.1029/2005GL022585 (2005).
4. Zheng, T.Y., Zhao, L. & Chen, L. A detailed receiver function image of the

sedimentary structure in the Bohai Bay Basin, *Physics of the Earth and Planetary Interiors, 152*, 129-143 (2005).
5. Chen, L., Zheng, T. Y. & Xu, W. W. Receiver Function Migration Image of the Deep Structure in the Bohai Bay Basin, Northeastern China, *Geophys. Res. Lett., 33,* GL027593 (2006).
6. Zheng, T. Y., Chen, L., Zhao, L., Xu, W. W., & Zhu, R. X. Crust-mantle structure difference across the gravity gradient zone in North China Craton: Seismic image of the thinned continental crust, *Physics of the Earth and Planetary Interiors, 159,* 43-58 (2006).
7. Zheng, T. Y., Zhao, L. & Zhu, R. X. Insight into the geodynamics of cratonic reactivation from seismic analysis of the crust-mantle boundary. *Geophysical Research Letters, 35*, L08303, doi:10.1029/2008GL033439 (2008).
8. Chen L. Lithospheric structure variations between the eastern and central North China Craton from S- and P-receiver function migration. *Physics of the Earth and Planetary Interiors 173*, 216–227 (2009).
9. Chen, L., Cheng, C. & Wei, Z. G. Seismic evidence for significant lateral variations in lithospheric thickness beneath the central and western North China Craton. *Earth and Planetary Science Letters, 286,* 171-183 (2009).
10. Zhao, L., Richard, M. A., Zheng, T. Y. & Hung, S. H. Reactivation of an Archean craton: Constraints from P- and S-wave tomography in North China. *Geophysical Research Letters, 36*, L17306, doi:10.1029/2009GL039781 (2009).
11. An, M., Feng, M. & Zhao, Y. Destruction of lithosphere within the north China craton inferred from surface wave tomography, *Geochem. Geophys. Geosyst., 10*, Q08016, doi:10.1029/2009GC002562 (2009).
12. Chen, L. & Ai, Y. S. Discontinuity structure of the mantle transition zone beneath the North China Craton from receiver function migration. *Journal of Geophysical Research, 114,* B06307, doi:10.1029/2008JB006221 (2009).
13. Zhao, L. & Xue, M. Mantle flow pattern and geodynamic cause of the North China Craton reactivation: Evidence from seismic anisotropy. *Geochemistry, Geophysics, Geosystems*, 11, Q07010, doi:10.1029/2010GC003068 (2010).
14. Xu, W. W., Zheng, T. Y. & Zhao, L. Mantle dynamics of the reactivating North China Craton: Constraints from the topographies of the 410-km and 660-km discontinuities, *Science China Earth Sciences, 54,* 881-887 (2011).
15. Zheng, T. Y., Zhu　R. X., Zhao, L. & Ai, Y. S. Intralithospheric mantle structures recorded continental subduction. *Journal of Geophysical Research, 117*, B03308, doi:10.1029/2011JB008873 (2012).
16. Zhao, L., Allen, R. M., Zheng, T. Y. & Zhu, R. X. High-resolution body-wave tomography models of the upper mantle beneath eastern China and the adjacent areas. *Geochemistry, Geophysics, Geosystems, 13,* Q06007, doi:10.1029/2012GC004119 (2012).
17. Zhao, L., Zheng, T. Y., & Lu, G. Distinct upper mantle deformation of cratons in response to subduction: constraints from SKS wave splitting measurements in eastern China. *Gondwana Research 23*, 39-53 (2013).

18. Cheng, C., Chen, L., Yao, H. J., Jiang, M. M. & Wang, B. Y. Distinct variations of crustal shear wave velocity structure and radial anisotropy beneath the North China Craton and tectonic implications. *Gondwana Research 23*, 25-38 (2013).
19. Si, S. K., Zheng, Y. P., Liu, B. H., & Tian, X. B., Structure of the mantle transition zone beneath the North China Craton, Journal of Asian Earth Sciences 116, 69–80, http://dx.doi.org/10.1016/j.jseaes.2015.11.006 (2016).

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