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Study on the basement structure in the southeastern North China by blasting seismic

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ABSTRACT

Since the Mesozoic, southeastern North China Craton has experienced intense crustal thinning and lithosphere destruction. Some of the responses of the deep activity in the upper crust crystalline basement have been retained in a series of tectonic evolution. The study of the upper crust velocity structure, especially the properties of the basement interface, is of great significance for studying the tectonic evolution and seismic hazard in the southeastern part of North China. In this study, we selected Pg waves of the blasting seismic data in the southeastern part of North China in recent years, which reflect the west Shandong uplift, offshore sedimentary basins and the Tanlu Fault zone and the Sulu orogenic transition zone, to study the structural and seismological characteristics of basement in North China Craton. The results of this study showed as follows: First, the obvious lag of Pg wave arrival time in Dongying depression and North Jiangsu basin reveals the thick sedimentary, low velocity and unstable basement structure. Second, the advance Pg wave arrival time with high apparent velocity, which reflects the basement structure of the west Shandong uplift, indicates the thin sediments and the shallow basement. Third, combined with many geophysical phenomena, such as electrical structure, density structure and terrestrial heat flow, we hold that the Tanlu tectonic belt and the Sulu orogenic belt have experienced great lithosphere destruction and there is shallow crust and the thinnest lithosphere in the vicinity of the Tanlu fault zone.

1. Introduction

In the past decades, a series of scientific problems surrounding the extent, scope and mechanism of lithospheric thinning in the eastern part of North China have been studied from different perspectives by using different methods such as magnetotellurics, geochemistry and geology, and achieved a series of research results [1–7]. The study of crust-mantle structure in North China by artificial blasting seismic exploration began in the 1970s. Some of the early detection profiles were mostly in the range of 300–400 km, which were mainly aimed at detecting the crust. In recent years, dozens of deep seismic wide-angle reflection/refraction profiles are completed, and achieved abundant research achievements. Those achievements revealed the differences and characteristics in different tectonic regions of crust mantle structure, and obtained the complex relationship of deep and shallow seismic fault, fine crustal structure and seismogenic environment of the seismically active zone [8–12]. These studies are relatively few in the East China. In the late 90s, the drilling and blasting efficiency, instrumentation equipment, and data processing technology of blasting seismic detection methods, have been continuously improved along with the rapid development of science and technology. In this study, the seismic data of three profiles with high-performance blasting completed in recent years, which reflects the upper crustal structure in the southeastern part of North China were selected to systematic analyze and comprehensive research on seismological characteristics of the craton destruction in different tectonic zone, such as west Shandong uplift and Dongying sag, north Jiangsu basin, Tanlu fault zone and Sulu orogenic transition zone. Through

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these studies and analysis, we obtain the search results on the basement of the key structural parts in the southeastern part of North China, provide a direct basis of Seismology in key scientific problems.

The profile of HB01 is Dafeng-Baotou seismic profile in Fig. 1, which was completed in 2011. It had implemented 21 explosions in 1340 km long. In this study, we selected some data of its southeastern section of about 600 km. This section from the southeast-northwest direction pass through the main geological structures: northern of north Jiangsu basin, Sulu orogenic, Tanlu fault zone, west Shandong uplift. HB02 is Zhucheng—Yichuan profile which was completed in 2008, it is 500 km long, and it had implemented 8 explosions. In this study, we selected some data of its eastern section of about 500 km. This section from east to west pass through north of Sulu orogenic, Tanlu fault zone and the west Shandong uplift. HB03 is Zhangqiu—Lijin profile completed in 2011, it is 210 km long, and it had implemented 2 explosions. Most of the section is located in the Dongying sag, and the southeast section enters in the north of west Shandong uplift. The above three seismic exploration profiles have taken high-performance blasting excitation to obtain excellent upper crust seismic wave records. Those records provide direct evidence for analysis and research on the mechanism of lithospheric thinning, the range and extent of the damage of different tectonic blocks, and the difference in space of the region.

2. Regional geological background

Located in the eastern part of the North China Craton, the tectonic zone is a Mesozoic-Cenozoic intraplate rift basin developed on the ancient stable continental block. It has been kept relatively stable state in the long process of tectonic evolution. However, since Mesozoic, there were large tectonic deformation, and formed magmatism and basin and orogenic belt. There are thick Cenozoic sedimentary strata in Subei basin, which is a late Paleogene residual basin. The basin has experienced many uplifting and denudation and formed the shape of asymmetric dustpan. The Luxi uplift is extensional tectonics of the North China plate, and the extensional faults are well developed. It consists of crystalline basement of Precambrian system and sedimentary cap rock of Paleozoic, Mesozoic and Cenozoic. The Tanlu fault zone is a large fault belt that runs through the east of China. Its origin is related to the collision and amalgamation of the North China Craton and the Yangtze craton during Indosinian epoch. Since Mesozoic, it has undergone a complex process of evolution, such as strong left translation, extension and compression.

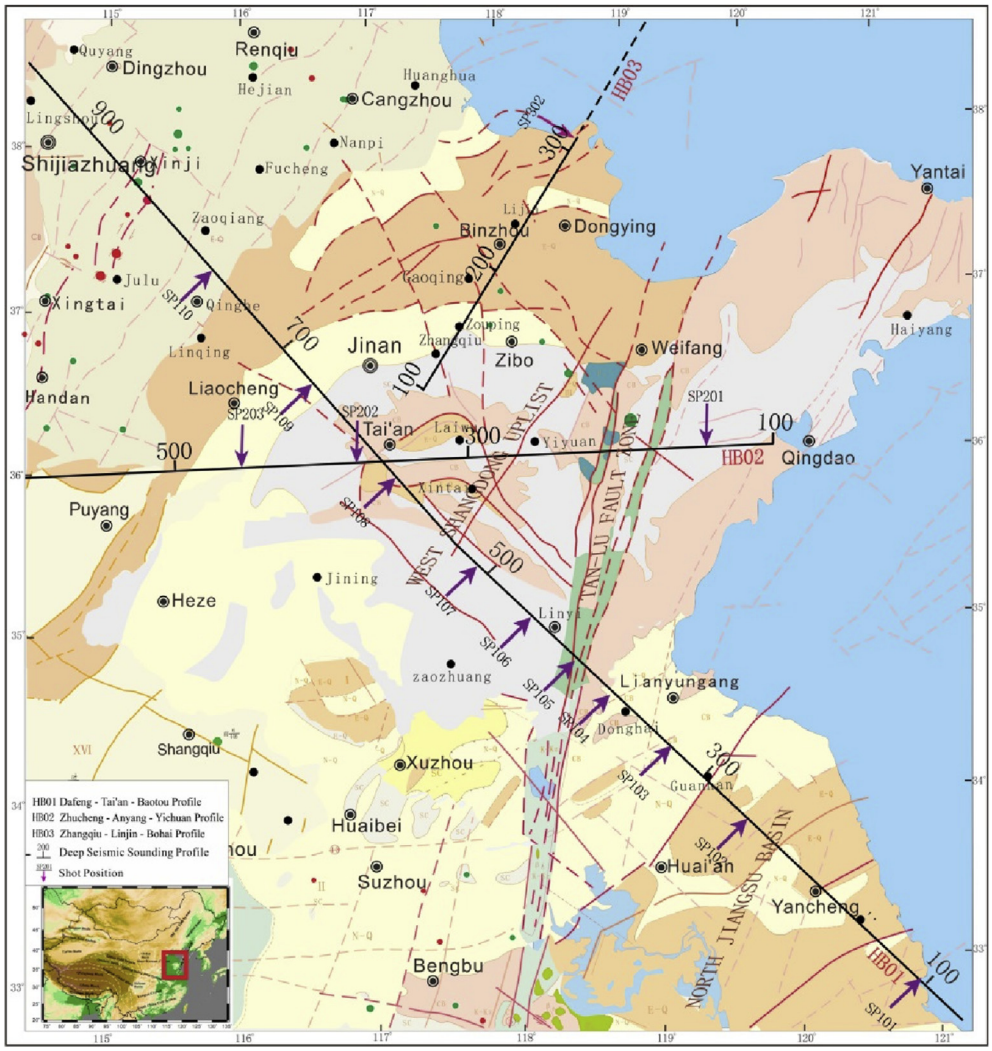

Fig. 1. Main geological structure in eastern North China and location of seismic profiles.

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