Exploration of Lintong-Chang'an Fault in relation to Lintong Line of Rapid Rail Transit in Xi'an city

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Abstract: In this paper, the method of combining high-density electrical exploration and shallow seismic exploration is used to explore the Lintong-chang'an fault in relation to Lintong line of rapid rail transit in Xi'an city. The distribution and activity of the fault are determined, providing a basis for seismic fortification and seismic geological disaster evaluation in the line.

1 Introduction

In general, Lintong-Chang'an fault is a boundary fault between the Lishan Uplift and the Zhouzhi-Huxian Sag in the Weihe Basin. It extends from Lishan Town, Lintong District, Xi'an City in the north, and cuts across Henglingyuan, Bailuyuan, Shaolingyuan and Shenheyuan to Fengyukou, Chang'an District, Xi'an in the southwest. The fault is about 47km long, with an overall strike of 50 ° NE and a local strike of 75 ° NE and a dip of NW. It is a tensile normal fault. Lintong Chang'an fault is mainly composed of two large faults. One is Majie-niujiaojian-dabaopi-nianwan fault, the other is Hujiagou-xiaojiazhai-yuedengge-shoupazhang fault.

The project of "Xi'an earthquake active fault detection and seismic risk assessment" (Shaanxi Earthquake Agency, 2008), and "Seismic Microzonation of Xi'an City" (Shaanxi Engineering Seismic Survey and Research Institute, 2011), and other projects have done a lot of work on the Lintong-chang'an fault. According to the analysis of previous data, Lintong Chang'an fault is a late Pleistocene active fault, which may pass through the Moling temple depot of Lintong line of Xi'an rapid rail transit. In order to further understand the location of the fault crossing the line and the fault activity characteristics, based on the collected data, this paper adopts the methods of high-density electrical prospecting and shallow seismic exploration to carry out detailed exploration of Lintong Chang'an fault in the site area, so as to accurately determine the intersection position of the fault and the site area, and provide the basis for the engineering seismic work of the line.

2 Project overview and distribution of active faults in the project site

The starting point of the Lintong Line of Xi'an City Rapid Rail Transit is located at Textile City station which is the terminal of Xi'an Metro Line 1, and the terminal is located at Lintong Qinhan Avenue. The line passes through Baqiao district, Lintong National tourism and leisure resort in Qujiang, and Lintong district, with a total length of about 25.919 kilometers (Figure 1). It is a major lifeline project with large investment and high safety requirements.

Figure 1. Main active faults in the engineering site

Figure 1 shows the distribution of major active faults in the site of Lintong Line of Xi'an Rapid Rail Transit. It can be seen from Figure 1 that the main active faults in

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the site are the the Lintong-Chang'an fault and Lishan piedmont fault. For the Lishan piedmont fault, predecessors have done a lot of work (Zhang Anliang, 1988; Xu Liangxin, 2019), which can basically determine the distribution and activity of the fault in the site area. This paper focuses on the exploration of Lintong Chang'an fault.

3 Investigation of Lintong -Chang'an fault

It can be seen from Figure 1 that Lintong Chang'an fault may pass through moling temple depot of Lintong line. Therefore, in order to find out whether Lintong Chang'an fault passes through the site, shallow seismic exploration and high-density electrical prospecting were carried out along the site. Because the general strike of Lintong Chang'an fault is NE, we have set up a high-density electrical profile (DF1-1') and a shallow seismic profile (DZ1-1') along NW direction, with length of 1134m and 2500m respectively. The survey work layout and fault distribution are shown in Figure 2.

Figure 2 The survey work layout and fault distribution

3.1 High-density electrical exploration and its results

In this work, the high-density electrical prospecting was firstly carried out. The ρ_s contour profile and image analysis of the survey line DF1-1' is shown in Fig.3. From the analysis of the image chart, the apparent resistivity curves are basically layered, the apparent

resistivity of the survey line increases gradually in the range of sounding, and the apparent resistivity varies from 0 to 1800 $\Omega \cdot m$. From south to north, there is obvious high resistivity anomaly near 570m, which tends to NW. The resistivity on the left side of the anomaly is between 0-1000 $\Omega \cdot m$ and that on the right side is between 0-450 $\Omega \cdot m$, which indicates that there are obvious differences between the strata on both sides of the survey line.

Figure 3 Interpretation of high-density electrical exploration

3.2 Shallow seismic exploration and its results

Figure 4 shows the interpretation of the shallow seismic line DZ1-1'. It can be seen from the figure that the reflected wave group has rich information, with a high signal-to-noise ratio, clear wave group characteristics and good continuity. The wave impedance at the interface of the in-phase axis is not much different, and their respective characteristics are not obvious, but the overall occurrence state of the stratum is clear. The interpretation

of the DZ1-1' section shows that there is a fault anomaly. The upper breakpoint of the abnormal position extends to the ground at 3420m, and the fault dip is NW. It is a normal fault. The upper breakpoint of the fault extends to 50m above the ground. Combined with the fault outcrop and trench profile found in the project of "Seismic Microzonation of Xi'an City" (Shaanxi Engineering Seismic Survey and Research Institute, 2011), it is considered that the buried depth of the upper breakpoint of Lintong Chang'an fault is within 5m from the ground.

Figure 4 DZ1-1' shallow seismic time profile interpretation diagram

4 Conclusion

The high-density resistivity method has obvious high resistivity anomaly in the middle path of the depot from the south to the north of 570m, and the resistivity on both sides changes greatly, which reflects the obvious difference of strata on both sides of the survey line and the existence of fault anomaly. Shallow earthquakes also have fault anomalies in the southwest of this point, with the trend of NW. The connecting line of the two abnormal points is NE trending, which is basically consistent with the occurrence of Lintong Chang'an fault. Combined with the surrounding landform and other geological data, it is speculated that Lintong Chang'an fault passes through Moling temple depot. The latest active age of the fault is late Pleistocene. It is suggested that the influence of the ground surface dislocations should be considered during designing the route.

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