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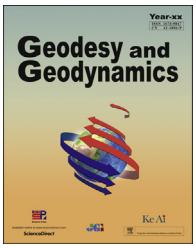

Seismogenic structure of the 2016 Ms6.4 Menyuan earthquake and its effect on the Tianzhu seismic gap

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ABSTRACT

On January 21, 2016, a strong earthquake with a magnitude of Ms6.4 occurred at Menyuan, Qinghai Province of China. In almost the same region, there was another strong earthquake happened in 1986, with similar magnitude and focal mechanism. Based on comprehensive analysis of regional active faults, focal mechanism solutions, precise locations of aftershocks, as well as GPS crustal deformation, we inferred that the Lenglongling active fault dips NE rather than SW as suggested by previous studies. Considering the facts that the 2016 and 1986 Ms6.4 Menyuan earthquakes are closely located with similar focal mechanisms, both of the quakes are on the north side of the Lenglongling Fault and adjacent to the fault, and the fault is dipping NE direction, we suggest that the fault should be the seismogenic structure of the two events. The Lenglongling Fault, as the western segment of the well-known Tianzhu seismic gap in the Qilian-Haiyuan active fault system, is in a relatively active state with frequent earthquakes in recent years, implying a high level of strain accumulation and a high potential of major event. It is also possible that the Lenglongling Fault and its adjacent fault, the Jinqianghe Fault in the Tianzhu seismic gap, are rupturing simultaneously in the future.

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1. Introduction

On 21 January 2016, an earthquake with the magnitude of Ms6.4 occurred in Menyuan County, Qinghai Province of China. According to China Seismic Network Center (CENC), the epicenter of the earthquake is at 37.68°N, 101.62E° (Fig. 1b), with a focal depth of about 10 km. Field investigations revealed that the intensity of the meizoseismal area is VIII degree. The whole Qinghai Province, as well as some places in Gansu Province, such as Lanzhou, Wuwei, Zhangye, and Jinchang have been shaken by the quake to varied degrees. The long-axis of the isoseismal lines is NWW (http://news.ceic.ac.cn/CC20160121011313.html), in agreement with the strikes of a series of sub-parallel faults such as the Lenglongling, Menyuan, Minle-Damaying, and Huangcheng-Shuangta faults [1]. As the event took place in a sparsely populated area, no serious casualties and property loss were reported. However, it caught the attention of the seismological society because there was another Ms6.4 earthquake happened in 1986 at almost the same place with similar focal mechanism. Besides, there were many middle-sized events, such as 1991 Ms5.1 and 2013 Ms5.3 earthquakes, occurred around the same area. Considering that all these events are close to the Lenglongling active fault, which is part of the well-known Tianzhu seismic gap [2,3], people are increasing their concerns about the potential great earthquakes in the gap. To clarify the relationship between the 2016 Ms6.4 Menyuan earthquake and the Lenglongling Fault is of great significance for understanding the mechanism of recurrence of the earthquakes and assessing the seismic risk of this region. In this work, we based on the data of regional active faults, focal mechanism solutions, precise locations of aftershocks, as well as GPS crustal deformation to explore the seismogenic structure of the 2016 Ms6.4 Menyuan earthquake, and further discuss the future tendency of strong earthquakes in the Tianzhu seismic gap.

2. Tectonic setting

The 2016 Ms6.4 Menyuan earthquake took place in the North Qilian fold zone of the northeastern margin of the Tibetan Plateau. Its north side of the seismogenic region is the Hexi corridor transition belt, and the south side is the Middle Qilian uplift zone. In a range of 50 km surrounding the epicenter, there are series of NW-NWW trending active faults (Figs. 1b and 2), which are Minle-Damaying, Huangcheng-Shuangta, Lenglongling and Menyuan faults from north to south. Of them, the Minle-Damaying Fault is a thrust fault and used to be active in Late Pleistocene, dipping SW linking the west end of the Huangcheng-Shuangta Fault in a left-stepping manner. No historical earthquakes were documented in relation with this fault. The Huangcheng-Shuangta Fault, with a length of about 120 km, dips SW, dominated by thrust with a sinistral-slip component [1], which is considered to be responsible for the 1927 Gulang M8.0 earthquake [4–6]. The

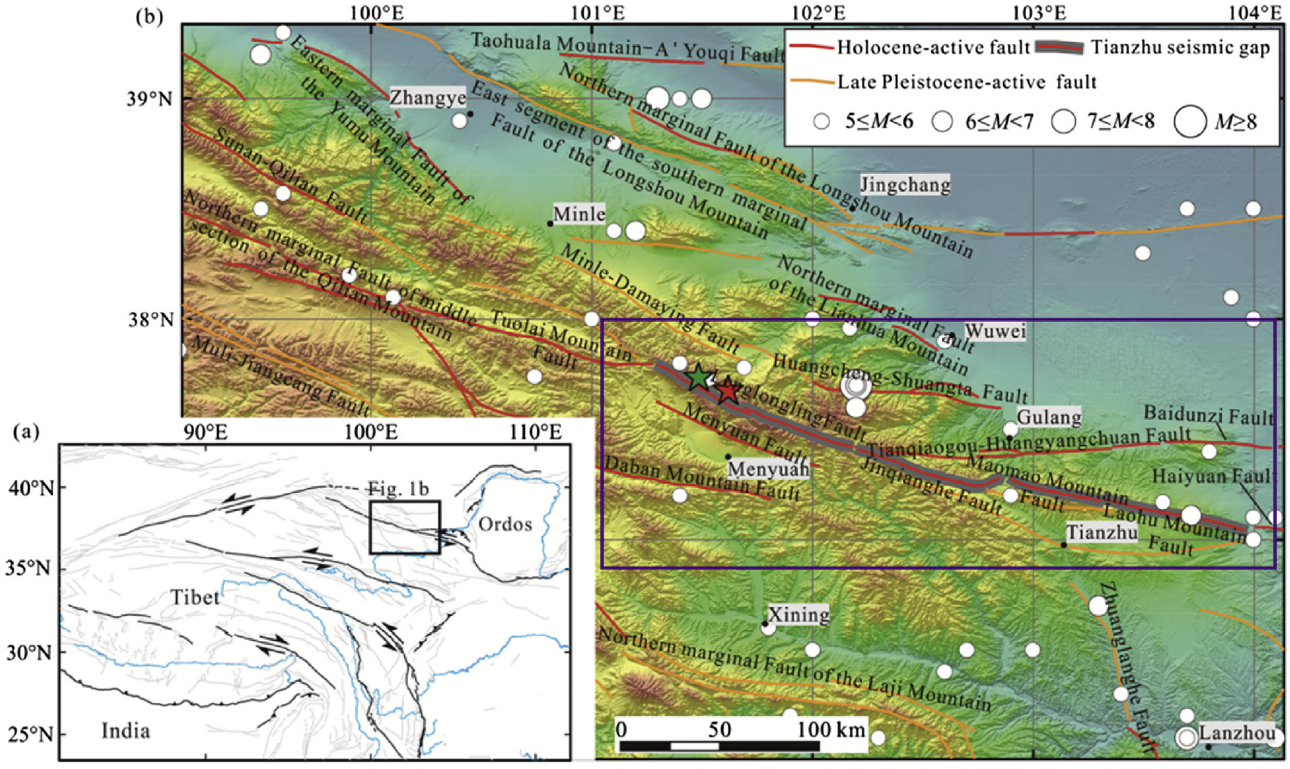

Fig. 1 – Maps (a,b) showing the seismotectonics around the epicenter of the 2016 Ms6.4 Menyuan earthquake. The red star indicates the epicenter of the 2016 Menyuan Ms6.4 earthquake, and the green star, the 1986 Ms6.4 Menyuan earthquake (from USGS); the purple rectangle, the study area of Fig. 2a.