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Research Advances

New Discovery of Holocene Activity along the Weixi-Qiaohou Fault in Southeastern Margin of the Tibetan Plateau and its Neotectonic Significance

CHANG Zufeng *, ZANG Yang and CHANG Hao

Yunnan Earthquake Agency, Kunming, 650224, China

Objective

The lateral extrusion eastward of the Tibetan Plateau leads to the formation of the Sichuan–Yunnan block, which is the most representative active block in the southeastern margin of the Tibetan Plateau, characterized by strong and frequent seismicity (Li Ping et al., 1975; Zhang Peizhen et al., 2003; Li Yong et al., 2017). Its eastern boundary is composed of sinistral faults including the Xianshuihe, Xiaojiang faults, etc., and the western boundary consists of the dextral Red River and Jinsha River faults, etc.. The Jinsha River fault has been a multiple active suture, the northern reach of which is regarded as being active from Pleistocene to Holocene. Locating at the western edge of Sichuan–Yunnan block as well, The Weixi–Qiaohou fault connects both with the Red river fault in south and the Jinsha River fault in north, respectively. Does it have a similar active characteristic to these two faults? Is it a significant boundary component of Sichuan–Yunnan block? Comprehensive research on these issues will have important theoretical and practical significances for further understanding the tectonic deformation mechanism and evolution process of the block margin.

Methods

On the basis of interpretation of satellite images and aerial photographs, we systematically studied the late Quaternary activity, latest active time, slip rate of the Weixi–Qiaohou fault, and carried out the 280-km-long 1:50000 active fault mapping by geotechnical means of careful geomorphic investigation, trench excavation and chronological dating. Totally 100 samples were dated, including 40 optically stimulated luminescence (OSL) samples and up to 60 radio carbon (AMS) samples.

Results

The active tectonic geomorphology at Yushichang is remarkable, develops a clear valley in the slope and a fault scarp with a height of 2–3 m. The trench nearby the scarp reveals five faults. Among them, the two faults of F_1 and F_2 have offset layer ⑤ gray-white clay with gravels and layer ④ black peat clay, ^{14}C ages of layer ⑤ and lower part of layer ④ are dated as (1490±30) a. B. P. (C70) and (1390±30) a.B.P. (C72), respectively. Faults of F_3 and F_4 have displaced layer ⑤, layer ④, and layer ③ yellowish brown clay with sands, which have been covered by layer ① brown modern soil that has no tectonic deformation. Between the F_3 and F_4, an earthquake wedge developed, which filled with the layer ③ (Fig. 1a and 1b). The ^{14}C age of the upper part of layer ④ is (1190±30) a. B.P. (C69), the dating age (OSL) of layer ③ is (0.6±0.2) ka (OSL70). The F_5 fault has displaced layer ⑤. All these evidently indicate that the latest active time of the faults are in late Holocene, meanwhile, three earthquake events may be here inferred from the relationships of the strata offset and dating data**.** The first event is presented by F_5, the second may be expressed by F_1 and F_2, and the third is manifested by F_3 and F_4.

The trench across a fault scarp at Desheng village reveals that three faults have dislocated terrace strata of Holocene. The top part of strata offset is dated as (200±30) a.B.P., parts of strata offset in depth of 1.2m, 1.5m and 4.5m are dated as (1780±20) a.B.P., (1905±20) a.B.P and (2045±20) a.B.P. by radio carbon dating, respectively.

In addition, several faults, earthquake wedge and diastrophic layers are discovered inside the trench at Gaichang. The deposit layers both sides of the wedge are offset apparently, with a most displacement up to 35 centimeter. Dating ages of offset layer are (36900±350) a.B.P. and (28330±160) a.B.P., suggesting there has been a paleoearthquake here between 36900 a.B.P. and 28330 a.B.P..

In tectonic landforms, synchronous right-lateral dislocation of mountain ridges and rivers are showed along the fault trace, for example, three ridges are offset synchronously around 15~20m by the fault at Yushuiping. It is estimated the fault has an average rate of 1.8–2.4 mm/

* Corresponding author. E-mail: zufch@163.com

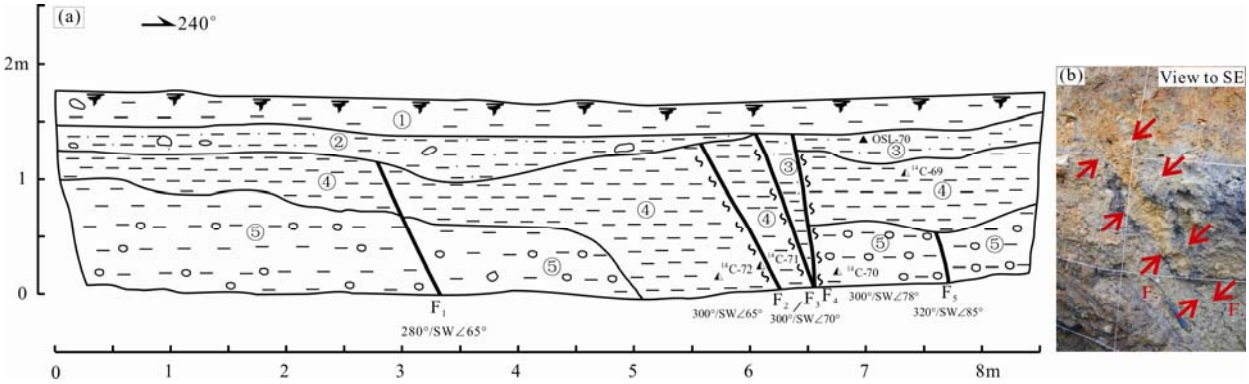

Fig. 1. Section of SE wall of the trench at Yushichang.
①,Brown modern soil; ②,Gray-black, yellow clay with sands and gravels; ③,Yellowish brown clay with sands; ④,Black peat clay; ⑤,Gray-white clay with gravels.

yr. horizontally and 0.3–0.35mm/yr. vertically since late Pleistocene, based on displaced magnitudes of the alluvial fans and river terraces and dating ages.

The Xuelongshan ductile shear zone has developed in northern segment of the Weixi–Qiaohou fault, together with other ductile shear zones in Ailaoshan, Diancangshan and Day Nui Con Voi of Vietnam, constituting a 1000-km -long large ductile shear zone, which is the boundary of southeast movement of the Indosinian plate in early Cenozoic. Accordingly, the Weixi-Qiaohou fault has a close relation to the Red river fault tectonically. In late Quaternary, the Weixi-Qiaohou fault is dominated by right -lateral strike-slip, which is similar to those of the Red river and the Jinsha river faults. Thus, in terms of neotectonics, it should be the northern elongated segment of the Red river fault.

Conclusions

It is revealed that the Weixi–Qiaohou fault displaced Holocene accumulations revealed by trenches at Yushichang and Desheng, etc., displaying dextral strike-slip with an average rate of 1.8–2.4 mm/yr. horizontally and 0.3–0.35 mm/yr. vertically since late Pleistocene. The fault is regarded as the northward extension of the Red river fault, together with Red River and Jinsha River faults, constituting the western active boundary of Sichuan –Yunnan block.

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