

中國雲南省紅河斷裂帶南段的活動性與運動特徵

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摘要

在板塊邊界斷層上，長期的強震記錄有助於理解大地震的破裂行為及地震災害評估。然而，對於滑移速率較低的邊界斷層（如紅河斷層帶，Red River fault zone, RRFZ），大規模地震（ $M \geq 7$ ）的記錄極為罕見。紅河斷裂帶是標誌著揚子地台（或華南地塊）西南邊界的重要板塊邊界斷層。自西元 886 年有地震記錄以來，RRFZ 南段（包括越南境內的部分）未曾發生過 $M \geq 7$ 的大地震，僅在其北段記錄到 1652 年彌渡(Midu) $M7$ 地震及 1925 年大理(Dali) $M7$ 地震。目前對於 RRFZ 南段未來是否會發生大地震，或者它是否是一個具有長週期復發特徵的強震孕震帶仍存有爭議，部分原因是缺乏地質證據的約束。這一爭議嚴重限制了對 RRFZ 南段未來大地震的風險評估。

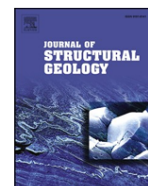
本研究透過高解析度遙測影像解釋，結合詳細的野外地質與地貌調查，在 RRFZ 南段的嘎沙（Gasha）至窯街（Yaojie）、元江（Yuanjiang）至河口（Hekou）區域發現了一系列斷層谷地及基岩露頭。透過多條槽溝開挖及放射性碳定年分析，我們確認 RRFZ 南段的中谷斷層是一條活動斷層。從嘎沙至窯街及元江至河口的地質與地貌證據表明，RRFZ 南段的中谷斷層表現出正斷層及右旋走滑運動特徵。這一結果與先前研究認為該斷層僅具有純走滑運動的結論不符。此外，在俄架地區開挖的槽溝顯示，RRFZ 南段的前緣斷層仍然處於活動狀態，與先前研究認為該斷層已停止活動的觀點不同。因此，應對 RRFZ 南段的地震災害風險應進行重新評估。

關鍵字：紅河斷裂帶、多條槽溝、正斷層與右旋走滑運動特徵、活動斷層。



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Activity and motion characteristics on the southern segment of the Red River fault zone, Yunnan province, China

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ABSTRACT

The longer time for recording large earthquakes on a plate boundary fault, the better that understanding of large earthquake rupture behavior and seismic hazard on the fault zone. However, large earthquakes ($M \geq 7$) are rarely recorded on the boundary fault with slow slipping rate, such as the Red River fault zone (RRFZ), which is an important plate boundary fault that marks the southwestern boundary of the Yangtze platform or south China block. There have been no large earthquake records on the southern segments (including the segment in Vietnam) of the RRFZ since historical earthquake records began in 886 AD, except the 1652 Midu $M 7$ earthquake and the 1925 Dali $M 7$ earthquake on the northern segment. The southern segment of the RRFZ will not have a large earthquake in the future or as a large earthquake seismogenic zone with a long period of recurrence, remains controversial, in part because of the absence of constraints from geological evidence. This controversial seriously restricts the risk assessment of future large earthquakes on the southern segment of the RRFZ. By careful interpretations of high resolution remote sensing images, in combination with a detailed field geological and geomorphic survey, we found a series of fault valleys and bedrock outcrops from Gasha to Yaojie and Yuanjiang to Hekou on the southern segment of the RRFZ. Multiple trench excavation and radiocarbon dating sample analyses show that the mid valley trace in the southern segment of the RRFZ is an active fault. Geological and geomorphic evidence from Gasha to Yaojie and Yuanjiang to Hekou indicate that the mid valley trace in the southern segment of the RRFZ exhibits dip slip and dextral strike slip motion characteristics. This result is inconsistent with those of previous studies that the mid valley trace is purely strike slip. Furthermore, trenches opened on the range front trace in the southern segment of the RRFZ in Ejia are found to still be active, differing from previous studies. Thus, the seismic hazard on the southern segment of the RRFZ should be reevaluated.