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Paleoseismic study of Milun fault activated by the 2018 Mw 6.4 Hualien earthquake rupture in Eastern Taiwan

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The active Milun Fault is the northernmost segment of the suture between Philippine Sea plate and Eurasian plate on the Taiwan Island. Historically, it was linked to two destructive earthquakes on October 22^{nd}, 1951, and February 6^{th}, 2018, respectively. The 1951 M_L7.3 earthquake and the 2018 M_W6.4 earthquake both produced surface ruptures along the Milun Fault, causing casualties and damage on buildings in the Hualien city, which is the most populated area in eastern Taiwan. Although the Milun Fault is surely intimidating, the subsurface configuration and history of this active fault remain little exposed. The purpose of this study is to uncover the fault at shallow depth, reason the activity and seismic history of the Milun Fault and estimate the recurrence interval. Two trenches along with four boreholes were carried out six months after the shock at the study site, located $\sim$ 2.6 km north of downtown Hualien, where surface ruptures were reported during the 2018 earthquake. The walls of one trench revealed a high dip angle of 80˚ to the east for the main fault of the Milun Fault and its branch faults dip 36˚, 56˚, and 70˚ to the east, respectively. The growth strata in the footwall of the branch faults were folded. Distinctive sedimentary features such as the colluvial-wedge deposits and soil liquefaction were also observed on the trench walls. By compiling the results of restoration and stripping of strata in conjunction with the age constraints, five paleo-earthquake events associated with the Milun Fault are resolved: (1) the 2018 event and the earlier ones occurred at (2) 380-0 yr BP (3) 686-380 yr BP (4) 2184-1396 yr BP (5) 3232-2630 yr BP. Although the recurrence interval was estimated as ca. 70 yrs earlier, our data suggest that the recurrence interval could be longer than previously expected. However, due to the limited records of stratigraphy and possible absence of paleo-earthquakes, further investigation will be needed to generate a more sophisticated estimate of the recurrence interval. In addition, based on the borehole data, the slip rate of the Milun fault is about 6.0 to 6.5 mm/yr within the past 5000 yrs. These new findings shall benefit the earthquake hazard assessment for the region.