

Prehistoric earthquakes along the Shanchiao fault, Taipei Basin, northern Taiwan

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Abstract

Stratigraphic relations recorded in boreholes drilled along the Shanchiao fault, a normal fault that bounds the western margin of metropolitan Taipei, reveal evidence of early–mid Holocene subsidence and active extension of the Taipei Basin. Paleoseismic data suggest that the maximum displacement for each subsidence event ranges from 2.3 to 4.5 m. Despite large uncertainties, the large offsets imply earthquake magnitudes that range in size from 6.9 to 7.1. Our results suggest that large magnitude earthquakes along the Shanchiao fault are one of the major seismic hazards in the metropolitan Taipei area.

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1. Introduction

The island of Taiwan is one of the most seismically active regions of the world. Numerous large magnitude earthquakes have produced surface ruptures in the last century, such as the M_w 7.6 1999 Chi-chi earthquake. This destructive earthquake has raised public awareness of seismic hazards in densely populated cities, in particular within the city of Taipei and surrounding metropolitan areas (Fig. 1).

With an unknown historic record of damaging earthquakes, the Shanchiao fault, a north–south trending normal fault, presents a poorly characterized earthquake hazard to Taipei. Similar to faults in other densely populated and urbanized basins, normal faults may pose greater hazards than much more distant plate boundary faults (McCalpin and Nishenko, 1996; Schwartz and Copersmith, 1984). According to the archives on seismological activity of Central Weather Bureau, a magnitude 5.5

earthquake occurred in April 1694 and likely produced a marine intrusion into Taipei Basin, which is the only record that demonstrates recent co-seismic subsidence in the Taipei area. Efforts to characterize earthquake hazards in Taipei Basin are hampered by the absence of key data, such as fault slip rates and repeat times between earthquakes. This investigation along the Shanchiao fault is the first to constrain the timing of Holocene earthquakes along the fault.

Seismologic studies in Taiwan have traditionally focused on reverse and strike-slip faults because most of the island is located along a convergent boundary (Fig. 1) that absorbs nearly 85% of the total relative convergence of 82 mm/yr between the Eurasian and Philippine Sea plates (Bos and Spakman, 2003; Yu et al., 1997). Recent geodetic studies indicate that the Taipei area is undergoing northwest–southeast extension at about 0.3–2.1 mm/yr (Yu et al., 1999a). This investigation of eight continuous borings across the Shanchiao fault is the first paleoseismic study in Taipei Basin to use sub-surface drill core data to provide long-term rates of earthquake occurrence (Fig. 2).

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