Evidence of Large Earthquakes on the Surigao Segment of the Philippine Fault Zone, Northeastern Mindanao, Philippines

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The 1,200-km-long Philippine fault zone (PFZ) is a major left-lateral strike-slip fault system that transects the whole Philippine archipelago from northwestern Luzon to southeastern Mindanao. It has generated destructive earthquakes with surface rupture in recent years such as the 1990 Luzon earthquake (Mw 7.7), 1973 Ragay Gulf earthquake (M 7.0) and 2003 Masbate earthquake (Ms 6.2).

A review of historical earthquakes on the southern extent of the PFZ in Eastern Mindanao revealed that surface ruptures have resulted from large magnitude earthquakes in the past. One such earthquake was the destructive 1879 Surigao earthquake (M7.4). Written historical accounts for this earthquake indicate that approximately half a meter drop was observed across the plains located south of Lake Mainit, Agusan Del Norte (Repetti, 1946). Several fissures which may have been related to surface fault rupture were also reported in this area. In this study, we have conducted aerial photo interpretation, field mapping and paleoseismic studies to determine the activity of this segment.

Aerial photograph interpretation and field mapping revealed recent tectonic landforms, such as offset streams and fault scarps with significant vertical displacement that may be related to the 1879 Surigao earthquake surface rupture. Field measurements of offset river terraces, that maybe related to the recent activity indicates horizontal displacement of 5.7 ± 1 m while vertical displacement of 0.5 m to 1.0 m was measured by fault scarp profiling. Trench excavation investigation in two sites also shows at least two and probably four seismic faulting events produced by this segment for the past 1,300 years.

Keywords: Philippine fault, paleoseismology, active tectonics

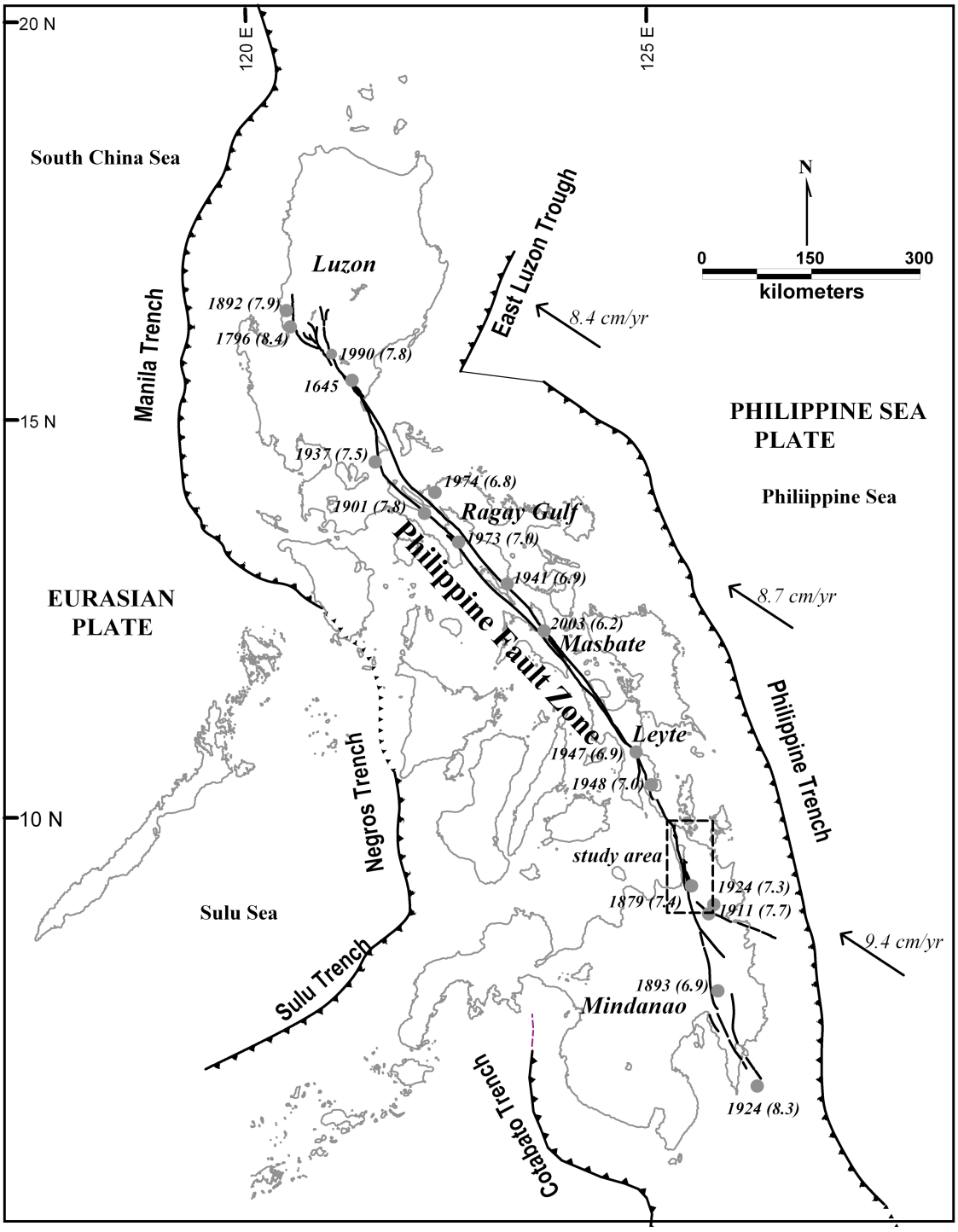

Figure: The Philippine fault zone (PFZ) and the study area. Gray circles indicate locations of large earthquakes along the PFZ.