

Boulder deposition of a seventeenth century tsunami on Penghu Islands, Taiwan

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Tsunami risks are widespread in the South China Sea and diverse in source origins from trench megathrust to intraplate earthquake or landslide and remain poorly understood, because historical and geological records are scarce. Cliff-top gravels and basalt boulders were identified on Penghu Islands in the Taiwan Strait in this study, presenting facies constraints on sediment transport, wave estimates from incipient motion formulas, and stratigraphic links to the probable sources. The boulders are supported by a pumice-bearing mud matrix that reflects a suspension-rich turbulent flow process and a rolling–saltation transport that are typically related to bore-like wave processes. Calibrating for ancient sea level height and 100 year surge indicates that the storm waves that are likely to form in the shallow interisland bathymetry only enable boulder sliding–rolling and are incapable of the 2.5 m high cliff-top deposition. The estimated minimum height of tsunami waves is also insufficient and needs to add to 3.2 m high for a minimum cliff-top overflow of 0.5 m depth for terminal rolling before deposition. Coeval gravels in two other outcrops also record the time and extent of tsunami deposition and are characterized by beach- derived bioclasts and stranded pumices, sharp base, matrix support, poor sorting, and elevation reaching above the 100 year surge. The gravels mark the local minimum wave run-ups and reach 2.4–4.0 m above sea level. The 1575–1706 radiocarbon age of the studied boulder suggests a probable tie to the disastrous 1661 earthquake in the SW Taiwan Orogen and the megathrust source in the northern Manila Trench.

Keywords: Tsunami boulder; Megathrust earthquake; Manila Trench; Seventh century; Penghu Islands