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Assessing the rate of post-depositional change within the 2004 Indian Ocean tsunami deposit: implications for long-term records of paleotsunamis

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Foraminifera are commonly used to examine patterns of tsunami inundation occurring over centennial to millennial timescales. However, the impacts of post-depositional change on geologic reconstructions is unknown. In tropical environments, the taphonomic character (i.e. test surface condition) of a foraminifer can deteriorate, rendering them unidentifiable, and in the worst case, dissolve them entirely. Here, we investigate the rates and extent of post-depositional change associated with the foraminiferal assemblages found within the 2004 Indian Ocean Tsunami (IOT) deposit over a 15-year time interval in Aceh, Indonesia from 2007 to 2019.

The IOT deposit consisted of a 13-18cm thick, medium-fine sand unit that sharply overlays a muddy sand contact. During the 15-year time series analysis, the IOT deposit remained a consistent thickness and maintained easily recognizable stratigraphical contacts between the overlying soil layer and the underlying mud layer. The overlying soil layer increased in thickness from 2cm in 2007 to 6cm in 2019 and resulted in roots bioturbating the IOT deposit. Calcareous taxa dominated the IOT deposit assemblage, where hyaline taxa accounted for 62% of the assemblage, porcelaneous taxa for 34% of the assemblage and agglutinated taxa for 4% of the assemblage. The concentration of calcareous foraminifera within the tsunami deposit decreased by 5% from 2007 to 2019. This trend is attributable to the high abundance of delicate porcelaneous tests, which are more susceptible to post-depositional processes than the more robust hyaline tests. The taphonomic character of the foraminiferal assemblage became more corraded (dissolved, abraded and/or pitted) over the 15-year period. The relative abundance of corraded individuals within the foraminiferal assemblage increased by 4% in the IOT deposit, to reach a relative abundance of 50% by 2019 compared to 46% in 2007. Our results indicate that there is minimal change occurring within the deposit and presents good evidence that microfossils can be used as reliable indictors of tsunami origin and to identify characteristics of a tsunami

deposit. While it is minimal, we recommend that post-depositional change should still be considered, especially with regards to the more delicate porcelaneous tests and over longer taphonomic timescales.