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Sedimentological Comparison of Recent Storm and Tsunami Deposits from the South-Eastern Coastline of India

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Storm and tsunami deposits have been identified and described from many siliciclastic coastlines globally, but detailed comparison of both known storm and tsunami deposits from the same coastlines are lacking. An opportunity to compare storm and tsunami sedimentary deposits was recognised following sediment deposition by Cyclone Thane (25th to 31st December 2011) that were superimposed on sediments deposited during the Indian Ocean Tsunami (26th December 2004) in a pit (DPM3a) near Cuddalore, on the south-eastern Indian coastline. A second pit, at Silver Beach (SB1) was located 2 km south of Pit DPM3a, was examined for comparison with Pit DPM3a.

Pit DPM3a contained four distinct units, an oldest intertidal unit, the 2004 Indian Ocean Tsunami, and a reworked aeolian sand that is capped by the Cyclone Thane deposit. Pit SB1 contained an oldest intertidal deposit, an estuarine beach and capped by the Cyclone Thane deposit. The identification of these units was verified from satellite imagery. The pits were examined at 1cm increments for grainsize and grain shape characteristics, loss on ignition, heavy mineral concentrations and microfossils. Representative samples from each unit were collected for detailed mineralogy analysis using X-ray Diffraction.

A suite of statistical analyses, including exploratory data analysis techniques, analysis of variance and principal component analysis (PCA) and discriminant function analysis (DFA) was used to compare the measured parameters and the individual deposits within and between pits DPM3a and SB1. Individual deposits showed significant differences in many of the parameters, but no individual variable was diagnostic of the deposits. PCA of Pit DPM3a suggested that the proportion of heavy minerals was the strongest parameter to distinguish the storm deposit from the tidal, aeolian and tsunami deposit, but that significant overlap between the deposits occurred. The application of DFA showed that in Pit DPM3a, the storm deposit could be distinguished from the tsunami, tidal and aeolian deposits. However, applying the same data analysed from Pit SB1 showed a marked difference in unit characteristics, highlighting that the discriminant function models can only be applied to the training dataset (Pit DPM3a) and cannot be applied to nearby sites (e.g. Pit SB1).