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Role of depositional environments in the preservation and detection of past tsunamis: lessons from 2004 Indian Ocean tsunami

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Reconstructing the tsunamigenic earthquake history of a region aids hazard assessment, and in the absence of written records, tsunami geology is the only tool to constrain the chronology and magnitudes of previous tsunamis to have affected a region. Observations along the Andaman-Nicobar Islands and the east coast of India suggest that distant and geomorphologically sheltered sites provide more conducive environments for tsunami deposition and preservation. The 2004 deposits from the Andaman Islands are mainly organic debris, sand sheets, coral debris and boulder deposits. The 2004 coseismic deformational features include uplift and subsidence of land as well as soil liquefaction. We use sites of tsunami deposits and deformational features to obtain evidence leading to past tsunamigenic earthquakes. The study spans latitudes from 7-14° N, from Campbell Bay to East Island. We classify the ages into three grades, A, B and C, based on the stratigraphic context of the deposit and the material and the age uncertainties. The earliest of the tsunamis occurred between 2nd and 6th centuries AD, evidenced by the coastal boulder beds of the southern Car Nicobar Island. A subsequent tsunami probably in the age range AD 770-1040 is inferred from both the Andaman and Nicobar Islands and on the Indian subcontinent. It is the strongest candidate for a 2004-caliber earthquake in the past 1500 years or more. The A&N Islands also contain tsunami deposits from AD 1250-1450 that probably matches those previously reported from Sumatra and Thailand. Evidence from what we consider as protected inland sites as well as coseismic deformation and liquefaction fall in the same age brackets as AD 1250-1450 from Indonesia, Thailand and AD 770-1040, from Indonesia, Sri Lanka and the east coast of India. By using deposits from the inland locations within the rupture as well as transoceanic sites, and other proxies dated in the same age bracket, we suggest that the ∼1000 year old earthquake best mimics the 2004 event in rupture characteristics and tsunami extent.