Paper Number: 1103

Tsunamigenic slope failures in the Pacific – an inconvenient truth

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Tsunamigenic Slope Failures (TSFs) are being increasingly recognised as an important source of tsunamis in the Pacific Basin (Figure 1). As such, their general omission from existing tsunami hazard assessments for Pacific Island Countries and Territories (PICTs) is a significant problem. TSFs can occur in many settings, but the flank collapse of oceanic volcanic edifices is a more credible mechanism than fault ruptures for the initiation of local (and possibly regional) tsunamis. While to many this may seem a contentious statement, its justification has been reinvigorated through a recent modification of Darwin's subsidence theory of atoll formation and the development of a unique range of multiple indicators that can be utilised for identifying the evidence of past tsunamis [1,2]. The issue is far more relevant in the Pacific Ocean than in the Atlantic. The reasoning is two-fold: there are well over 20000 islands scattered across the Pacific that are potentially affected by such events, whilst single island or low archipelago countries (e.g. Niue, Nauru, Tuvalu, Kiribati) are sufficiently vulnerable that a single TSF has the potential to destroy the bulk of their GDP, population and infrastructure.

Currently TSFs are most likely under-represented as sources in existing tsunami databases for two key reasons. First, relatively low magnitude earthquakes are often assigned as the tsunamigenic source as opposed to the TSFs they generate. Second, flank collapse of volcanic edifices is a largely unquantified threat for innumerable oceanic islands and seamounts. Even a cursory examination of available data indicates that 10s of thousands of slope failures probably exist, but the timing and tsunamigenic nature of such events remains unclear and much work is still needed to understand fully the magnitude and extent of TSFs within the Pacific. However, although it is now possible to model such TSFs, the lack of detailed bathymetry and landslide mass data is likely to constrain progress for the immediate future. The most logical way forward, therefore, is to use the multiple indicators available to us to distinguish evidence of past tsunamis. Indicators have both geological and archaeological components, including coastal megaclasts, oral traditions of vanished islands and giant waves, and the abandonment of prehistoric coastal sites. Some of these indicators are examined and the characteristics of several past events are discussed.

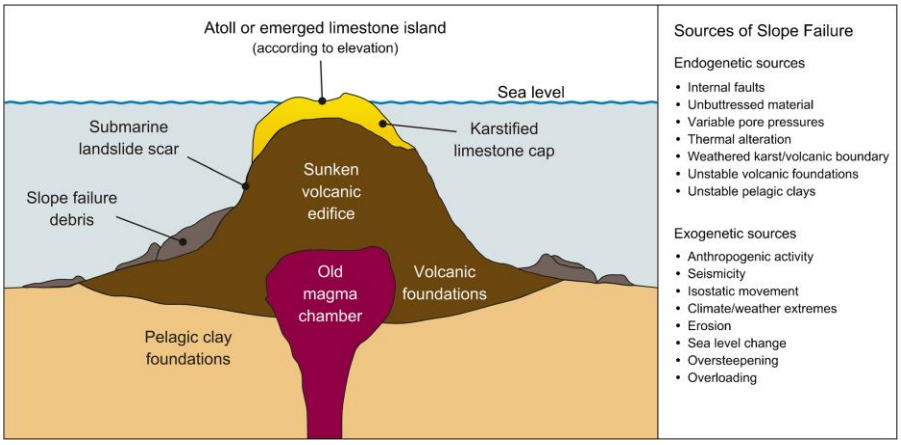

Figure 1: Volcanic islands and seamounts (with or without a carbonate cap) are vulnerable to collapse for a variety of reasons (listed right), producing submarine slope failures (as illustrated left) [1].

References:

[1] Goff J and Terry JP (in press) Landslides doi:10.1007/s10346-015-0649-3
[2] Terry JP and Goff J (2013) The Holocene 23:613-617