Palaeotsunamis and Ethnoarchaeological Enigmas in Samoa: Exploring the Associations

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Introduction and Background

Tsunami investigation is a fundamental component of coastal hazard mitigation and risk reduction. Recent history reveals that such hazards can influence rapid changes in global cultural dynamics through extensive loss of life (e.g. 2004 Indian Ocean Tsunami), lifeline destruction (e.g. 2011 Tohoku Tsunami) and property damage (e.g. 2014 Chile Tsunami), affecting the mobilization of regional and global humanitarian and financial resources.

The 2009 South Pacific Tsunami (2009 SPT) in the Samoan Islands, which had devastating local impacts, provided the opportunity to better understand tsunami characteristics and subsequent hazard potential in this region (Figure 1). Lessons were learned from the impacts of this event in the context of local and regional tsunami mitigation.
A tsunami and cyclone geochronological model spanning the last 3,000 years or so was developed. Estimation of tsunami frequency of similar or greater magnitude events than the 2009 SPT likely originating from the near-field Northern Tongan Subduction Arc (NTSA) source was also made possible. The results suggested a minimum 87 year recurrence interval of 2009 SPT-type tsunami intensities or stronger associated with a likely NTSA origin (Williams, 2014).
This paper assesses the contemporaneity between the prehistoric tsunamis (or palaeotsunamis) identified by Williams (2014), with anomalous and/or enigmatic sequences in the Samoan ethnoarchaeological record (e.g. Golsen, 1969; Davidson, 1979; Linnekin et al., 1995; Petchey, 2001; Martinsson-Wallin, 2007; Rieth and Addison, 2008; Rieth and Hunt, 2008; Martinsson-Wallin, 2011), as well as in the broader region (e.g. Allen and Wallace, 2007). The interpretation that contemporaneous ethnoarchaeological events provide likely indicators of the possible hazard extent associated with the identified tsunamis is made. Potential associations are discussed in the broader context of tsunami risk reduction in Samoa.

**Tsunamis in the Geologic Record**

Details associated with the development of the long-term tsunami chronology in the Samoan Islands are provided by Williams (2014), and are not repeated here. In summary, however, the apparent differences in the sedimentary and geochemical proxy patterns between the 2009 SPT, with the 1990/1991 Cyclones, provided an avenue to determine whether identified marine inundation deposits (MIDs) deeper in the geologic record at each site were more likely tsunami or cyclone in origin (Figure 1). That is, if an MID identified at a particular site showed a similar signature pattern to the 2009 SPT analogue, then it was more likely formed by a tsunami. The same logic applied to MIDs showing similar signature patterns to the 1990/1991 Cyclone analogues.

Geochronological indicators (e.g. palaeosols, shells, plant fragments, charcoal, wood), obtained from each site provided time-markers to estimate the probable timing of identified MIDs within their respective stratigraphies. Moreover, they provided an avenue for associating the timing of identified MIDs with historical tsunamis or cyclones (e.g. 1960 Chile Tsunami, 1917 Samoa-Tonga Tsunami, and the 1990 and 1991 Cyclones Ofa and Val, respectively).

Assessment of the contemporaneity of determined MID origins using available geochronological data between the different sites, facilitated the establishment of associated
MIDs which likely formed from the same event. This provided a means to understand the distribution of inundation locations (or impacts) associated with a single MID-forming event. Further, it enabled the placement of the 2009 SPT within the context of the longer-term geological hazard for this region. In turn, this provided a relative control on interpreting the likely magnitudes of individual MID-forming events, as well as likely tsunami frequency associated with known, or inferred, tsunamigenic sources.

The focus of this paper, however, is not on the development of the Samoan tsunami chronology. The emphasis here is on the contemporaneity of the identified palaeotsunamis (prehistoric tsunamis) with ethnoarchaeological events in the Samoan Islands. This provides the opportunity to identify anomalous or enigmatic trends in the cultural chronology that may be associated with the identified palaeotsunamis (Figure 2). Further, it provides a means to hypothesize the influence that these palaeotsunamis may have had on impacted coastal settlements, thereby enabling possible estimations on the long-term tsunami hazard and risk in this region.

Ethnoarchaeological Associations

The 2009 SPT not only provided the opportunity to understand tsunami signatures in the Samoan Islands, it also offered a modern analogue of the hazard associated with prehistoric events of similar and greater magnitudes. For example, families in vulnerable areas impacted by the 2009 SPT were displaced, and for the case of Saleapaga village on the southeast Upolu coast, around 90% of the entire village was abandoned in favour of the safety offered inland (F. Nelson, pers. comm., 2014). This was largely due to associated property destruction as well as the uncertainty of subsequent tsunami impacting in the immediate future. Almost five years after the 2009 SPT, many families have resettled their temporarily abandoned coastal properties. However, more than 70% of the original pre-2009 SPT inhabitants of Saleapaga remain inland (F. Nelson, pers. comm., 2014).
Interestingly, similar abandonments have been recorded in the archaeological record (e.g. Davidson, 1979). Further, the timing of some of the interpreted abandonments appears to coincide with the timing of identified palaeotsunamis. For example, archaeological findings at Mulifanua on west Upolu led to the suggestion that settlements in the area are thought to have been abandoned in 18-C (AD 1700s). This corresponds to the AD 1650 – 1830 tsunami identified by Williams (2014). Moreover, the existence of stronger MID signatures most likely associated with this palaeotsunami suggests that it may have been more intense than the 2009 SPT.

Similar archaeological enigmas possibly associated with the AD 1650 – 1830 tsunami reported in Davidson (1979) include:

The abundant archaeological evidence that mid 19-C (mid AD 1800s) coastal population concentration in Samoa was a response to the beginning of European contact, and the abandonment of inland areas in favour of the coast during this period was rapid (Davidson, 1979: 96).

In Lalomanu village on southeast Upolu (south of Satitoa), 13 star mounds (settlement remains) found in the remote bush adjacent to extensive abandoned settlement areas closer to the coast (Davidson, 1979: 97). This likely suggests a similar pattern with the modern 2009 SPT hazard analogue at Saleapaga.

The appearance of large earthen mounds associated with a despotic chief around 17-C (AD 1600s) at Vailele village on north Upolu (east of neighbouring Fagali‘i) extending some distance inland (Davidson, 1979: 98). The coincidence in the timing of such structures could perhaps suggest a form of traditional tsunami mitigation, although such speculation is premature at this stage.

Other clues in the ethno-archaeological record likely associated with the AD 1650 – 1830 tsunami include evidence of inland cave dwellings (Seuao cave) around c. 240 ± 50 BP (AD 1660 – 1760) near Sa’anapu on southwest Upolu (Golson, 1969:19; Martinsson-Wallin,
Similarly, genealogical evidence of occupation exists at the Pulemelei stone mound inland of Satupaitea around AD 1650 (Martinsson-Wallin, 2011:106) (Figure 2). Both cases could suggest a possible correlation with the pattern of abandonment at Saleapaga following the 2009 SPT.

The AD 1145 – 1490 tsunami is also contemporaneous with initial occupancy at the Pulemelei stone mound around AD 1111 – 1311 (Martinsson-Wallin 2007:105). This mound is the largest known human-built structure in prehistoric Polynesia, and lies several kilometers inland of Satupaitea. Similar to the case at Fale o le Fe’ e, it is possible that initial inhabitant desire to expand or move inland from the coast during this period, is associated with a potential AD 1145 – 1490 tsunami.

The timing of this tsunami also coincides with the emergence of cannibalism in Samoa (Davidson, 1979:101), which appears to have been around AD 1130 – 1335. Evidence for this cannibalism was found at the coast of Lotofaga on southeast Upolu, and also coincided with the timing at which the area first became habitable. The reason for the area becoming habitable was interpreted by Davidson (1979:101) to be the result of shoreline changes around AD 579 – 1179. It is possible that both of these coincidences at Lotofaga are associated with a potential AD 1145 – 1490 tsunami influence.

Ethno-historically, this tsunami also coincides with the emergence of the Malietoa paramount matai (chief) lineage around AD 1250 (Linnekin et al, 1995). This title emerged following the demise of the likely 300 year Tui-Tonga rule of parts of Samoa, which is thought to have predominantly been on southern Samoan areas. The timing of this sequence of cultural events suggests a possible correlation with an AD 1145 – 1490 tsunami influence. The predominant location of the so called Tongan occupation of southern Samoan areas, relative to the location of the NTSA, possibly suggests an NTSA source for the AD 1145 – 1490 tsunami. Further, it could also imply an associated tsunami influence on the Tui-Tonga weakening, vulnerability, and subsequent defeat following a 300 year rule.
Interestingly, this tsunami is also contemporaneous with interpreted repeated coastal settlement disruptions by major coastal inundations in the Cook Islands around AD 1220 – 1440 (Allen and Wallace, 2007:1167). It is possible that one of the coastal inundations is associated with the AD 1145 – 1490 tsunami in Samoa, which would further imply that this tsunami may have had far-reaching regional impacts.

The AD 520 – 945 and AD 260 – 520 tsunamis coincide with the timing of the Samoan archaeological Dark Ages around AD 500 - 1000 (Reith and Addison, 2008). The Dark Ages in Samoa refer to a period with a dearth of pottery-bearing cultural deposits. It is possible that there is some connection between this enigma and the associated contemporaneous palaeotsunamis identified (Figure 2).

Possible connections also exist between the two tsunamis between BC 1365 – 700, with earliest colonisation of Samoa around 2,900 – 2,600 BP (Petchey, 2001). These palaeotsunamis coincide with a relatively quick change (1 – 2 centuries after initial colonization) in the style of pottery making in Samoa (from Lapita dentate to local variants of plainware techniques), around BC 850 – 450 (Reith and Hunt, 2008). It is possible that the associated palaeotsunamis may have played a role in influencing such cultural changes (e.g. through sudden loss of life of pottery-making knowledge holders). However, further investigation is required to test such a correlation.

The discussions presented here suggest possibilities on the associations between palaeotsunamis in Samoa with contemporaneous anomalies and/or enigmas in the Samoan ethnoarchaeological record. If correct these would imply an approximate 3,000 year tsunami hazard history in Samoa.
However, unlike the 2009 SPT hazard analogue at Saleapaga, local and international humanitarian aid experienced during response to and recovery from this tsunami cannot be assumed to have occurred following similar or stronger palaeo-events within the deeper Samoan history. That is, modern frameworks of centralized government, emergency deployment, and international humanitarian support including financial aid, are not comparable to prehistoric disaster recovery and mitigation arrangements.

Therefore past tsunami of similar or greater impact-magnitude than the 2009 SPT may have played a major role in influencing longer coastal abandonments, as well as alternative cultural settlement dynamics and manifestations (e.g. cannibalism). Such observations in the ethno-archaeological record are recognized in contemporaneity with associated palaeotsunamis in the Samoan geologic record.

**Summary and Conclusions**

No definitive cause-effect hazard relationships can be presently established between the palaeotsunamis identified by Williams (2014), with anomalous and/or enigmatic sequences in the Samoan ethnoarchaeological record. Contemporaneous associations between the two chronologies, however, do provide the possibility that such relationships may exist. Further investigation is required to draw more definitive conclusions. Based on the evidence discussed here, the interpretation is made that likely associations do exist, implying that the identified palaeotsunamis were most likely hazardous.

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References


