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Natural Hazards and Earth System Sciences

Benefitting from differences in knowledge, practice and belief: Māori oral traditions and natural hazards science

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Abstract. This paper builds upon earlier work that argued the information and experience contained within the knowledge-practice-belief complex of *Mātauranga Māori* [Māori knowledge] is a valuable and neglected area of information and understanding about past catastrophic events in Aotearoa/New Zealand (A/NZ). Here we map Māori oral traditions (*pūrākau*) that relate experience with extreme environmental disturbance (in particular, tsunamis) around the A/NZ coast, compare the findings with geo-archaeological evidence, and discuss the scientific benefits to be gained by considering *pūrākau* as legitimate perspectives on history. Not surprisingly, there are both differences and complementarities between traditional Māori narratives and the available geo-archaeological evidence on extreme coastal disturbances. The findings presented here raise new and important questions about accepted geographies of tsunami risk, the causes and sources of their generation, as well as reasons for the relative paucity and abundance of information in some regions. Ways in which *Mātauranga Taiao* [Māori environmental knowledge] and contemporary science can be combined to produce new narratives about extreme environmental disturbance along the A/NZ coastline will require not only acceptance of other ways of knowing but also open engagement with Māori that respects their rights to tell their own histories. These efforts are encouraged to revitalise and ground-truth the interpretation of traditional stories, corroborate and/or question previous scientific deductions, and improve our collective understanding of the recurring impact of tectonic, geologic and meteorological-based events across A/NZ.

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Rāpopotonga

He mea hāngai anō tēnei pepa ki ētahi o mua, ki taua tohe anō ko ngā wheako mai i te pūnahatanga o ngā tikanga o te Mātauranga Māori he mea whaimana, he aha koa tē arongia ai, he whai mōhiohio hoki i ngā parekura i pā mai ki Aotearoa. Ko tā mātou he whakaatu i ngā pūrākau i reira ētahi whakapuakitanga o ngā pānga mai o ngā ngaringari nui ā-taiao (he oti rā te pāhoro ngaru moana) i pā mai ki te tākutai moana o Aotearoa, he whakarite ki ngā kitenga mai i ngā taunakitanga ā-huakanga whenua, me te whakawhitiwhiti whakaaro i ngā painga mai i te tirotiro i te pūrākau hei tirohanga tika i te hitori. Waihoki, mō ngā ngaringari whakaharahara ki te tākutai, he ōritenga, he rerekētanga anō nō waenga o ngā kōrero tuku iho me ngā taunakitanga ā-huakanga whenua. Mai i ngā kitenga, he uiui hōu anō ki ngā mātaiwhenua o te wā ki ngā mōrearea pāhoro ngaru moana, ngā mātāpuna me ngā pūtaketanga tae atu ki te nunui, te korekore rānei o ngā kōrero ki ngā takiwā. Mō te hono i te Mātauranga Māori me te pūtaiao o nāianei me te whakaputa kōrero hōu ki ngā ngaringari whakaharahara o te taiao ki te tākutai moana o Aotearoa, he tautoko rā anō i te pūnaha mātauranga rerekē, he mahitahi hoki me te Māori, mai i te aro tūturu ki tāna whakaatu i āna ake kōrero tuku iho. Me mea whakatūturu te whakamāoritanga o ngā pūrākau, mā te tautoko rānei, mā te urupounamu rānei i ngā whakataunga pūtaiao, ka uta mai ai i reira he mea whakarei i ā tātou mōhio tahitanga ki ngā pānga auau o ngā take nukupapa, pūtaiao-ā-nuku, tirorangi hoki.

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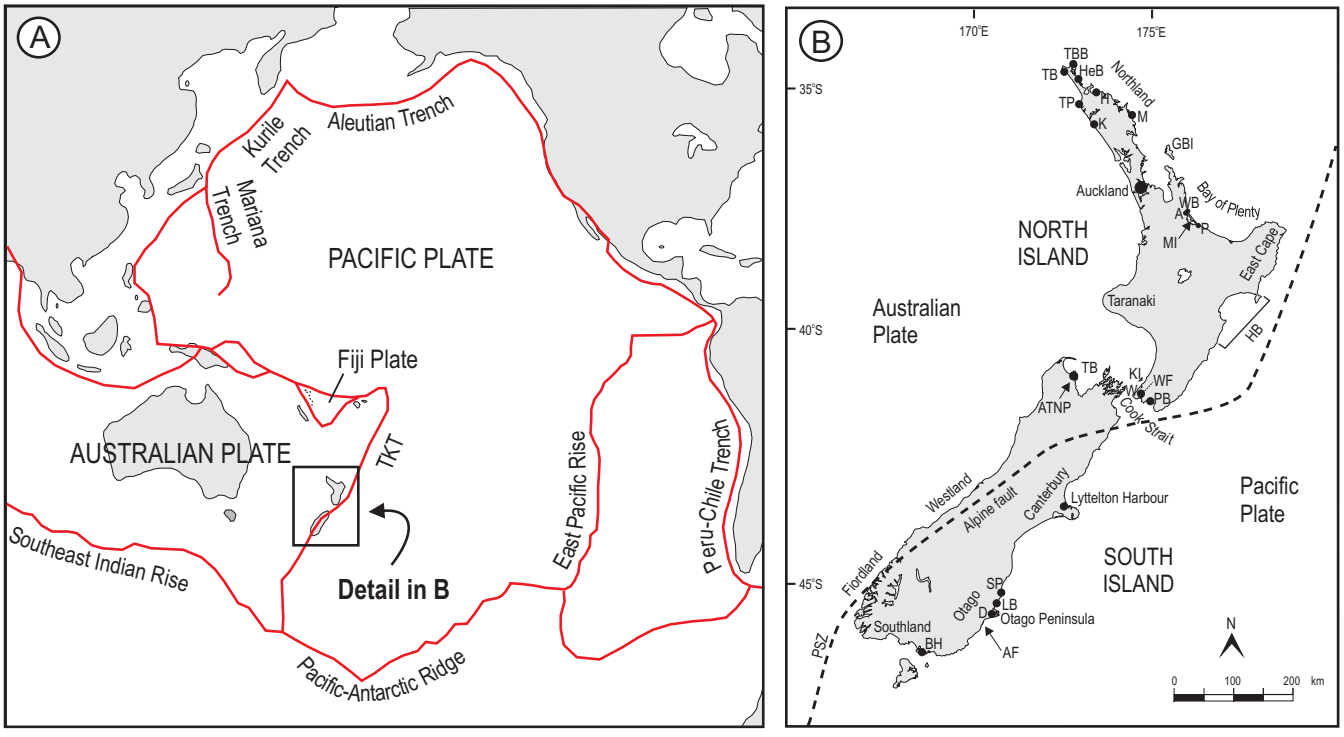

Fig. 1. **(A)** Aotearoa/New Zealand's tectonic location in the South Pacific with major plate boundaries shown in red (TKT = Tonga Kermadec Trench); **(B)** Map of Aotearoa/New Zealand with locations mentioned in the text (A = Athenree, ATNP = Abel Tasman National Park, AF = Akatore fault, BH = Bluff harbour, D = Dunedin, GBI = Great Barrier Island, H = Hihi, HB = Hawke's Bay, HeB = Henderson Bay, K = Kawerua, KI = Kapiti Island, LB = Long Beach, M = Mimiwhangata, MI = Matakana Island, P = Papamoa, PB = Palliser Bay, PSZ = Puysegur Subduction Zone, SP = Shag Point, TB = Tasman Bay, TP = Tauroa Point, TB = Twilight Beach, TBB = Tom Bowling Bay, W = Wellington, WB = Waihi Beach, WF = Wellington fault). The dashed line represents the approximate boundary between the Australian and Pacific Plates (the Hikurangi Trough to the NE, The Puysegur Subduction Zone to the SW).

1 Introduction

The recognition of the existence and the value of indigenous knowledge of extreme events is not new. French explorer Jean-François de Galoup, Comte de la Pérouse visited Lituya Bay, Alaska, on 2 July 1786 and during his encounters with the local Tlingit people he learned of an oral tradition which told of a monster that dwelt in the bay. The monster would periodically "destroy all who entered his domain by grasping the surface of the water and shaking it as if it were a sheet" (Emmons, 1911, 294–298). On 9 July 1958, this traditional narrative was again brought to life, when a local, landslide-generated megatsunami, swept through the bay (Miller, 1960).

Oral traditions that relate experience with extreme environmental disturbance are part of the knowledge complex of many indigenous peoples, assisting with the transfer of culturally important knowledge from one generation to another, and providing mechanisms through which experience can be taught, memory retained and causes explained. In particular, Māori oral traditions (*pūrākau*) from Aotearoa/New Zealand (A/NZ) contain substantial evidence of extreme disturbances across local land and seascapes, including stories of major floods, landslides, volcanic eruptions, earthquakes and tsunamis. These narratives are derived from a history of geographically diverse Māori settlement in A/NZ spanning some 800 years (Howe, 2003; McFadgen, 2007; Wilmshurst et al., 2008), with subsequent European colonisation in the early 1800s. This human history exists against a background of active tectonism – with A/NZ situated astride the boundary between the Pacific and Australian Plates in the southwest Pacific Ocean (Fig. 1a and b). Geological processes have played an important role in shaping A/NZ, and their geophysical effects on the landscape are well-recognised for the recent past (Goff and McFadgen, 2002). The results of earthquakes and volcanism have ranged from barely detectable, to large-scale land and sea movements that destroyed towns/cities and caused widespread regional disruption (e.g. Grapes and Downes, 1997; Goff et al., 2003). A/NZ also lies close to key atmospheric circulation and ocean current boundaries. As such, it is noticeably affected by circulation anomalies such as the El Niño-Southern

Oscillation which can cause marked climatic and meteorological extremes (Gordon, 1986; Kidson, 2000). For most of the last millennium in A/NZ records of landscape disturbance and change derive from Māori oral histories and traditions and palaeo-environmental reconstructions.

It is recognised that knowledge sharing through *pūrākau* is increasingly at risk, even fragmented, as respected elders with strong links to the past are lost each year, and contemporary living arrangements find many Māori disconnected from traditional lands, resources and social networks (Barlow, 1994). Further, in many instances, attempts to share information are complicated by a "disconnect" between Māori and non-Māori populations. At the same time, despite a growing body of data from geological and archaeological studies, tsunami research in A/NZ is still in its infancy, with much of the work conducted to date based on random site selection and geomorphological interpretations (McFadgen, 2007). The importance of these early developments is undeniable but there remain many questions and ambiguities about the timing, source and magnitude of many past events not to mention gaps in our knowledge of the exposure of human and natural systems to tsunami impacts.

Since both oral tradition and contemporary science have relevance to the understanding of natural hazards, there is an opportunity to advance our collective understanding of tsunami history (and processes) by learning from insights derived from these different knowledge systems. Key questions are now being asked about how oral traditions can contribute to documenting the varieties of historical understanding in areas of the world where written documents are either relatively recent or even absent (Berkes, 2007). Not surprisingly, indigenous environmental knowledge is increasingly being sought as the basis for thinking more laterally about our current understanding of the world (Smith, 2001).

This paper builds on a previous publication where the authors examined *Mātauranga Taiao* [Māori environmental knowledge] of a range of physical environmental hazards and proposed a list of contributions to natural hazards management and science (King et al., 2007). It concluded that the information contained within *Mātauranga Māori* [the wider Māori knowledge-practice-belief complex] is a valuable and neglected area of information and understanding about past catastrophic events in A/NZ. This paper builds upon that review by exploring Māori oral traditions (*pūrākau*) – derived entirely from written sources – that reference and/or relate experience with tsunami and/or storm surge along the A/NZ coast. These *pūrākau* are mapped and compared with contemporary scientific data to better understand the record of past tsunamis in A/NZ. We then consider *pūrākau* as legitimate perspectives on history and discuss the benefits to be gained by comparing and integrating the narratives of tsunami occurrence from different world views. Finally, we conclude by signalling future directions in this emerging research field. It is anticipated this approach will lead to improvements in our collective understanding of how recurring seismic events and tsunami impacts in A/NZ have affected the coastline over the last 1000 years.

2 Attending to the value inherent in oral traditions

This section, (i) reviews past work that has explored geophysical disturbances through indigenous oral traditions, and (ii) considers some features of these transmission devices (with a particular emphasis on written records) that can limit their meaning and use when removed from cultural contexts. We distinguish between oral history and oral tradition – the former of which, is based on first hand experience, contrasted with the latter, whereby oral narratives, accounts and messages are transmitted by subsequent generations (Vansina, 1985).

Many indigenous traditions provide accounts of extreme environmental disturbance (Blong, 1982; Heaton and Snavely, 1985; Clague, 1995; McMillan and Hutchinson, 2002; Cronin and Cashman, 2005; King et al., 2007); and these narratives are gaining increasing recognition from researchers in a variety of academic fields (Stevenson, 1996; Berkes, 2007). Blong (1982) examined in detail "the time of darkness" traditions of indigenous communities across Papua New Guinea. These traditions detailed a cataclysmic eruption that occurred ∼300 years ago. This study helped to understand the eruption, its magnitude and effects as well as the limitations and challenges associated with using oral traditions as historical evidence (e.g. event stylisation and embellishment). Shortly thereafter, Heaton and Snavely (1985) reviewed an indigenous "legend" (based on the early ethnographical writings of James Swan) of great sea-level disturbances along the Oregon, Washington and British Columbia coasts. The pair concluded that numerous details within the oral tradition are consistent with tsunami inundation processes (e.g. the sudden receding of coastal waters) but that the features described were questionable when compared with the scale of anything experienced in modern times. McMillan and Hutchinson (2002) subsequently reviewed a series of oral traditions from the northwestern United States which provided remarkable details about recurring Holocene seismic activity and impacts on human populations throughout the Cascade Ranges. They concluded that oral traditions provide important independent sources of information about past geological events that can compliment a growing body of data from geological and archaeological research. Meanwhile a number of native Hawaiian scholars are re-examining their own oral histories and traditions that relate an extended history of human exposure to tectonic and geologic hazards – including tsunamis. These developments are taking place against a back-drop of political and cultural re-affirmation (Lucas, 2004).

A number of recent studies have also identified how indigenous knowledge of extreme environmental disturbance can become a part of a shared learning effort to address natural hazards and associated risks. Cronin and Cashman (2005) focussed on the use of oral traditions for volcanic hazard assessment and mitigation in the Pacific Islands and North America. Their study determined that despite the challenges of working with oral traditions, the experiences contained within these stories are a valuable source of historic information that can be used to educate local people about their own hazard histories. Further, McFadgen (2007) collated geophysical evidence and indigenous narratives surrounding catastrophic disturbances of coastal environments in prehistoric A/NZ to improve understanding of the geographic distribution and impact of geologic events (earthquakes, eruptions and tsunamis) upon early Māori coastal communities. Drawing upon a wide field of information and experience (anthropology, archaeology, geology and geomorphology) his review determined that the fifteenth century in A/NZ was a period of enhanced disturbance marked by frequent seismic activity and increased tsunami occurrence. Later work by the authors reviewed written records, looking specifically at stories, songs, place names and narratives that related Māori experience with a range of physical natural hazards (King et al., 2007). This work concluded that Māori possess considerable "specific" knowledge (i.e. empirical or practical knowledge) of natural hazards and environmental change – referred to as *Mātauranga Taiao* – and that this archive of inter-generational experience (as well as contemporary practice) can contribute to natural hazards management and mitigation in A/NZ.

Importantly, *Mātauranga Taiao* is interconnected with the broader epistemological system of *Mātauranga Māori* which as Mead (2003, p. 306) states is "...like a tool for thinking, organising information, considering the ethics of knowledge, the appropriateness of it all and informing us about our world and our place in it". This complex of knowledge is underpinned by values, beliefs and cultural practice, and is not only "traditional" but also contemporary, merging knowledge passed down through generations with new experiences and understanding.

While there is a growing recognition among indigenous and non-indigenous scholars that oral traditions be taken seriously as legitimate perspectives on history, at the same time there are a number of research issues and associated ethical debates that concern the interpretation and use of traditional narratives to inform about indigenous social and environmental histories (Binney, 1987; Cruickshank, 1994; Smith, 2001; Berkes, 2008).

A common research challenge for the interpreters of oral history and tradition pertains to the reliability of the information. As Binney (1987) explains, the narrators (and writers) of history, regardless of where they come from, are not objective – nor neutral. Consequently, personal bias – whether intentional or not, will always reflect the priorities of the story teller, and therein influence their documentation and retelling of history and tradition. Further, Williams (2000) contends that it is not unusual for stories to be deliberately tailored to support specific agendas, and that stylisation and embellishment are often part of the story-tellers framing of events. Recognition of these realities and subsequent limitations underscores the need for care, cross-checks and ground-truthing to help establish the veracity of historical information contained within oral histories and traditions (Blong, 1982). Geographical landmarks and knowledge of the character of the supplier of information are equally important, particularly from the point of view of event timing. The counting of generations to an eponymous ancestor can help to establish time brackets for the occurrence of events. However, this approach is complicated by highly variable life expectancies, and the merging as well as replacement of events and characters, respectively, into single narratives (Binney, 1987; McMillan and Hutchinson, 2002). Although as Berkes points out "how people say things may be more important than what they say" (2008, p. 59).

While much of the early ethnographical collation and preserving of Māori oral histories and traditions (themselves based on oral transmissions) retain significant historical and cultural value, the roles of historical ethnographers in fragmenting and distorting indigenous stories are also recognised (Salmond, 1985; Binney, 1987; Williams, 2000). This issue led Phillips (2000) to coin the term "synthetic oral traditions" to describe popular reinterpretations of Māori oral traditions by historical ethnographers that are considered to be inaccurate. Further, as Smith (2001) writes, indigenous scholars have mounted a critique of the way history has been told from the perspective of the colonisers – and this has resulted in new debates over who controls the framing of indigenous existence, historical realities and cultural representations shown to the wider world, and for whom is the writing being done. Oral histories, traditions and knowledge have therefore become important symbols for many groups to regain some authority in the face of colonisation over their cultural information. Smith (2001, p. 28) states "Indigenous peoples want to tell their own stories, write their own versions, in our own ways, for our own purposes". In association with these developments in thought there are an increasing number of research projects driven and owned by indigenous peoples who construct and conduct their work in culturally grounded ways. Thoughtful reviews of the privileging of theory and issues of power and voice when indigenous history is reconstructed by outsiders are offered by Cruickshank (1994), Smith (2001), and Berkes (2008).

A further related debate centres on whether different knowledge systems can adequately be integrated to enable meaningful translation and transfer of knowledge from one tradition to another. Indigenous narratives are often embedded in complicated metaphors and supernatural stories

(although they are certainly not limited to this form), and contain explanations and reflexive meanings that define social order (family and genealogy) and human-nature relations (Smith, 2001; Mead, 2003; Masse et al., 2007). Without first-hand experience and understanding of the underpinning knowledge-practice-belief complex (Berkes, 2008) the potential for confusion and misunderstanding of meaning derived from these cultural devices is significant. As Binney (1987) explains the challenge for non-Māori is to understand that oral history and traditions provide more than just alternative sources or even alternative perspectives. Rather they have their own purposes, which may include the use of non-linear devices to establish meaning for discrete and repeated events through time.

Subsequently, we acknowledge Māori oral histories and traditions are far from limited to describing historical facts and that they can have multiple levels of meaning that sometimes will find analogue with (and even enrich) those generated by the academy of contemporary science. Caution should therefore be employed by anyone seeking to codify indigenous concepts and frames of meaning within oral tradition.

3 Māori experience with extreme environmental disturbance

The *pūrākau* discussed below are sourced entirely from an extensive review of historical and contemporary written sources (themselves based on oral transmissions), and represent only part of the wider library of Māori oral traditions that relate experiences with the A/NZ coastline. For those readers unfamiliar with Māori history, the origins and arrival times of the first Polynesian explorers to A/NZ continue to be the subject of scholarly enquiry (Sutton, 1994; Wilmhurst et al., 2008) and there are many aspects where much of the detail is speculative and contested (Maaka, 2003). Whatever the historical reality (the most often quoted arrival time in writing is ca. 800 years BP, Wilmhurst et al., 2008) the result was that the earliest ancestors of Māori would have found and settled a diversity of physical environments across the islands of A/NZ. Through time, these occupations would have led to the development of knowledge about place, natural resources and natural processes. Furthermore, some of these learnings would have been shared through interactions with other kin-groups; although it is also likely that some experience and knowledge [including that related to extreme events] would have been lost as certain groups were subjugated and usurped (Maaka, 2003). In spite of these challenges to historical knowledge transfer, and the fact that Māori had no written language prior to European settlement, the preserving and handing down of knowledge in strict and systematic ways also ensured that some experience and knowledge were maintained (Beattie, 1990). Subsequently, the colonisation of A/NZ through the nineteenth century was thereafter accompanied by a rapid documentation of Māori life and oral history by colonial ethnographers. And, despite many of the important issues identified in the previous section, much of this written history provides valuable insights into past characters, experiences and ideas. Notwithstanding the development and uptake of more modern forms of knowledge transfer by Māori, the oral transmission of *Mātauranga Taiao* for some *whānau/hapū/iwi* (family/sub-tribe/tribe) remains the principal way that some traditional and contemporary experience and understanding is transferred from one generation to another.

Although some of the *pūrākau* presented here might relate experiences with extreme storms and/or swells generated by low pressures and high winds far from shore, the repeated occurrence of major earthquakes shown in the geological record suggests that at least some of the *pūrākau* are likely reflecting the impact of tsunamis (McFadgen, 2007). Multiple accounts of events from the same area may indicate large scale disturbances, whereas geographically focussed *pūrākau* might be indicative of locally significant events. Further, the relating of experience with large waves suggests that these extremes were likely outside the range of normal events causing loss of life and/or extreme disturbance of the environment. Note that many of the contextual details within the selected *pūrākau* are not explored in depth in this paper. Rather our discrete interpretations are regarded as first-order only, designed to raise new questions for future enquiry that will eventually lead to new understandings of extreme environmental disturbance along the A/NZ coastline. As opposed to discussing all *pūrākau* reported in written sources, we focus on notable clusters of *pūrākau* in Taranaki, Cook Strait, the southern South Island, and the Bay of Plenty. All locations referred to in the text are shown in Figs. 1 and 2.

Many of the *pūrākau* examined tell of impacts from great waves caused by water beings or giant lizards known as *taniwha* (Fig. 3). Stories of *taniwha* causing destructive surges that imperil the lives of people near the water are common across A/NZ. This is not entirely surprising given the widespread use and occupation of the coastal environment. These *taniwha* stories were likely created to explain environmental hazards and have their roots in traditional ways of interpreting natural phenomena as signs of something more than mere biophysical processes (King et al., 2007). Furthermore, in many cases *taniwha* are also related to the laws and protocols of *tapu* (sacrosanct, forbidden, inviolable). People who broke the *tapu* were often dragged into the water by a *taniwha* and drowned, but those who respected *tapu* were usually safe (Orbell, 1985). Another common element among many *pūrākau* is the eventual vanquishing of the *taniwha*, which as McFadgen (2007) argues is not incongruent with the cessation of such phenomena (like a tsunami, a storm surge, or a flood).

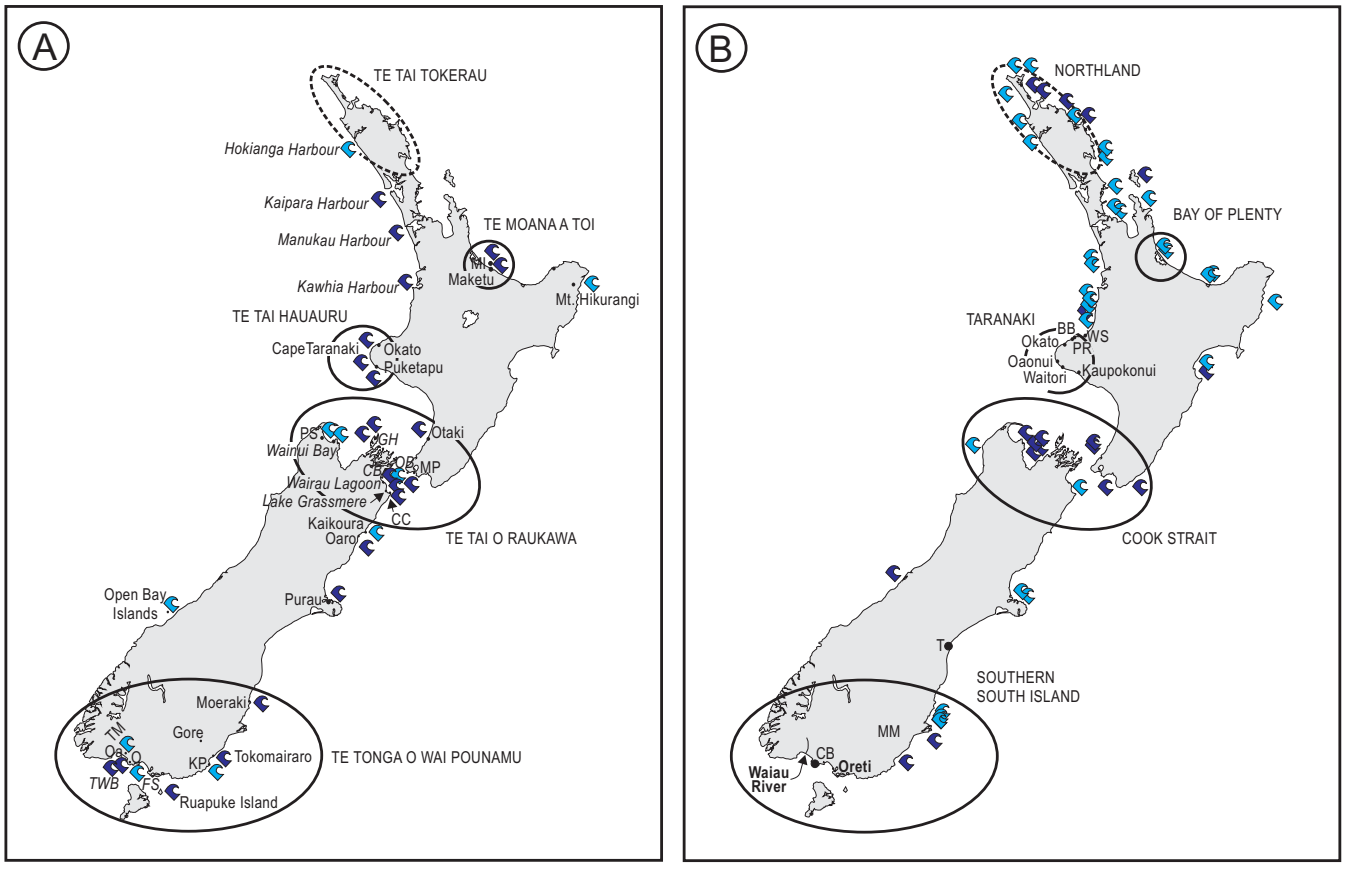

Fig. 2. (A) Aotearoa/New Zealand map showing locations of orally recorded events discussed in the text (CB = Cloudy Bay, FS = Foveaux Strait, GH = Greville Harbour, KP = Kaka Point, O = Orepuki, Oa = Orawia, OB = Oteranga Bay, MP = Miramar Peninsula, PS = Parapara Spit, TM = Takatimu Mountains, TWB = Te Waewae Bay). Dark blue symbols represent *pūrākau* believed to probably represent a past tsunami, light blue symbols represent *pūrākau* believed to possibly represent a past tsunami – see text for details. **(B)** Aotearoa/New Zealand map showing locations of geophysical evidence for palaeotsunamis that have occurred over the last 1000 years with a Validity Index of 1 or 2 (after Goff, 2008; Goff et al., 2010a). Dark blue symbols represent palaeotsunamis with a Validity Index of 1, light blue symbols palaeotsunamis with a Validity Index of 2 (the Validity Index ranges from 1 to 5, Excellent to Equivocal). Other sites discussed in the text include: BB = Bell Block, CB = Colac Bay, MM = Maungatua Mountain, PR = Perth Road, T = Timaru, WS = Waihi Stream.

Fig. 3. Ancient rock drawing of a *taniwha* consuming a human figure from the top of a limestone cave at Weka Pass Range near Waikari, Southern Canterbury, Aotearoa/New Zealand. The original figures were painted red and copied by T. S. Cousins (after Haast, 1877).

3.1 Te Tai Hauauru – Taranaki

Ethnographic accounts document a range of *pūrākau* from the Taranaki region. The most well known *pūrākau* in the region is the "Coming of the Sand" (Smith, 1910).

This centres on a place called Potiki-taua, just to the south of Cape Taranaki where Potiki and his group settled (Fig. 2a). Mango-huruhuru, the old priest, built a large house on low land near the sea while Potiki-roa and his wife put theirs on higher ground further inland. Mango-huruhuru's house had a rocky beach in front of it that was unsuitable for landing canoes and so he decided to use his powers to bring sand from Hawaiki. After sunset he sat on his roof and recited a *karakia* (prayer/chant). On conclusion a dark cloud with its burden of sand reached the shore. The women called out "A! The sea rises; the waves and the sand will overwhelm us". The people fell where they stood and were buried in the sand along with the house and cultivations and all the surrounding country, and with them, the old priest and his youngest daughter (memorialised and turned into a rock which stands there today). Potiki-roa and his wife escaped the disaster because their home was further inland and on higher ground. Smith (1910) used genealogical estimates to place this event around 1500 AD.

The events reported in this *pūrākau* are associated with lightning and high winds and as such may be interpreted as a vivid description of a large storm. However, the sea penetrates a long way inland, far enough to cover the whole area including all the cultivations in a thick layer of sand, and could therefore be interpreted as a tsunami.

There are similar *pūrākau* that appear to be variations of the "Coming of the Sand". According to an account provided by Taylor (1870) two strange canoes arrived on the Taranaki coast after being blown there by a storm. One of the canoes carried two daughters of a god. They were treated well by the Taranaki people and when the daughters returned home their father was very happy. He asked his daughters what he could give the people and they told him "sand for the coast". So he sent a large canoe full of sand for their beaches and to make dunes. On a similar theme, an old priest found the stones of the Taranaki coast hurt his feet and so in anger he uttered a spell and sand was immediately blown up onto the coast (Taylor, 1870). Similarities to the "Coming of the Sand" are apparent and can also be traced through a *pūrākau* from around Okato and Stoney Creek, NE of Cape Taranaki. Here a huge wall of water caused destruction "many years ago", where the wave washed over a stone pa (hill fort/settlement) destroying everything and killing over 100 Māori (H. O. Andrews, personnel communication, 15 August 1997). Interestingly, Skinner (1965) indicates that the name Okato relates to a tsunami that inundated the coast causing loss of life and communities. A final local *pūrākau* relates to the coast further south of Potiki-taua. While preparing for a canoe trip at Puketapu (Fig. 2a), one of the paddlers moved the *tohunga* (learned person, expert) Moke-uhi's fishing gear. He was greatly upset and refused to go out fishing. In anger, he called up a massive "tidal wave" and all except one of the canoes were lost (Smith, 1910).

It seems likely that multiple accounts from the same region and the tight geographical grouping of *pūrākau* may represent a single, notable event. On balance, the information points more strongly towards tsunami than storm largely because of the uniqueness and magnitude of the event.

3.2 Te Tai o Raukawa – Cook Strait

Arguably the most well-known *pūrākau* in A/NZ relates to the Hao-whenua earthquake in Wellington, on the north side of Cook Strait (Best, 1918). The island of Motu-kairangi was uplifted, draining the stream called Te Awa-a-Taia and creating what is today known as Miramar Peninsula (Fig. 2a). This was caused by a severe earthquake that occurred in the time of Te Ao-haere-tahi, about 18 generations ago. It was named Hao-whenua because of how it altered the land. The name Hao-whenua "to sweep the land clean" likely relates to the tsunami generated by this earthquake (Goff and McFadgen, 2003). Using genealogical data, Best (1918) dated this event to around 1460 AD.

Several *pūrākau* relate to events recorded on the south side of Cook Strait. According to Mitchell and Mitchell (2004) a tsunami called Tapu-arero-utuutu drowned nearly all the people living around Greville Harbour, D'Urville Island (Fig. 2a), piling the bodies into the sand dunes. There appear to be several versions of this *pūrākau*, many of which refer to a *taniwha* named Te Ngarara-huarau. Followers of Tainui canoe chief Tarapounamu settled at Moawhitu in Greville Harbour. They lived happily here until they were all killed by a tidal wave in the sixteenth century (Best, 1976). An apparent breach of *tapu* by a local woman led to the gods stirring up the deep ocean and causing great waves to sweep away the people where the erring woman was living – all perished in the upheaval, although other hamlets in the area escaped (Best, 1976). The *taniwha* was eventually vanquished and a part of the tail severed by a spear is preserved as a rock offshore named Tapu-arero-utuutu (Te Whetu, 1953).

While the Hao-whenua and Tapu-arero-utuutu *pūrākau* are the most detailed, there are several others of relevance to the region. To the west at Parapara Stream (Fig. 2a) there was a taniwha named Te Kai-whaka-ruaki. It ate many men until Poturu a famous seal hunter killed it (Tregear, 1904). Similarly, to the east, there was a taniwha that lived in a cave at Cape Campbell. It would attack and eat up to several hundred people at a time, and took the form of a large tidal wave which would wash them into Wairau Lagoon where they drowned. It could then eat them when it wished. The taniwha was eventually killed by a great warrior who made the coast safe for subsequent travellers (Carrington, 1934). In the same area it is said that Kupe (of the Matahourua canoe) created Lake Grassmere and Wairau Lagoon when he caused the sea to rise up and wash over Haumia's lands and gardens (Stack, 1877).

Like Taranaki, there appears to be a unique and catastrophic inundation event associated with the two main *pūrākau* with additional contextual information indicating a distinctly hazardous coastal environment.

3.3 Te Tonga o Wai Pounamu – Southern South Island

The sheer number of *pūrākau* between Te Waewae Bay and Moeraki is compelling (Fig. 2a). Several versions of what appears to be the same *pūrākau* are reported for Moeraki in the north. Rakitauneke was a famous *tohuka* (South Island dialect – *tohunga*) of old, who had a guardian whale called Tu-te-raki-hua-noa. One day the whale appeared off Moeraki and the children cursed it. In anger, Rakitauneke sent in a tidal wave which drowned them. They were standing by the freshwater Ka-wa creek at the time, which has been brackish ever since (Beattie, 1919). A variation indicates that the *tohuka* brought up lots of fish for the people because they wanted food but they complained that there were too many. As a result he called up Ruatapu (a tidal wave) who sent a big sea and washed the fish off (Beattie, 1994a).

A more ubiquitous *pūrākau* centres around the journey of the Takitimu canoe that is said to have been wrecked in Foveaux Strait and after which the Takitimu Mountains of Southland were named (Figs. 1b and 2a). There are two key themes. First, the Takitimu canoe had run down the east coast of the South Island until it was just south of Otago Peninsula when it struck a great wave represented today by the Maungatua mountain range (Figs. 1b and 2a). The canoe broached and the bailer was dropped and turned into rock which is now Hokanui Hill near Gore. One of the crew named Aonui was washed overboard, and being turned into stone, still stands on the Tokomairiro beach as the tall basaltic pillar later named Cook's Head. Then another wave (represented by the Okaka ridge west of Te Waewae Bay) struck her and she capsized. In a slightly different version, the Takitimu canoe was wrecked by three waves: O-te-wao, Oroko, and Okaka. These three waves are now represented by mountain ridges; O-te-wao is "a ridge up Oreti river way", Oroko (Orokoroko) is the southern portion of the Hokanui Hills, and Okaka is "The Hump" at Waiau River (Beattie, 1915).

Second, there is a strong association in the region between the Takitimu canoe and the sea. In another *pūrākau* linked with Te Waewae Bay, it states that when Tamatea and his crew lay opposite the Waiau River, his tohuka Rua-wharo and Te Tu-rongo-pa-tahi said, "this place will do, we will turn in here". The Takitimu canoe was turned, but as they paddled in to the shore it was stranded on a sand bank, and they could not refloat it. Tamatea became angry and said to Rua-wharo, "What do you mean by this, have you brought me here to drown me?" Rua-wharo was angered by this accusation and called to the sea to rise to his help. Immediately a great tidal wave came to his assistance and the canoe was lifted right into the river. The canoe stayed where it was while the scour back of the great wave made that river the deepest in the country (Downes, 1914). Te Waewae Bay is also the focus for a *pūrākau* from Orepuki on its eastern shores. A great tidal wave (Tai-koko) is said to have swept away people of Te-Manu-o-te-Rapuwai tribe travelling along the beach near the village (Beattie, 1915). This is thought have occurred after a large battle between northern and southern Māori (Smith, 2003).

We reviewed only two *pūrākau* related to *taniwha* in the southern South Island. A famous taniwha named Kaitiaki-o-tukete lived in Foveaux Strait and another in Wai-o-tokarire lagoon, Ruapuke Island (Fig. 2a). The latter is still regarded with awe and was *tapu* for a long time (Beattie, 1919, 1994b). *Purakau* from the southern South Island give a strong sense of human-environment interactions. Reference to three large waves or possible a single wave in the case of Orepuki is indicative of a tsunami as opposed to storm waves that are common in the area. Once again, the uniqueness and magnitude of the event are notable.

3.4 Te Moana a Toi – Bay of Plenty

Contrary to the previous examples there are only two *pūrākau* for the Motiti Island area (Fig. 2a). This is not entirely surprising since it is a small near-shore island (∼607 ha), but it is interesting to note that these *pūrākau* are the only ones we found documented for the entire Bay of Plenty region.

Grace (2003) provides a detailed translation of a *pūrākau*: "...the sea grew dark and troubled and angry, and presently a great wave, which gathered strength as it came, swept towards the shore. It advanced over the beach, sweeping Titipa and all his fish before it till with the noise of thunder it struck the cliff on which the people stood... The great wave receded, sucking with it innumerable boulders and the helpless, struggling Titipa. Then another wave, greater than the previous one, came with tremendous force and, sweeping the shore, struck the cliff with a thunderous roar. This was followed by a third which, when it receded, left the beach scoured and bare Titipa and all his fish had disappeared" (Grace, 2003).

The second *pūrākau* relates to an area around Motiti Island and the settlement of Maketu on the adjacent mainland coast. In it Manaia is said to have wanted to attack Nga-toro-rangi and his sisters, but with his canoes offshore in deeper water in the evening Nga-toro-rangi said "why not attack in the morning I cannot be killed at night anyway". During the night Nga-toro-rangi and his sisters uttered spells and created a great wave that destroyed the whole of Manaia's fleet and killed all his men (Taylor, 1870).

The first *pūrākau* provides a remarkably detailed description of a series of three large waves striking and scouring the beach. The second example seems to infer only one large wave that was particularly damaging in the near-shore environment and at the coast as opposed to offshore. Both provide plausible descriptions of a tsunami as opposed to storm waves. Importantly, the authors acknowledge that a considerable amount of contextual detail connected with *pūrākau* may have been lost through the discrete capturing of these oral accounts. Further work that considers related cultural elements needs to be carried out to determine whether these *pūrākau* have greater meaning.

4 Complementarity of geophysical evidence

The mapping of *pūrākau* from written sources demonstrates some clear geographical distributions. Some of these may simply reflect the geographies of early ethnographical work, while others may reflect a loss of knowledge due to the direct impacts of large magnitude events, inter-group conflict and the later, but also fatal, introduction of the musket into the north (Ballara, 2003). Similarly, the mapping of geophysical evidence of tsunamis reflects a degree of random site selection during the early years of palaeotsunami

research. An equally important *proviso* should therefore be applied that states that the absence of geophysical evidence does not mean that an event did not occur. By the same token, multiple accounts of events from the same area may indicate large scale disturbances, whereas geographically focussed *pūrākau* might be indicative of locally significant events. Notwithstanding all of these possible explanations, in this section we examine how the geophysical evidence fits with the experience related in the mapped *pūrākau* and we offer some preliminary conclusions drawn from considering the knowledge derived from these different sources.

Figure 2a and b displays the geographical distribution of *pūrākau* and currently documented palaeotsunamis, respectively. The *pūrākau* have been split into probable and possible evidence for past tsunamis. While it is acknowledged that this will always be a subjective, and potentially tautological exercise, we have based our classifications on variables including oral recordings from tsunami survivors in the recent past (Dudley et al., 2009), and the documented process interactions of actual tsunamis and storms at the coast. However, as coastal flooding clearly results from a variety of natural factors, caution must always be used when attributing flood traditions to the impact of tsunamis.

4.1 Te Tai Hauauru – Taranaki

The "Coming of the Sand" *pūrākau* in association with additional material provides a strong indication of at least one event which would appear to have affected much of northern to south central Taranaki coast. Smith (1910) used genealogy to estimate an event chronology of around 1500 AD. While this dating should be considered tentative at best, it is probably indicative of an approximate event chronology range of 1400–1600 AD.

At first glance, the strength of these *pūrākau* is at odds with the lack of a geophysical record. That is, there are no Validity Index (VI) 1 or 2 palaeotsunami records in this region (Goff et al., 2010a). The VI for palaeotsunami evidence is based upon a number of factors including the nature and type of geologic evidence, and the association with other sites of similar inferred age. The index ranges from 1 (excellent), 2 (good), 3 (moderate), 4 (poor), to 5 (equivocal). The reason for this lack of high quality palaeotsunami data for the region is threefold. First, much of the early research was conducted in other coastal regions considered most likely to have been affected by palaeotsunamis, with known tsunamigenic sources (Goff et al., 2001). Second, it is only in recent years that more wide-ranging palaeotsunami research has been carried out along A/NZ's coast. As a result, the palaeotsunami database now includes three Taranaki sites; Waitore (VI 3), Kaupokonui (VI 4) and Oaonui (VI 4) (Fig. 2b). Their low VI ratings are indicative of the limited amount of research carried out at the sites (Goff, 2008; Goff et al., 2010a). Third, as part of a reconnaissance study of the tsunami risk for the region, Goff (2007) identified several additional sites that are yet to be added to the palaeotsunami dataset. These include Waihi Stream (WS), Bell Block (BB), Perth Road (PR), and Okato. These currently have a VI of 3 (Fig. 2b). Much of the geophysical evidence is based upon the presence of high elevation marine pebbles and gravels (up to 20 m a.s.l.) either overlying or separating prehistoric coastal Māori occupation layers (Goff, 2007). At Waitore however, the evidence is more compelling with marine sands incorporating reworked and broken artefacts rising to an elevation of some 4 m a.s.l. (Cassels, 1979; McFadgen, 2007). Radiocarbon dates from basal peats at Waitore places the event sometime between 1430 and 1645 AD, but a wider regional correlation with palaeotsunami sites in the southern North Island and northern South Island places the event most reasonably in the late 15th century (McFadgen, 2007).

The strength of these *pūrākau* provides a key signal that geophysical research needs to be focussed on this region.

4.2 Te Tai o Raukawa – Cook Strait

There are two notable groups of *pūrākau* in this area. A wealth of *taniwha* related *pūrākau* suggests that the coastal waters bounding Cook Strait were reasonably treacherous. A second group comprises the Hao-whenua (Wellington), Tapu-arero-utuutu (Greville Harbour, Tasman Bay), and Kupe *pūrākau*. These refer to site specific catastrophic events on either side of Cook Strait. These are most likely tsunami-related, although it is difficult to determine whether they refer to one or more region-wide events. Reference to Kupe around Wairau Lagoon and Lake Grassmere suggests that this might have been an event that occurred at a relatively early time of Māori settlement. More specific genealogical dating tends to place the others around the 15th or 16th centuries (Best, 1918, 1976).

A rich geophysical record for the region supports the geographical spread of the *pūrākau*, with recognised palaeotsunami deposits reported from Abel Tasman National Park, Tasman Bay (Goff and Chagué-Goff, 1999), Palliser Bay, Wellington region (Goff et al., 1998), and Wairau Bar (McFadgen and Goff, 2007), as well as Kapiti Island (Goff et al., 2000). The bulk of the evidence at these sites consists of anomalous, high-energy marine sediment layers deposited in low-energy coastal wetland systems. The Wairau Bar evidence however, consists almost entirely of archaeological data (McFadgen and Goff, 2007). This site is the key representative example used for determining archaeological evidence for past tsunami inundation in A/NZ. Chronologically, at least two events have been reported, one around the late 13th century (Abel Tasman National Park and Kapiti Island) and the other in the late 15th century (Abel Tasman National Park, Kapiti Island, Palliser Bay) (Goff and Chagué-Goff, 1999; McFadgen, 2007). It is most probable that the chronology of the Wairau Bar site is contemporaneous with others noted for the late 13th century.

A tighter chronological control however, allows us to date the event between 1300 and 1330 AD (McFadgen, 2007; McFadgen and Goff, 2007) which could place it slightly later than at the other sites. There has been some debate over the most likely tsunamigenic sources for this region. Goff and Chagué-Goff (1999) initially assigned these palaeotsunamis to the effects of 13th and 15th century ruptures of either the Alpine or Wellington faults. While these seem reasonable suggestions, McFadgen and Goff (2003) noted a 3 m uplift event at the Heaphy River mouth in the NW South Island that was dated to between about 1250–1465 AD and linked with an unknown offshore fault rupture. An earlier date seems most reasonable since the site is associated with a relatively early Māori settlement, and this may well be the tsunamigenic source for the late 13th century palaeotsunami.

The geophysical data show remarkable agreement with the *pūrākau*. In particular, the early event associated with the Lake Grassmere/Wairau Lagoon area, and the later one associated with the Hao-whenua and Tapu-arero-utuutu *pūrākau*. It is interesting to note that geophysical evidence points to an earlier tsunami in the region. This supports the wealth of taniwha related *pūrākau* indicating a long-term recognition that the waters and associated currents of the Cook Strait were (and are) hazardous on a daily basis.

4.3 Te Moana a Toi – Bay of Plenty

The Motiti Island and Maketu *pūrākau* relate to a small area in the Bay of Plenty. One provides possibly the most accurate description of coastal inundation by a tsunami for any area of the country (Grace, 2003). The second *pūrākau* indicates the relative safety of an offshore location and that the event occurred at night (Taylor, 1870). There are no other relevant *pūrākau* reported for the region which may be a function of limited engagement with the community, or alternatively might reflect the local nature of the event.

The Bay of Plenty coastline shows a marked division between geophysical evidence in the west and east (Fig. 2b). This is also recognised in a full display of all the VI data (Goff, 2008). There are only two VI 1 or 2 events noted and both related to sediment core data from Athenree and Waihi Beach. Evidence for a coarse, high-energy marine deposit are found at both sites, with dating of between 1430–1630 AD consistent with VI 3 palaeotsunami sites at Papamoa (adjacent to Motiti Island) and Matakana Island. This is a distinct grouping of sites that are stratigraphically different from other deposits within the same age range. This allows us to infer an age for this event of between around 1430–1480 AD. Based upon the geographical spread of geophysical evidence we infer that this was a local event. This inference is plausible because stratigraphic evidence indicates that tsunami inundation eroded both ends of Matakana Island, initiated a dune remobilisation phase on the island at the same time (Shepherd et al., 1997), and penetrated nearly 1.5 km inland at Waihi Beach. There is however, no further evidence for this event west of Waihi Beach and east of Maketu (Goff, 2008).

4.4 Te Tonga o Wai Pounamu – Southern South Island

The consistently strong *pūrākau* for this region likely relate a linked experience of coastal disturbance from Moeraki through to Te Waewae Bay. A unifying thread is the journey of the Takitimu canoe, but this is augmented by a site specific *pūrākau* from Moeraki Peninsula. As noted in other regions, *taniwha*-related *pūrākau* suggest a long-term recognition of the treacherous nature of the regions coastline.

Foveaux Strait and the southern South Island coast comprise a region exposed to frequent and severe storms, and have not been considered at particular risk from tsunamis (Berryman, 2005). A more recent synthesis however, identified a suite of archaeological sites that point to the likelihood of past tsunami inundation along the southern and south-eastern coasts of the South Island (Anderson et al., 1996; Leach and Hamel, 1981; McFadgen, 2007). This conclusion is supported by a detailed examination of the coastal geomorphology and geology of a number of bays along the Otago coastline by Goff et al. (2007, 2009). Benefiting from research following the 2004 IOT, Goff et al. (2007, 2009) were able to identify a distinct tsunami geomorphology along much of the Otago coast from Tokomairiro beach to Shag Point. The direct association between a tsunami geomorphology and *pūrākau* at Tokomairiro beach is compelling. Archaeological data comprises two main lines of evidence. Subsidence of coastal occupation sites by ground-shaking following a large earthquake could be traced as far south as Bluff Harbour (McFadgen, 2007), and sedimentary evidence of tsunami inundation over an occupation site is reported from Long Beach (Goff et al., 2009). The ability to date these abandoned archaeological sites allowed the event (or events) to be placed around the late 14th to early 15th centuries. Identification of a tsunami source proved problematic however, since the region has relatively few active faults. Until recently it was believed that the most likely source was the Akatore fault just south of Dunedin, but numerical modelling showed that resultant tsunamis were too small (Goff et al., 2009). It may have caused some of the subsidence from ground-shaking but again this would have only been locally significant and not led to a contemporaneous tsunami event throughout the region. Comparisons between numerical modelling of potential tsunami sources and the tsunami geomorphology led to the discovery that the most plausible source was the Puysegur Subduction Zone to the south-west of the South Island (Goff et al., 2009). Of interest, a tsunami from this source affects both the south and south-east coasts of the South Island. Figure 2b outlines only VI 1 and 2 palaeotsunami sites, whereas the incorporation of VI 3–5 sites (primarily assigned a lower VI status because they

have only been assessed archaeologically and have not been assessed for geological and geomorphological evidence) adds a further 14 contemporaneous locations ranging from Colac Bay (VI 4) in the south-west of the region to Timaru (VI 5) in the NE (Goff, 2008). This greatly enhances the geographical range of the geophysical data.

With the incorporation of a full suite of VI palaeotsunami data the geophysical evidence almost exactly mirrors the ubiquitous Takitimu canoe *pūrākau* for the region. This event does not however appear to be associated with the Moeraki *pūrākau*. While there is no clear chronological difference between the dates for the geophysical evidence, the numerical modelling shows that it is unlikely that a Puysegur Subduction Zone tsunami would significantly inundate coastal areas as far north as Moeraki Peninsula and beyond (Goff et al., 2009). There is a marked difference between the nature and extent of the Takitimu canoe and Moeraki Peninsula *pūrākau* which point towards this conclusion. There is therefore a need for a focussed geophysical study around the Moeraki Peninsula and the coastline to the north.

4.5 Te Tai Tokerau – Northland

What is apparent from our analysis of the geographical significance of *pūrākau* is the relative paucity of stories that derive from the Tai Tokerau (Northland) region. Incidentally no written *pūrākau* were identified in the Poverty Bay area either despite a cluster of geological and archaeological evidence for palaeotsunamis from this area.

There are 12 VI 1 and 2 geophysical sites located within the Tai Tokerau/Northland region. This site density is equivalent to those found in Cook Strait, but is markedly more pronounced with 39 sites when all VI categories are considered. The bulk of these sites have been stratigraphically correlated with a small group of key sites. Stratigraphic correlation has been achieved through the recognition of two lines of evidence. First, the consistent observation of high elevation, surface deposits of discontinuous marine pebble/gravel veneers overlying prehistoric coastal archaeological sites (Nichol et al., 2003a). Second, the direct link between marine pebble/gravel veneers and other associated features such as marine sand sheets and microfossil evidence in a landward continuum indicative of tsunami inundation (Nichol et al., 2003b) (Fig. 4). The majority of the sites consist of discontinuous pebbles veneers although more detailed investigations have been carried out at VI 1 sites in both Tai Tokerau/Northland (Henderson Bay, Hihi, Mimiwhangata) and Auckland (Great Barrier Island) (Nichol et al., 2003a, 2004; Pearce, 2006; Goff et al., 2010a, b). The geographical extent of the palaeotsunami extends well beyond the Tai Tokerau/Northland region with contemporaneous evidence reported at least as far as the eastern Auckland region (Nichol et al., 2003a). What makes this even more remarkable is that deposits have

Fig. 4. Palaeotsunami deposit, Henderson Bay (after Nichol et al., 2003b).

been reported up to 42 m a.s.l. in the northernmost site (Tom Bowling Bay) and 32 m a.s.l. at Henderson Bay (Goff, 2008). On the western side of the region, deposits reach elevations of up to 15 m a.s.l. at Twilight Beach, >30 m a.s.l. at Tauroa Point, and about 10 m a.s.l. at Kawerua. Nichol et al. (2003a) constrained the age of the event to post-1400 AD, and a more recent cross-correlation between geological and archaeological data placed the event around 1450–1485 AD (McFadgen, 2007).

With the exception of one *pūrākau* from Hokianga Harbour (Fig. 2a) which notes that Nuku-tawhiti successfully called a mountainous wave ashore to rescue a whale (Smith, 1896), there is a complete absence of any similar recordings. This is most likely the result of a lack of any easily accessible written records and associated dearth of ethnographic fieldwork conducted in the region, coupled with the possibility of a significant loss of indigenous knowledge caused by large magnitude events. The absence of recorded traditions however, does not mean that such traditions do not or did not exist (McMillan and Hutchinson, 2002).

5 Benefitting from differences

The narratives examined hitherto provide a wide pool of experience on past extreme disturbances that have affected human settlements along the A/NZ coastline. There is also considerable first-order agreement with the information derived from these stories and subsequent geological and archaeological investigations. What can we take from this exercise and what are some of the benefits to be gained by examining the narratives of extreme environmental disturbance from different knowledge systems?

The authors point first out that our consideration of the *pūrākau* selected in this review does not necessarily suggest that the *pūrākau* speak for themselves in any

simple way or that their meanings are self-evident. Rather, there is a genuine need to engage with Māori from where *pūrākau* of extreme environmental disturbance have been identified. This action is imperative for not only avoiding the misinterpretation and potential generation of "synthetic oral traditions" but also because it recognises the *mana* (authority) of Māori who are linked through *whakapapa* (ancestral lineage) to specific traditions to tell their stories in their own words. This might be an unwelcome challenge to those "housed" within the academy of contemporary science but nonetheless one that many Māori believe is a necessity in a world dominated by the frequent co-option of indigenous culture, heritage and tradition by outsiders (Smith, 2001).

What is apparent from our analysis of the geographical significance of *pūrākau* is the relative paucity of stories that derive from the Northland, Bay of Plenty and Poverty Bay regions – despite clusters of geological and archaeological evidence from these areas. Again, there is an opportunity to engage with Māori in areas where there is a dearth of published narrative on extreme environmental disturbance.

Apart from the "Coming of the Sand" traditions from the Taranaki coastline, there is considerable geographical agreement shown between the numerous *pūrākau* and archaeological and geological evidence from the south-eastern South Island and Cook Strait regions of A/NZ. Given the strength of evidence from across these areas there is likely to be more information that corroborates, lends support to, and challenges current knowledge about the tectonic and meteorologic histories of these regions. There is subsequently, a need to conduct research that is focussed across these regions. Of course, we must remain mindful that some of these events may relate to processes other than tsunamis.

The use of *pūrākau* to guide scientific hypotheses and geophysical research remains an important opportunity to help determine the timing, magnitude and character of extreme hazard episodes along the A/NZ coastline over the past 1000 years. Cruickshank (1994, p. 408) also suggests that "one of the more direct contributions oral tradition can make to academic discourse is to complicate our questions". While Durie (2004, p. 8) argues that scientific knowledge does not have a monopoly on truth. Hence, rather than "contesting validities", there are opportunities to use the interface between scientific and indigenous knowledge as a source of inventiveness. In this way, the insights from different approaches to knowledge can be used to enhance the other – and do not need to be viewed as replacements for each other.

Inclusion of *Mātauranga Taiao* by government authorities into planning, risk assessments and hazard education offers presently unrealised opportunities and potential that may contribute to lessening the exposure and resulting vulnerability of communities and individuals to extreme environmental disturbances (King et al., 2007). In addition, wider societal opportunities exist to consider and learn from Māori perspectives on history and to co-produce new narratives about tsunami and storm surge hazards in A/NZ.

At the same time, conscious and concerted efforts are required to meet the increasing challenges facing the protection and continuity of Māori perspectives, language and culture in A/NZ. This includes the protection of stories and associated language as local practices and social relations change in a rapidly changing world. This research space is also an opportunity for Māori to acknowledge and integrate some of the experience and related narrative of the past with new knowledge and ideas. This is not, however, a new idea. It is well known that in spite of indigenous peoples having their own world views they are also enriched through contact with other traditions and values systems (Berkes, 2007). Additional benefits from this work include the building of Māori scientific capacity based on the integration of Māori knowledge and contemporary science. This means contemporary science recognising the value and importance of Māori knowledge to future knowledge development in A/NZ. Many other countries do not have this opportunity.

6 Summary

It is apparent from this preliminary exercise that there exist both differences and complementarities between traditional Māori narratives and the available archaeological and geological evidence relating to environmental disturbance along the A/NZ coastline. Use of indigenous environmental knowledge to corroborate geophysical studies raises valuable questions about regions of tsunami risk, the causes and sources of their generation, as well as reasons for the relative paucity of *pūrākau* in some regions. Ways in which *Mātauranga Taiao* and contemporary science can be combined to produce new narratives about extreme environmental disturbance will require not only acceptance of other ways of knowing but also open engagement with Māori that respects their rights to tell their own histories. These efforts are encouraged to help revitalise and ground-truth the interpretation of traditional stories, corroborate and/or question previous scientific deductions, and improve our collective understanding of the recurring impact of tectonic, geologic and metrological-based events across A/NZ.

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