

The Zealandia continent: a worthy replacement for Pacifica?

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Citation analysis for papers suggesting a laterally dispersed continent ('Pacifica') and a submerged continent in the region of New Caledonia and New Zealand indicates sustained preference for the latter, certainly on geological evidence and probably on biogeographic evidence. However, the name assigned by geologists to this entity – 'Zealandia' – is historically inaccurate and politically contentious. A politically acceptable name for the continent that does not kindle post-colonial dissent might be 'Vallardia', reflecting the sixteenth century Portuguese maps of the region, but is unlikely to find favour with historians. A solution to this conundrum is to revive the name 'Pacifica'.

Keywords: citation analysis, New Zealand, Zealandia, Pacifica, politics

Prologue: An apparent obituary for Pacifica

Pacifica is barely mentioned in the geological literature today. New data collected since the 1980s has shown that those earlier interpretations were not correct: none of the present-day Pacific Ocean ridges and rises is continental crust, but instead all are thickened oceanic crust.

With those words in a populist geological reinterpretation of the geology of New Zealand as a part of a much larger continent – Zealandia – Mortimer & Campbell (2014: 116) dismiss the thirty-year-old idea of the dispersal of an earlier proposed continent – Pacifica. This paper traces the development and demise of the idea, largely through citation analysis of the papers in which it was initially suggested. Pacifica's replacement – Zealandia – may be more acceptable geologically, but its nationalistic associations undermine its credibility.

The concept of Pacifica

Fragments of the continent of Pacifica appear to have been first identified around the margins of the Pacific Ocean by two Stanford University staff-members, Amos Nur and Zvi Ben-Avraham; the idea was picked up by Peter Kamp, at that time a PhD candidate and junior lecturer at the University of Waikato in Hamilton, New Zealand. Both of these papers were published in *Nature*, with the earlier briefly titled and concisely written globally focused paper by Nur & Ben Avraham (1977)

receiving nearly three times the number of citations of Kamp (1980), which was rather longer (both in title and in the text) and more regionally focused (explaining the origin of a suite of rocks in the eastern part of New Zealand's South Island).

Citation analysis – Pacifica

Research papers generally show a peak in the number of citations within a few years of publication, and the number of citations declines reasonably rapidly thereafter (Hodder & Balog 1984), the curve resembling a product life-cycle (e.g. Hodder & Hodder 2009). Figure 1 shows that both Pacifica papers generated an initial flurry of interest in Pacifica, which declined to low levels in the mid-1990s.

However, by the mid-1990s, the notion of a continent in the Pacific Ocean that had fractured into numerous fragments of crust (so-called 'exotic terranes') and been transported laterally across the globe to, and come to rest at, the margins of other continents or islands, the remnants being identified in subduction zones in the western and northern Pacific, appears to have become less convincing, prompting van Andel (1994: 163) to comment:

The idea of exotic terranes has caught the fancy of many a geologist concerned with the margins of the Pacific, and examples have multiplied like rabbits.... It is not clear just how exotic many proposed terranes really are, nor can it be confirmed that all come from far away. This frenzy to find exotic terranes appears a bit overdone.... but the concept is useful and in a sizable number of cases well documented.

However, van Andel did concede, 'Continental fragments adrift are not impossible, however; the Seychelles Islands in the Indian Ocean are one example, New Zealand is another.' This assertion may have helped maintain interest in the idea and continued citation of Kamp's paper in particular. There was a second flurry of interest at the turn of the century and a brief spike in 2009. The low numbers of citations (typically 1–2 annually) since 2009 suggest that interest in Pacifica has waned.

The similar citation trend for both papers suggests that their audiences were similar. Based on the titles of the citing articles and on the journals in which they were published, the

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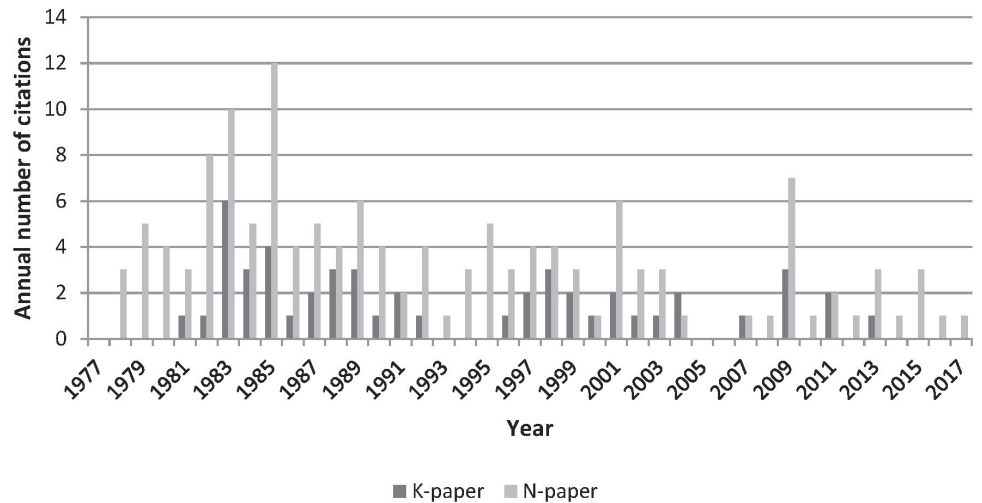


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Figure 1. Variation of citations of Pacifica-themed papers with time: 'K-paper' is for Kamp (1980); 'N-paper' is for Nur & Ben Avraham (1977).

Citations for Kamp (1980) compiled from: <https://scholar.google.co.nz/scholar?um=1&ie=UTF-8&lr&cites=8495463365729202186>.

Citations for Nur & Ben Avraham (1977) compiled from: https://scholar.google.co.nz/scholar?cites=109456357712869662138&as_sdt=2005&sciold=0,5&hl=en



two papers attracted similar levels of interest in the geological (43%) and biological (56%) research communities. Geologists were interested in the similarity and ages of suites of rocks at the margins of the Pacific Ocean, while the biologists were interested in seeing whether a laterally moving continent or its fragments helped or hindered their explanation of the distribution of fauna and flora.

From the content of the articles, it is possible to determine whether the citing authors agree or disagree with the Pacifica concept, or are neutral, either because they consider that data and information provided are not sufficient or appropriate to lead them to a particular view, or because the purpose of their article is essentially one of presenting the options and choosing not to 'take sides'. From the date of Kamp's (1980) publication, there was always a difference of opinion on the veracity of Pacifica and its application and Figure 2 shows clearly that the number and proportion of negative citations increased with time. This suggests that the decline in the number of citations is caused by increasing scientific disbelief in the concept, rather than being the result of changing fashions in research, which Nicholson (2003: 375-376) has suggested:

A very likely reason [for the decline] is that for a decade or so, the terrane concept constituted a fast-moving subfield, attractive to young, imaginative and ambitious geologists. Now that the concept is well-established, avant garde geologists have moved on to more fashionable fields.

Pacifica lives on

Of course Pacifica was not the first continent in the Pacific for which there was scientific evidence; Nunn (2008: 112) asserted that '... Terra Australis has the distinction of being the first mythical continent in the Pacific whose presence was inferred by science rather than being simply a product of wishful thinking', further observing (Nunn 2008: 113) that:

The failure of the search for Terra Australis has not discouraged some people from believing in a large continent in the Pacific. Yet since the continent clearly does not exist above water; then, they argue, it must have become submerged. Often it is termed a lost continent, a number of which have been sug-

gested as lying beneath the surface of the Pacific [Examples described subsequently in the book include a Pacific version of Lemuria (Cervé 1931) and Mu (Churchward 1926).] Yet no such continents do exist. They never did. Nor indeed is it theoretically possible that a continent could sink.

The inability of a continent to sink beneath the sea is attributed to the relative buoyancy of continental crust relative to oceanic crust, and renders forever unlikely continents that are required to be disposed of by foundering. By contrast, lateral movements of continents are credible; indeed they are an essential feature of plate tectonics. They are convincingly inferred to have occurred throughout most of Earth's past and to continue well into its future (Nield 2007). Interestingly, the notion of lateral continental movements is central to interpretations of the geological history of Tolkien's Middle-earth (Tolkien 1954–1955), whether based on Europe (e.g. Fonstad 1991), or New Zealand (Hodder 2015: 171–205). Taking a more ecocritical perspective, lateral movement of landscape features, especially mountains, are described in New Zealand Māori legends (e.g. Heremia 2017), of which there is wide public knowledge, at least in New Zealand. The idea of 'lateral movement' also resonates with the – albeit controversial – migration and settlement patterns of the peoples of the South Pacific (e.g. Howe 2003; Kirch & Rallu 2007). Thus, despite scientific objections, Pacifica might not yet be as easily dismissed as its vertically foundered predecessors Lemuria and Ur.

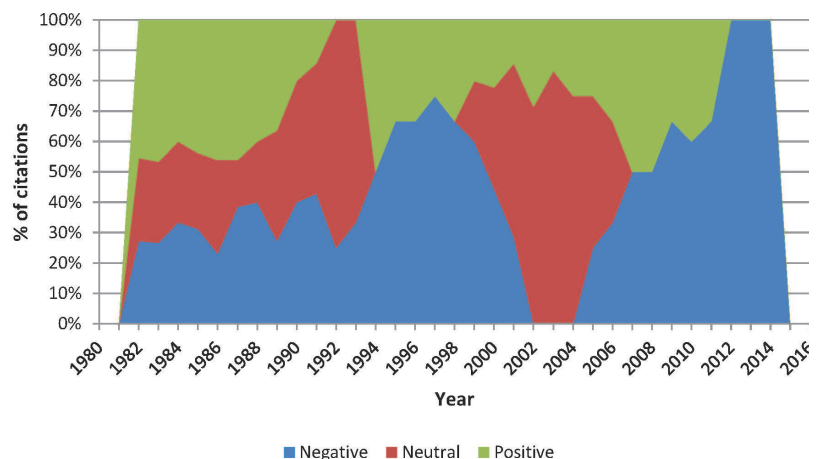


Figure 2. Variation of proportions of negative, neutral and positive citations of Kamp's (1980) Pacifica paper, calculated as five-year moving averages.

Zealandia – a successor to Pacifica?

An alternative to a continent's 'sinking' is its submergence by rising sea level, an explanation advanced in respect of the submerged Yonaguni Underwater Pyramid off Japan (Kimura 2004). Further south, in the New Zealand region, episodic submergence and emergence of land has long been recognised as a feature of its geological history. Even before plate tectonics became pervasive in geological explanations, 'mobile phases' of the landscape, attributed to vertical movements of land and changes of sea level, were central to the overall interpretation of New Zealand geology (Suggate 1978). Numerous paleogeographic maps have shown New Zealand as an archipelago of islands of various sizes and shapes for at least the last 250 million years (e.g. Stevens 1974: 30, fig. 2.1), and have continued to do so.

In a bold move, Nick Mortimer and Hamish Campbell, well-known New Zealand geologists, declared in the preface to their recently published book – *Zealandia Our Continent Revealed* – (Mortimer & Campbell 2014: 9):

It is not very often that a new continent is proclaimed... How can a continent have remained hidden until now? Partly this depends on how a continent is defined: geographical or geological? But the main reason is that Zealandia is largely submerged, concealed by the ocean. No wonder it is not obvious. ... This new entry in the annals of human discovery is a classic case of piecing together scraps of scientific information and being able to see the big picture.

Targeted at a public audience, the book includes few references to scholarly works; but this is compensated for by the comprehensive reference list in what might be considered a companion scholarly paper, by Mortimer *et al.* (2017). As was the case with Pacifica, these references portray a 'journey' to developing the concept of Zealandia, which has involved a long period of research using a variety of field and analytical techniques both in the New Zealand region and elsewhere and models of continental crust suture and disruption.

This Zealandia paper does not specifically mention the continent of Pacifica, but does include a disparaging reference to such tectonic reconstructions: 'The importance of Zealandia is not so much that there is now a case for a formerly little-known continent, but that by virtue of its being thinned and submerged, but not shredded into microcontinents, it is a new and useful continental end member.' This view is reiterated in the conclusion to the paper, 'Zealandia is not a collection of partially submerged continental fragments [as was inferred for Pacifica] but is a coherent 4.9 Mkm² continent.'

Citation analysis – Zealandia

The paper by Mortimer *et al.* (2017) has already received seven citations, surpassing the initial citation rate of either Nur & Ben Avraham's (1977) paper or Kamp's (1980) paper. Although the numbers of citations

are low, the distribution of initial citations by the geological and biological research communities is more weighted towards geologists for the Zealandia paper than was the case for the two Pacifica papers discussed earlier. Not surprisingly, Mortimer *et al.* (2017) refer to earlier papers about Zealandia, and the earliest three of these are used in the citation analysis described below.

Luyendyk's (1995) paper is the earliest reference to Zealandia noted by Mortimer *et al.* (2017): the trend in annual numbers of citations for this paper since its publication is shown in Figure 3. The pattern of citations with time shown in this plot differs somewhat from that in Figure 1, showing a high baseline and reaching its maximum citation count 15 years after publication. Figure 3 also shows comparable plots for two Zealandia-themed papers cited in Mortimer *et al.* (2017) from the mid-2000s, viz. Kula *et al.* (2007) and Mortimer *et al.* (2006). Both of these plots show the typical increase in citations a few years after publication, but both plots also show a resurgence of interest in 2016.

Most papers citing these three articles are positive about the concept of a continent in the New Zealand region, collectively using a range of types of evidence, including paleomagnetic investigations, gravity surveys, and radiometric dating. Figure 4 (an analogous plot to that in Figure 2) suggests that the concept of the Zealandia continent appears to have entered the mainstream of geological thinking to an extent that the Pacifica continent was unable to attain; in that there is a sustained high proportion of citing articles that positively refer to the concept of Zealandia. Moreover, in contrast to both Pacifica-themed papers discussed earlier, very few biogeographers have cited the Zealandia paper, and of those that have done so, most were supportive of the concept. This observation and the citation analysis suggest that in scientific circles the Zealandia continent might persist.

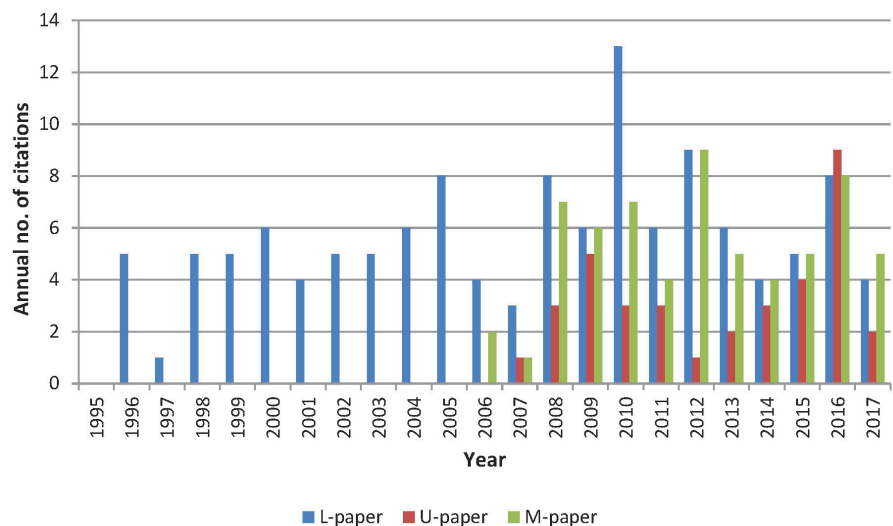


Figure 3. Variation with time of citations for Luyendyk (1995) – 'L-paper'; Kula *et al.* (2007) – 'U-paper'; and Mortimer *et al.* (2006) – 'M-paper'. The L-paper does not include the term Zealandia in its title, but it is included in its abstract; 'U-paper' and 'M-paper' include the term 'Zealandia' in the title.

Citations for L-paper compiled from: <https://scholar.google.co.nz/scholar?um=1&ie=UTF-8&lr&cites=1282618523195665222>

Citations for 'U-paper' from: <https://scholar.google.co.nz/scholar?um=1&ie=UTF-8&lr&cites=3389943439707408427>

Citations for 'M-paper' from: <https://scholar.google.co.nz/scholar?um=1&ie=UTF-8&lr&cites=16870958545418866542>

Political and economic implications of Zealandia

Mortimer & Campbell (2014, p. 9) presented an optimistic view of the political and economic future for island nations that become continents:

New Zealand and New Caledonia have gained new identities, new personas, as emergent parts of a sunken continent. The consequences and implications are huge. To be island nations is one thing, but to grow suddenly in stature and take on a continental identity changes everything.

New Zealand's recently expanded exclusive economic zone already includes much of Zealandia (Mortimer & Campbell 2014: 237, fig 5.5). Long-standing interest in the mining of surficial phosphate deposits on the Chatham Rise east of New Zealand (Kearns 1976) has benefited by the expansion of the exclusive economic zone, and the resource certainly offers the prospect of tangible benefits to the agribusiness interests in New Zealand (Chatham Rock Phosphate Ltd 2017), as suggested by previous field trials (Rajan 1987). Similarly, long-standing interest in petroleum and natural gas exploration in the region may be enhanced by the expansion (New Zealand Petroleum and Minerals 2014). It is noteworthy that while New Zealand seems interested in the economic potential for its expanded exclusive economic zone, New Caledonia views at least part of its expanded exclusive economic zone (Radio New Zealand 2015) as part of its conservation estate (Conservation International, undated), raising the prospect of a future debate between New Zealand and France. Although the emergent lands of Zealandia – New Zealand and New Caledonia – have comparatively modest resources of metal ores and other extractive resources, including, for New Caledonia, rare-earth elements (Lesnov 2010: 2-9), the depth of water to the submerged parts of Zealandia is likely to constrain both the exploration for and the recovery of such materials.

Agreement on the northern boundary of New Zealand's exclusive economic zone requires negotiation with the island nations of Fiji and Tonga, as well as with France in respect of New Caledonia.

New Zealand has enjoyed good relationships with Tonga (Campbell 2011, 2015), while in recent decades its relationship with Fiji has been tested by a series of military coups in that country (e.g. Alley 2001; Frankel 2009; Ratuva 2011). Race-based government and the coups' repeated threat to Fijian – and potentially other Pacific nations' – democracy is inconsistent with New Zealand's values and its commitment to Westminster-style politics.

The good relationship between New Zealand and France was strained when France was testing nuclear weapons in the atmosphere above Mururoa (or Moruroa) Atoll in French Polynesia. The replacement of atmospheric testing by underground testing did not diminish New Zealand's concerns, and contributed to New Zealand passing its nuclear-free legislation (Hensley 2013). France's terrorist act of sinking Greenpeace's *Rainbow Warrior* at its berth in Auckland, New Zealand's largest city, in 1985 (Robie 2015) led to an impasse between the two countries, which included mutual trade embargoes. The United Nations

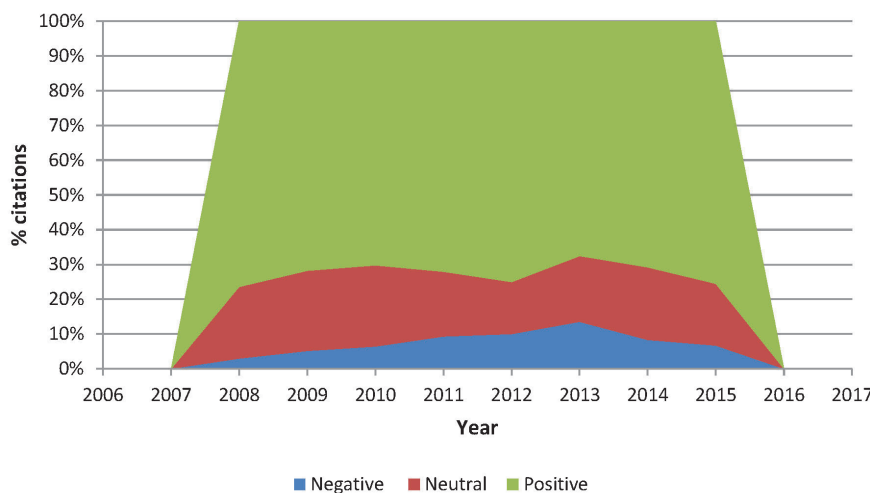


Figure 4. Variation of proportions of negative, neutral and positive citations relating to Zealandia of a combination of papers by Kula *et al.* (2007) and Mortimer *et al.* (2006); all calculated as five-year moving averages

ultimately intervened in the dispute, but the relationship between the two countries has taken decades to normalise.

While it is difficult to envisage that political and economic relationships between the nation-states of the submerged continent of Zealandia would be significantly different from that currently occurring between these island nations, 'Zealandia' has been used previously as a term evocative of New Zealand – as described below, and this may have implications for its use in socio-political contexts.

What's in a name?

The use of a female figure of Zealandia on a 1901 New Zealand postage-stamp was 'intended to become a figure of national personification representing the then British colony in much the same way as 'Britannia' represents the United Kingdom' (Stamps NZ, undated). Zealandia was also used as a symbol of nationhood at the Centennial Exhibition in Wellington in 1939–1940, by which time New Zealand had become a Dominion of the British Empire (Figure 5).

However, the name 'Zealandia' bears no relationship to the name of the country; rather, the country is named after 'Zeeland,' a maritime province in the Netherlands. The name 'Nieuw Zeeland' was conferred on the 'land uplifted high' that Dutch explorer Abel Tasman discovered in 1642 by Joan Blaeu, official Dutch cartographer to the Dutch East India Company (Wilson 2016a). To better represent actual history, then, at the very least, the spelling of 'Zealandia' should be changed to 'Zeelandia'. However it is spelt, this name can be argued as too partisan for a continent that Mortimer & Campbell (2014) recognise is the home of other nation-states and territories as well as New Zealand.

Abel Tasman's name was given to the Tasman Sea, which separates New Zealand from Australia, and which overlies 'Tasmantis' – a name for a part of the submerged continent which was revived by Cullen (1969) from its earlier use by Süssmilch & David (1919). Abel Tasman's excursion to New Zealand was brief; a much more definitive New Zealand was established by the British navigator James Cook's circumnavigation of its two main islands in 1769. On Cook's next voyage he discovered New Caledonia, in 1774. Thus, New Caledonia and New Zealand have a shared history of discovery, and this

Figure 5. Certificate of attendance at the New Zealand Centennial Exhibition held in Wellington in 1940. It shows 'a female figure [Zealandia?] partially draped in New Zealand flag, before a montage of New Zealand scenes including Maori whare and canoes, sailing ship and steamship in harbour, woodpigeon and tui on pohutukawa, kowhai, with clematis, manuka, and a kiwi in centre foreground. Edges are a frame of Maori carving and patterns'. [Image: Alexander Turnbull Library, Eph-C-EXHIBITION-1939-01]



suggests that the name of the submerged continent of which they are both emergent islands should reflect that heritage. As a name, 'Cookia' is hardly euphonious, but, more significantly, there are contested views about the effect of James Cook's visit on the lands claimed for the British crown, an example of which is shown in Figure 6. Thus, adopting Cook's name or a variant thereof for the continent would be contentious.

Also likely to be contentious would be a name derived from the sixteenth-century explorations of Portuguese explorer Cristóvão de Mendonça along the west and east coasts of Australia and the North Island of New Zealand – this last inferred by Trickett (2007: 232) to be 'Illa da Magna' – 'Island of Mahogany', portrayed on one of the Vallard sixteenth century maps (Vallard 1547). Although currently identified by Trickett (2007, p. 256) as possibly Tonga, the north-easternmost island on this map, referred to as 'y de Tubaros' in Richardson (2015: fig. 9) might yet be construed to be part of New Caledonia.

The prospect of pre-Tasman excursions in the region are becoming more acceptable, e.g. reference to a book on the subject (Cowie 2015) being added in 2016 to *Te Ara*, New Zealand's 'official' online encyclopedia (Wilson 2016b), but not all historians and scientists in New Zealand and Australia are convinced that the Portuguese were in the area before Tasman and Cook – e.g. Moon 2013; in which Moon's view is unchanged from that presented four decades earlier by Stokes (1970). This is rather a shame, as Mendonsia (a latinised form of Mendonça's anglicised name Medonsa) could have been an appropriate name for a continent that includes both New Zealand and New Caledonia.

Although the precise interpretation of the Vallard maps continues to be debated (e.g. Richardson 2015), the maps themselves *are* physical entities related to the geographic area of the submerged continent. On that basis, 'Vallardia' could be worthy of consideration for the name of the continent. However,



Figure 6. (Left) Emmanuel Phillip Fox's depiction of the landing of Captain James Cook at Botany Bay (Australia) in 1770, which was commissioned and painted in 1902. [Image: National Gallery of Victoria, Melbourne: <https://www.ngv.vic.gov.au/explore/collection/work/5576/>]

(Right) Reworking of Fox's depiction, by aboriginal artist Daniel Boyd. His 2006 image has the caption 'We call them pirates out here', and portrays James Cook as 'a pirate ready to take part in the great colonial land grab. Boyd has inserted the faces of his friends as the ship's crew, hoisting the flag whilst Cook surveys the scene with his one-eye. Smoke in the far distance is evidence of an inhabited land in direct contrast to Cook's taking of the land and the later proclamation of it as Terra Nullius [meaning 'no-body's land']. [Image: Museum of Contemporary Art: <https://www.mca.com.au/collection/work/2006.25/>]

although the name has no association with colonial activities in New Zealand, New Caledonia or Australia, and France might find the name appealing because it ignores British imperial aspirations in the region, this suggestion is unlikely to be well received by historians.

Epilogue: Pacifica regained

As the first proponents of 'Pacifica', Kamp (1980) and Nur & Ben Avraham (1977) could be considered to have been undertaking a sub-creation, in the sense used by J.R.R. Tolkien in his sub-creation of Middle-earth, viz. 'creating another or secondary world with such skill that it has an 'inner consistency of reality'' (Duriez 2001: 231), most evident in his *The Silmarillion* (Tolkien & Tolkien 1977). Peter Kamp, one of the sub-creators of Pacifica – by virtue of his 1980 paper, cites his own work on this matter only once subsequently (Kamp 1986).

The fall of Pacifica from favour among scientists could again be considered analogous to Tolkien's 'theme of fall as one of the central concerns of his mythology of Middle-earth' (Duriez 2001: 176). However, as readers of *The Lord of the Rings* (Tolkien 1954–1955) know only too well, the success of the hobbits' activities ensured the survival of Middle-earth, both socially and geographically – Tolkien's 'eucatastrophe' (Shippey 2001: 206–212). Kamp took no part in the development of the idea that culminated in the suggestion of Zealandia as a continent, although two more recent papers of which he is a co-author refer to it (Furlong & Kamp 2009; Lindow *et al.* 2016). Nevertheless, if the 'fall' of Pacifica, and the subsequent development of Zealandia are considered part of the same sub-creation, then there is no reason why the term 'Pacifica' could not be revived.

Of course, Tolkien has not been alone in portraying 'fall' and revival; John Milton explored the idea from a decidedly Christian stand-point nearly three centuries earlier in his poem *Paradise Lost* (Milton 1667), in respect of 'the fall' (Compton 2015); and its sequel *Paradise Regained* (Milton 1671), in respect of reinstatement (Dyson 1961). Thus, on at least the basis of Milton and Tolkien, there is an argument for the term Pacifica to be 'regained' as the name for the provisionally named Zealandia.

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