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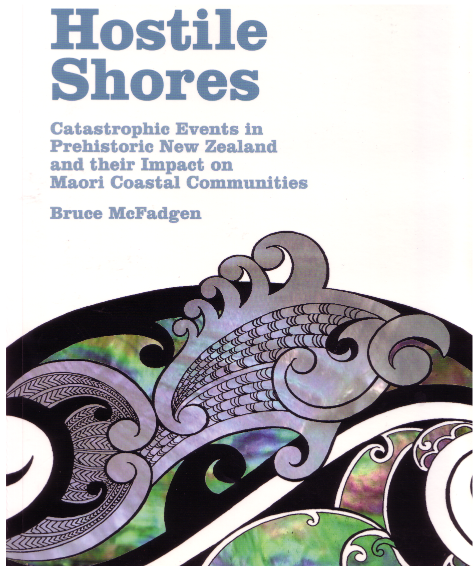
BOOK REVIEW



Bruce McFadgen. *Hostile Shores, Catastrophic Events in Prehistoric New Zealand and Their Impact on Maori Coastal Communities*. 2007. Auckland: Auckland University Press. 298 pages. ISBN: 9781869403904. List price $35 US, trade paperback.

Reviewed by: William B Bull, Professor Emeritus, Department of Geosciences, University of Arizona, 1040 E 4th St., Tucson, Arizona 85721, USA. Email: bill@activetectonics.com.

Hostile Shores is a meticulous geoarchaeological essay. It is a treasure trove of ways to use radiocarbon dating to better understand when and how Polynesians colonized New Zealand. These settlers did not have a written language, so the challenge facing McFadgen was to discern how these people adapted to population growth, changing food resources, and to the immediate and long-term consequences of natural hazards. These include volcanic eruptions and of course the earthquakes that shake this island nation astride the boundary between the Australian and Pacific tectonic plates. Such a task represents much of a lifetime of observations, using newly developed techniques, and appraisals of ^{14}C dating in the age range of AD 800 to 1800.

The chapter about ^{14}C dating is a major strong point, and should be required reading in many earth-science courses that utilize ^{14}C analyses. His most welcome approach to ^{14}C dating is outstanding in the way it uses the strengths and deals with the weaknesses of ^{14}C dating. As a paleoseismologist, I have grown weary of claims where stratigraphic ^{14}C samples are used to "date" the time of a prehistoric earthquake. Only terrestrial cosmogenic nuclide ^{14}C could do this for surface-exposure dating of samples such as coseismic rockfalls. Traditional ^{14}C analyses of samples from a stratigraphic section can only provide estimates of the ages of organic matter created before or after the seismic-shaking event of interest. ^{14}C dating constrains, not dates, the time of an earthquake.

McFadgen confronts this "inbuilt" component of age error estimates in several ways. We commonly present geological and archaeological ^{14}C age estimates at the 1-σ confidence level, but McFadgen opts to present ^{14}C age estimates at the 2-σ (95%) confidence level. His standard approach is to use many, not one, age estimates to constrain the most likely age of the event being studied. The age ranges shown in his "bracket diagrams" span considerable time because they are all at the 95% confidence level. His admission of the before-and-after quality of ^{14}C dating is handled by upward and downward pointing age-estimate ranges in his bracket diagrams. This approach uses ^{14}C dating to define the most likely age range for an event. Defining the minimum possible age is one nice result of the bracket-range approach.

The numerous bracket diagrams in his book typically use 10 to 30 calendric ^{14}C dates arranged in a left to right sequence. The goal is to discern the younger limit of the oldest minimum age and the older limit of the youngest maximum age (both at the 95% confidence level). The resulting bracket range generally exceeds 100 yr, but this cautious, rigorous method acknowledges potential sources of error.

McFadgen's refreshing approach to ^{14}C dating includes admitting when an age estimate is unusable. Dates are also classed as close, minimum, and maximum. Why bother? Maori colonized New Zealand in the late 13th century, but many of the 1000 ^{14}C dates previously led to an incorrect estimated time of arrival of about AD 800. Wood and charcoal samples from unknown parts of slow-growing species of trees can be so misleading that it is better to class samples as unusable if the magnitude of the inbuilt age factor is unknown. Confidence in results is improved if samples are restricted to twigs and leaves, bark and outermost rings, and to wood and charcoal that has been identified as a fast-growing species. Class the sample as unusable if you cannot estimate its inbuilt age.

This is a rigorous approach for earth scientists who commonly are lucky to find only 1 or 2 samples for ^{14}C dating in a trench across a fault scarp, or in a streambank exposure of a gravelly valley fill. That lone piece of charcoal will have an even larger inbuilt age if recycled from an upstream stream deposit. Being able to collect a large chunk of charcoal that is big enough for standard ^{14}C dating surely will have a larger inbuilt age than carbonized outermost rings of a tree.

This geoarchaeological treatise provides a most complete assessment of human activities in New Zealand before the arrival of European settlers in the 19th century. McFadgen demonstrates a nice skill in asking key questions in his research about coastal settlements and then he obtains the essential data to resolve a particular issue. His geological background allows him to recognize the importance of the most incipient of soil profiles as times representing landscape stability that separate different intervals and rates of geomorphic process in a stratigraphic exposure. His archaeological background allows him to document earthquake- or volcanic-generated changes in landscapes through the use of ^{14}C-dated shells in numerous coastal middens.

New Zealand's shorelines provided diverse sources of food and fertile soils for the Maori settlers of an island paradise the size of the UK. Luckily, the North Island volcanic eruptions since AD 1300 did not have a major impact. Numerous large earthquakes did. Damage from seismic shaking was minimal, but food resources were affected in several ways. Coastal uplift of 1 to 3 m changed shellfish habitats, and would drain shallow lagoons. Tectonic subsidence or liquefaction of silty deposits would have placed low-lying settlements and fields under threat from storm waves. The longer-term consequences of earthquakes were caused by large increases of sediment yield from mountain watersheds where seismic shaking had caused many landslides. Waves of sand and gravel would move down stream channels to the coast to create new sand dunes that covered fertile fields and then advanced inland. Maintaining fields and settlements was difficult.

Readers should keep in mind that the processes of erosion and deposition in New Zealand may be 100 times faster than what they are used to. For example, each earthquake on the Alpine fault creates a new, large beach ridge as sand is blown inland after pulses of sediment are washed down rivers (Wells and Goff 2006, 2007).

It was tsunamis that were the most damaging earthquake-related hazard. Earthquake-generated waves that swept inland for as much as 1 km and to altitudes of >20 m surely caused immediate loss of life and property. Specialized skills, such as localized crafting of fine adzes, were lost forever. Fields were blanketed with infertile sand and salt would have to be leached before soil fertility could be restored. Food resources were reduced so severely that survivors moved to higher ground where they could best defend remaining stored food. The Maori way of life changed after the many earthquakes of the 15th century.

Bruce McFadgen is a truly meticulous scientist who makes sure that he does not overstate his case. *Hostile Shores* is a detailed examination of prehistory that reveals unusual skills in archaeology, geology, and ^{14}C dating.

REFERENCES

Wells A, Goff J. 2006. Coastal dune ridge systems as chronological markers of palaeoseismic activity—a 650-yr record from southwest New Zealand. *The Holocene* 16(4):543–50.

Wells A, Goff J. 2007. Coastal dunes in Westland, New Zealand, provide a record of paleoseismic activity on the Alpine fault. *Geology* 35(8):731–4.