



THEMATIC SECTION

Consequences of Sea-Level Change During the Holocene in the Pacific Basin: Introduction

Among the sessions at the XVIII Pacific Science Congress, held June 5–12 1995 in Beijing, China, was one on Geography, convened by Harley Manner (University of Guam) and Zhang Piyuan (Chinese Academy of Sciences) and sponsored by the Pacific Science Committee on Geography. A sub-session was devoted to looking at the consequences—human and physical—of Holocene sea-level changes in the Pacific Basin, defined as both the islands and the continental periphery.

This sub-session attracted numerous fine papers and considerable discussion. It brought together geoscientists and archaeologists, paleontologists and prehistorians, oceanographers and sociologists. It has not been possible to gather all the papers and discussions for publication, so a selection is given here. This selection touches on all the main issues covered and characterises the entire session successfully.

Humans were inhabiting most parts of the Pacific Rim probably long before the start of the Holocene 10,000 years BP but only apparently during the later part of the epoch did they begin moving out into the islands. It is plausible to assume that this movement was stimulated by coastal flooding caused by postglacial sea-level rise, particularly in east and southeast Asia. Initial human occupation of Pacific islands may have been controlled largely by contemporaneous sea-level changes, so an understanding of the latter provides the key to unlocking the precise nature of the former.

Particularly since the influential compilation of Rhodes Fairbridge (1961), the course of Holocene sea-level changes has been vigorously debated. Fairbridge favored the view that sea level rose above its present mean level in the middle Holocene and then fell to its present level. The 1967 Carmarsel expedition was mounted with a view to testing this idea in the tectonically-stable Caroline and Marshall Islands of the northwest Pacific and concluded that, contrary to the view of Fairbridge, sea level had been rising continuously up until the present (BLOOM, 1970).

Over the next decade, data were gathered from various parts of the Pacific (and elsewhere) in support of both views. By the end of the decade, the debate was neatly polarised (BLOOM, 1980; SCHOFIELD, 1980).

Since 1980, for the Pacific (although not the Caribbean), the data have almost exclusively favored the Fairbridge-Schofield model of a mid-Holocene sea-level rise and a late Holocene sea-level fall. Syntheses of such studies in the Pacific islands include those from Japan (OTA *et al.*, 1985), New Zealand (GIBB, 1986), French Polynesia (PIRAZZOLI and

MONTAGGIONI, 1987), Fiji, Tonga and Samoa (NUNN, 1990, 1991). By the end of the 1980s, only some of the northwest and northeast Pacific islands, notably Micronesia and the Hawaii group, appeared not to have experienced a mid-Holocene high sea level. An important study of modern reef age distribution in New Caledonia (LECOLLE and CABIOCH, 1988) showed how the Carmarsel expedition could have been deceived by a lack of emerged reef into thinking that Holocene sea level had been rising continuously (NUNN, 1994). This paved the way for a re-evaluation of the evidence for Holocene sea-level change in Micronesia (KAWANA *et al.*, 1995) which showed that, *contra* Carmarsel, there had been a mid-Holocene high sea level in the region.

The first paper in this special section is a similar re-evaluation of the evidence in the Hawaii islands. In it, Anthony Jones argues that the geomorphic evidence for a Holocene high sea level is overwhelming, and discusses several sites which he has investigated. The idea of a Pacific-wide higher-than-present sea level in the middle to late Holocene is consonant with the most plausible models of rheological response to deglaciation.

The meshing of sea-level and human histories in the Pacific islands during the Holocene is still in its early stages. Hence Melinda Allen's study of Aitutaki is important since it demonstrates that human settlement here occurred at the same time as sea level was falling during the late Holocene. By implication, the lack of earlier indicators of human occupation *may* be the result of their removal at the time of the sea-level maximum.

The next paper by Patrick Nunn looks at a neglected part of Holocene sea-level history—the last 1000 years—and shows, from a variety of evidence, that there were significant changes. The influence that these comparatively low-magnitude changes had on humans was overwhelmed by contemporary climate changes, although the existence of problematic data is acknowledged and discussed.

The focus shifts to the last 100 years and to the coast of China in the next paper by Ying Wang. The effects of sea-level rise have here been locally exacerbated by human activities, principally groundwater extraction and overloading of soft-rock coasts. Rates of submergence (sea-level rise plus subsidence) are causes of great concern, particularly given the vulnerability of China's coast to storm surges and tsunamis.

Such problems also affect the Pacific islands and, in the final paper, Nobuo Mimura and Patrick Nunn outline the nature of recent shoreline change in Fiji, and examine the ef-

ficacy of solutions. Improvements in seawall design and composition could significantly mitigate the effects of likely future sea-level rise.

The future study of the issues raised in this special section is likely to continue apace. There are now sufficient basic data to allow the course of Holocene sea-level change in the Pacific to be recognised. The next decade will probably concentrate on refining the record—a recent paper has shown how it could be interpreted as an oscillating rather than smooth signal (NUNN, 1995)—and linking it to model retrodictions of lithospheric response to deglaciation. These studies will benefit those of early human settlement in the Pacific islands, and hopefully the troubled question about what changes early humans caused to the coastal zone and what changes were out of their control will be resolved. This issue could extend to the last 1000 years if these become a focus for sea-level research, particularly in view of their value in the search for potential analogs of the present and future course of sea-level change. Just as an understanding of past sea-level changes and their environmental and human consequences can benefit an understanding of future changes, so it will be possible to understand more about past sea-level changes as we monitor the course of future sea-level change.

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