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# Holocene Climate in Coastal Peru: Potential Implications for Climate Dynamics during the Hypsithermal Period

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**Final Report for Period:** 08/1997 - 07/1998**Submitted on:** 02/17/1999**Principal Investigator:** Wright, James D.**Award ID:** 9711911**Organization:** University of Maine

Holocene Climate in Coastal Peru: Potential Implications for Climate Dynamics during the Hypsithermal Period

**Participant Individuals****Senior Personnel****Name:** Wright, James**Worked for more than 160 Hours:** Yes**Contribution to Project:****Post-doc****Graduate Student****Undergraduate Student****Partner Organizations****Other Collaborators****Activities and Findings****Research Activities:**

Faunal assemblages in shell middens along the coastal Peru (4 to 9°S) indicate that molluscan bioprovinces between 6000 to 5000 yr. ago were displaced up to 500 km to the south of their present positions. Previous studies have interpreted this as a classic response to global warming during the Hypsithermal. In contrast, oxygen isotope records from marine bivalves (4° and 9°S) indicate that coastal waters were 3 to 4°C cooler during the 'mid' Holocene relative to present temperatures. This study generated stable isotope records from planktonic foraminifera in two offshore cores (11°S) to try to resolve the apparent discrepancy. Approximately 100 stable isotope analyses from eight different species of planktonic foraminifera were made. The three most abundant species, *Gs. sacculifer*, *N. dutertrei* and *G. bulloides*, recorded ~1‰ higher  $\delta^{18}\text{O}$  values during the early and middle Holocene relative to the present day  $\delta^{18}\text{O}$  values. These data indicate that the coastal waters along northwestern Peru were ~4°C cooler during the mid-Holocene. Carbon and nitrogen stable isotopes,  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ , were measured on the sedimentary organic matter. There was little change in the  $\delta^{13}\text{C}$  values. The  $\delta^{15}\text{N}$  values, however, were ~3 per mil lower for the interval between 7000 to 5000 yr. ago relative to the present. Increased upwelling of colder waters is the best explanation for colder temperatures lower nitrogen isotope values. Two publications are being readied for submission.

Nicholas, S.L., J.D. Wright, D.H. Sandweiss, Northwestern Peruvian Climates during the Mid-Holocene: Evidence from Molluscan Stable Isotopes for Colder Waters. to be submitted to *Quat. Res.*

Wright, J.D., Planktonic foraminiferal stable isotopic evidence for increased upwelling along the Peruvian coast during the Mid-Holocene.

**Research Findings:**

It is difficult to interpret the  $\delta^{15}\text{N}$  data in terms of upwelling alone, but both the oxygen and nitrogen isotopic data are consistent with higher regional upwelling rates during the 'mid' Holocene. The following preliminary interpretations are made on these data. Evidence for wetter terrestrial climates in northwestern Peru prior to 5000 yr. ago combined with faunal and isotopic records suggesting that the coastal upwelling zone was located much further to the south than at present. This allowed seasonal rainfall in parts of northwestern Peru that are deserts today, accounting for the diverse molluscan fauna during the mid-Holocene. Beginning around 5000 yr. ago, the molluscan fauna migrated to their present positions, planktonic foraminifera oxygen isotopes decreased, and nitrogen isotopes increased to near near-modern values. The post-5000 changes recorded in this region may be linked to the insolation changes that are most pronounced in Africa and

southeast Asia.

**Research Training:**

**Education and Outreach:**

**Journal Publications**

**Books or Other One-time Publications**

**Web/Internet Sites**

**URL(s):**

**Description:**

**Other Specific Products**

**Contributions**

**Contributions within Discipline:**

This project reconstructed the marine conditions along northwest Peru during the Holocene. Faunal proxies indicate that mid-Holocene conditions differed from the present. Some interpretations suggest that northwestern Peru was warmer and resulted from different atmospheric circulation patterns during the mid-Holocene. As an exploratory project, planktonic foraminiferal stable isotope records were generated from marine cores near the region with anomalous molluscan faunas. The results to date show that the mid-Holocene planktonic foraminifera (*Gs. sacculifer*, *N. dutertrei*, and *G. bulloides*) recorded  $\delta^{18}O$  values that were 1‰ higher during the early and middle Holocene relative to their modern counterparts. The simplest explanation is that marine conditions were colder and not warmer during the early to middle Holocene. These data provide quantifiable results for an area that so far has been devoid of good data or reliant on poor data. These data can be used by climate modelers to better simulate the mid-Holocene climates to help understand the larger-scale operation of the ocean-atmosphere system.

**Contributions to Other Disciplines:**

A related subdiscipline that might be interested in these results is Atmospheric Sciences. The changes in the upwelling system along coastal Peru has strong implications for the atmospheric circulation patterns 6000 yr. ago.

**Contributions to Education and Human Resources:**

**Contributions to Science and Technology Infrastructure:**

**Beyond Science and Engineering:**

**Categories for which nothing is reported:**

Partner Organizations

Activities and Findings: Any Research Training

Activities and Findings: Any Education or Outreach

Any Journal

Any Book

Any Product

Contributions: To Any Education or Human Resource

Contributions: To Any Science or Technology Infrastructure

Contributions: Beyond Science or Engineering