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Holocene climate and seasonality of shell collection at the Dundas Islands Group, northern British Columbia, Canada—A bivalve sclerochronological approach

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ABSTRACT

To analyze environmental changes and the seasonality of shell collection in British Columbia during the Holocene, oxygen isotopes were measured from modern and archeological (1337–7438 cal yr BP) shells of the butter clam *Saxidomus gigantea*. 1697 discrete isotope samples were taken from two modern and 27 archeological shells with a high temporal resolution (sub-seasonal up to daily). Archeological shells were collected from five shell midden sites on the Dundas Islands Group, northern British Columbia, Canada. The oxygen isotope data reveal clear annual cycles, with the most positive $\delta^{18}O_{shell}$ values occurring during the cold season (slower growth, annual growth line formation) and the most negative $\delta^{18}O_{shell}$ values during the warm season (period of faster growth). Whereas the most positive $\delta^{18}O_{shell}$ values remained relatively constant throughout the Holocene, the warm season $\delta^{18}O_{shell}$ values reflected considerable variability. Summer values observed in the early and late Holocene became approximately 1‰ more negative around 2500–3000 and 5500–6000 BP, implying lower salinity during the Mid-Holocene. Variations in the oxygen isotopic composition of marine shells reflect changes in temperature and salinity. Such large changes in $\delta^{18}O_{shell}$ are unlikely being caused by temperature changes alone. Furthermore, the large annual $\delta^{18}O_{shell}$ amplitude of 3.29–6.56‰, which corresponds to a temperature range of 14.5–29.0 °C, exceeds the local annual temperature range by 2.5–17.0 °C (0.58–3.85‰). The shell isotope record was also compared with other proxy archives, such as pollen, lake sediments and chironomid communities. The climate changes reflected in the $\delta^{18}O_{shell}$ record match well with environmental changes reported for British Columbia.
In addition to the climate information outline above, details about the season of shell collection by the occupants of Dundas Islands can also be obtained from the oxygen isotope and sclerochronological analyses of shells. The oxygen isotope profiles reveal that the archeological shells were collected year-round through time, and that there is no difference in the collection pattern between small and large shell midden sites. This is indicative of a multi-seasonal shellfish harvesting as well as long-term variation in occupation patterns at the Dundas Islands. Despite changes in climate over the Holocene, people maintained a consistent pattern of year-round shellfish harvest. The Mid-Holocene transition is also characterized by a number of cultural changes ranging from technological changes to changes in settlement and subsistence practices of hunter–gatherer groups.

1. Introduction

Climate plays an important role in human–environmental interactions and the way in which cultural practices and historical events occur. People respond to climate changes through adaptations in technology, or changes in seasonal subsistence procurement (e.g., Kennett and Kennett, 2000). However, an abrupt and/or rapid climatic change may lead to a collapse of human populations. For example, it has been argued that droughts played a major role in the collapse of the Maya civilization and other cultures (Hodell et al., 1995; Binford et al., 1997; Brenner et al., 2001; deMenocal, 2001; Haug et al., 2003). Decreased solar activity or enhanced volcanic activity lead to a worldwide cooling, e.g., causing the Little Ice Age between the 16th and 19th centuries (e.g., Briffa et al., 1998; Mauquoy et al., 2002), which leads to a lower agricultural activity. The depletion of staple resources may cause populations to migrate (e.g., Döös, 1994; Meze-Hausken, 2000). Archeological data combined with paleoclimate proxy archives, such as tree rings, lake sediments and bivalve shells (Kennett and Voorhies, 1996; Woodhouse and Overpeck, 1998; Cook et al., 1999) can reveal links between culture and climate.

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