



## **The world's oldest pottery/stone arrowheads appeared in the coldest climate in Japan**

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Pottery is often accepted as the main criterion for the Neolithic Epoch in the hunter–fisher–gatherer continuum of East Asia, where pottery preceded agriculture by several millennia. By contrast, pottery and agriculture appeared almost simultaneously in Europe, and plant and animal husbandry developed before the emergence of pottery in the Near East. However, little is known about these environmental factors at the regional scale. Core MD01-2409 collected off the coast of northern Japan provided the alkenone sea surface temperature (SST) and ice volume change based upon the fluctuation of  $\delta^{18}\text{O}$  value of the benthic foraminifera *U. akitaensis* during the last 27 kyr. High correlation between SST and atmospheric temperature (AT) enables us to reconstruct quantitative AT from SST. The SST in 27–23 cal. kyr BP was 12.7°C and decreased in LGM (10.4–12.7°C, mean 11.9°C), where it was approximately 3.8°C colder than the current SST (15.7°C). The minimum SST (8.7°C) was not recorded in the LGM but at 15.68 cal. kyr BP in Heinrich Event I (HE-1). The SSTs indicated two-step warming, including the Bølling–Allerød Episode (10.4–14.0°C, mean 12.4°C) and the pre-Boreal Period (13.4–16.9°C, mean 15.0°C). This continuous warming was broken by the cold episode of the YD (Period 5, 11.9–14.0°C, mean 12.8°C). The SST showed a broad maximum (~17.3°C) in the mid-Holocene (5–7 cal. kyr BP), which corresponded to the Jōmon transgression. The Jōmon in the north of Honshu Island made the earliest projectile points (stone arrows) and pottery in 15.5–16.5 cal. kyr BP around HE-1 in the world, which corresponded to a period with an Asian Monsoon weakened by atmospheric circulation. Northern Japan experienced its coldest summer (SST of 8.7°C; AT of 5.2°C) around 15.68 cal. kyr BP; these summer temperatures were approximately 7–11°C lower than they are currently (~15.7°C and ~16.7°C), respectively. The climate was a little colder than that of the modern cities of Nemuro and/or Nosappu in Hokkaido. Even though the relationship between climate and their appearance in Japan might not be direct, the earliest pottery and projectile points (stone arrows) in the world were associated with the coldest period that *Homo sapiens* experienced since arriving in the colder regions of the Japanese archipelago.

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