Chronology, climate and technological innovation associated with the Howieson's Poort and Still Bay industries in South Africa

Jacobs *et al.*[1] have presented new dates relating to the chronology of two important African episodes in prehistory, associated with the Howieson's Poort (HP) and Still Bay (SB) industries linked to technological innovation. They present results based on optically stimulated luminescence (OSL) dating of sediments, suggesting ages of between 59.5 and 64.8 thousand years ago (kyr) for the HP (with 95% confidence limits ranging between 56.5 and 68.2 kyr at the lower and upper extremes, respectively). Their OSL ages for the SB are confined to between 71.0 and 71.9 kyr (with lower and upper 95% confidence limits ranging between 67.1 and 72.0 kyr), although earlier results had suggested that the SB at Blombos extended back to *c.* 77 kyr.[2] In the context of their data, Jacobs *et al.*[1] state that environmental factors 'were not necessarily the driving force behind the technological change'. This statement can be assessed in the context of independent data, including temperature indices for the Vostok core in Antarctica, dated by Petit *et al.*,[3,4] and temperature indices for a South African sequence at Klasies River.[5,6]

Given the OSL dates in relation to temperature indices based on deuterium isotope ratios from the Vostok ice core,[3,4] it would appear that the innovative SB industry corresponds to periods when temperatures were within the range of relatively warm (but cooling) temperatures close to the end of oxygen isotope stage (OIS) 5, and the HP episode of innovation falls within the range of relatively warm temperatures at the end of OIS 4, and at the beginning of OIS 3. Further, it would appear that the 'gap' between the HP and SB industries includes most of the coldest interval of OIS 4 associated with deuterium isotope ratios of about –482 parts per thousand (ppt) in the Vostok ice core. By comparison, the mean deuterium isotope ratios for the periods associated with the HP and SB dated by Jacobs *et al.*[1] are significantly warmer, with mean values of –474.3 (±3.8 ppt) and –467.3 (±2.7 ppt) respectively, using deuterium isotope ratios for Vostok published by Petit *et al.*[4] as a frame of reference.

On the basis of temperature indices for terrestrial sequences in southern Africa, based on multivariate analyses of rodents and insectivores, as well as on concentrations of marine molluscs which relate to variability in sea levels, Thackeray[5] has noted (through the use of graphs based on the quantification of indices for temperature and sea level) that the HP industry at Klasies River on the southern Cape coast coincides with a warm interval and a subsequent cooling episode. The temperature indices based on mammalian microfauna have been calibrated against deuterium isotope ratios from the Vostok core. Thus it is possible to look not only at patterns of temperature variation, but also the degree of variation on a calibrated scale. The results indicate that the mean temperature index (SSF1) for the Klasies River HP period can be expected to correspond to a mean deuterium isotope ratio of –469.4 ppt (associated with a range between –463 and –476 ppt), which is comparable to the deuterium isotope ratios within a range of –460 and –480 ppt for the warming episode at the end of OIS 4 and the subsequent cooling interval at the end of the warmest period of OIS 3.[5]

These observations suggest that environmental factors, notably temperature, are in fact important variables which contributed to archaeological visibility at times of technological innovation, consistent with data presented by Thackeray.[5,6]

I am grateful to C. Henshilwood, B. Chase and A. Morris for comments on this manuscript.

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J. Francis Thackeray

Institute for Human Evolution, University of the Witwatersrand, Wits 2050, South Africa.

E-mail: francis.thackeray@wits.ac.za