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Climatic controls on Later Stone Age human adaptation in Africa's southern Cape

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ABSTRACT

Africa's southern Cape is a key region for the evolution of our species, with early symbolic systems, marine faunal exploitation, and episodic production of microlithic stone tools taken as evidence for the appearance of distinctively complex human behavior. However, the temporally discontinuous nature of this evidence precludes ready assumptions of intrinsic adaptive benefit, and has encouraged diverse explanations for the occurrence of these behaviors, in terms of regional demographic, social and ecological conditions. Here, we present a new high-resolution multi-proxy record of environmental change that indicates that faunal exploitation patterns and lithic technologies track climatic variation across the last 22,300 years in the southern Cape. Conditions during the Last Glacial Maximum and deglaciation were humid, and zooarchaeological data indicate high foraging returns. By contrast, the Holocene is characterized by much drier conditions and a degraded resource base. Critically, we demonstrate that systems for technological delivery – or provisioning – were responsive to changing humidity and environmental productivity. However, in contrast to prevailing models, bladelet-rich microlithic technologies were deployed under conditions of high foraging returns and abandoned in response to increased aridity and less productive subsistence environments. This suggests that posited links between microlithic technologies and subsistence risk are not universal, and the behavioral sophistication of human populations is reflected in their adaptive flexibility rather than in the use of specific technological systems.

1. Introduction

South Africa's southern coastal margin is a key region for the evolution and development of our species (Ambrose and Lorenz, 1990; Ambrose, 2002; Henshilwood et al., 2002, 2004a; Powell et al., 2009; Marean, 2010; Brown et al., 2012). The southern Cape archaeological record has reframed the debate about the evolution of human behaviors, providing early examples of engravings, ornaments, heat treatment of tool-stone and the focussed consumption of marine resources (Henshilwood et al., 2002, 2004b, 2014; Marean, 2014; Delagnes et al., 2016). The region also exhibits regular technological turnover through the last 100,000 years, with the intermittent production of bladelets, bifacial points and backed artefacts and the use of fine-grained rock, interspersed with periods lacking regular retouched flake forms and dominated by locally available rocks such as quartzite and quartz (Deacon, 1984; Wilkins et al., 2017). The links between these variable technological and subsistence records and their environmental context – necessary to arguments about the evolution of human adaptation – remain surprisingly unclear (Deacon, 1982; Roberts et al., 2016). This reflects the region's

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particular climatic dynamism (Chase and Meadows, 2007) coupled with disagreement concerning the interpretation of its paleoenvironmental archives (e.g., Deacon and Lancaster, 1988; Chase and Meadows, 2007; Faith, 2013b; Marean et al., 2014).

In this paper, we focus on the Later Stone Age record in the southern Cape, for which – in contrast with the Middle Stone Age – high resolution environmental and archaeological data are now available. We explore the strength of coupling between environments, subsistence behavior and lithic technology over the last 22,300 years to understand whether, and how closely, human behavior tracked environmental change. Spanning the transition from the Last Glacial Maximum (LGM; 26.5–19 ka; Clark et al., 2009) to the Holocene (11.7 ka to present; Lowe et al., 2008), and episodes of the use of bladelet-rich technological systems, our data also have a bearing on broader debates about the role of what are often termed ‘microlithic’ technologies in issues of human adaptation and expansion.

2. Later Stone Age environments and archaeology in the southern Cape

Influenced by both temperate and tropical climate systems (Fig. 1), long-term climate change in the southern Cape is characterized by significant and often abrupt fluctuations (Heaton et al., 1986; Talma and Vogel, 1992; Chase and Meadows, 2007; Bard and Rickaby, 2009; Chase et al., 2013; Quick et al., 2015, 2016). Existing evidence indicates that during the Holocene the relative influences of the two dominant synoptic scale moisture-bearing systems – 1) the southern westerly storm track, which expands/shifts northward in the winter, and 2) the tropical easterly flow, which transports moisture from the Indian Ocean during the summer – have varied significantly (Chase et al., 2013, 2015b). However, there is little detailed paleoenvironmental evidence predating the Holocene (Chase and Meadows, 2007; Carr et al., 2016b), and as a result there are contradictory opinions concerning conditions since the LGM (Deacon and Lancaster, 1988; Partridge et al., 1999, 2004; Chase and Meadows, 2007; Kohfeld et al., 2013; Sime et al., 2013; Faith, 2013b; Stone, 2014), to the extent that some studies conclude that the region was exceptionally “harsh” and arid during the LGM (Scholtz, 1986; Deacon and Lancaster, 1988), while others infer greater humidity and highly productive terrestrial environments (e.g., Parkington et al., 2000; Faith, 2013b). This uncertainty has fundamentally hindered our understanding of past climate dynamics in the region, and, by extension, the impact of past climate change on hunter-gatherer adaptive and subsistence strategies during both the Later and Middle Stone Age.

In the southern Cape, the Later Stone Age archaeological sequence is typically divided into several industries or technocomplexes: early Later Stone Age (ELSA ~<40–24 cal kBP), Robberg (~24–12 cal kBP), Oakhurst (~12–8 cal kBP) and Wilton (~8–2 cal kBP), followed by the arrival of Khoikhoi herders in the last 2000 years (Deacon, 1978; Deacon et al., 1984; Mitchell, 1988; Lombard et al., 2012). The ELSA is associated with the production of small flakes, often through bipolar reduction of cores, though it otherwise lacks unifying characteristics and has been described as a period of technological heterogeneity (Mitchell, 1988; Wadley, 1993). The Robberg presents more coherent characteristics, including the production of large numbers of bladelets (small, elongate flakes usually less than 24 mm long) produced both from dedicated bladelet cores and from those worked by bipolar reduction (Mitchell, 1988). The Robberg also sees more concentrated, if episodic, use of fine-grained rocks such as a silcrete and chert than the preceding or subsequent phases (Deacon, 1978, 1982). The Oakhurst (or Albany) is typified by fewer bladelets, larger flakes, a range of scraper forms and declining use of fine-grained rock, while the Wilton features both scrapers and backed artefacts and highly variable patterns of raw material use (Deacon, 1972, 1978; Lombard et al., 2012). While these units are coarse and mask considerable variation, they provide a useful heuristic for discussing broad patterns in technological change across the later LSA.

Consistent with the imprecise meaning of the term (Pargeter, 2016), the ELSA, Robberg and Wilton have all been described as ‘microlithic’ (Deacon, 1984; Mitchell, 1988; Wadley, 1993; Bousman, 2005), but based on different characteristics – small flakes in the case of the ELSA, bladelets in the case of the Robberg and backed artefacts in the Wilton (Lombard et al., 2012). The advent of dedicated bladelet production in particular – as characterizes the Robberg – is argued to have presented humans with a significant adaptive advantage during our evolution and dispersal (Bar-Yosef and Kuhn, 1999; Ambrose, 2002; Foley and Lahr, 2003; Clarkson et al., 2009). Some researchers have linked an emphasis on bladelet production with responses to heightened subsistence risk associated with low or declining subsistence resource productivity (Elston and Brantingham, 2002; Petraglia et al., 2009) (for discussion of the risk concept used here see Bamforth and Bleed, 1997). Others have suggested that bladelet production provided benefits under conditions of high residential mobility (Goebel,

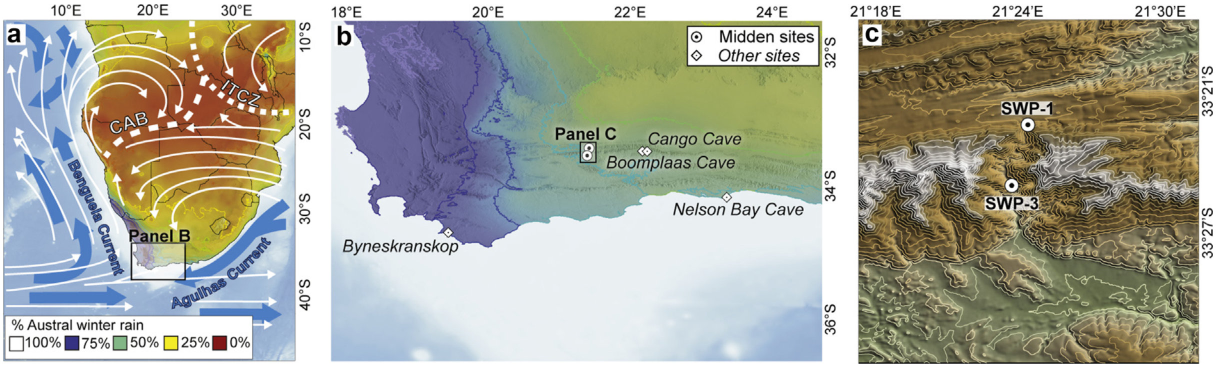

Figure 1. (a) Map of southern Africa showing seasonality of rainfall and climatic gradients dictated by the zones of summer/tropical (orange) and winter/temperate (blue) rainfall dominance. Winter rainfall is primarily a result of frontal systems embedded in the westerly storm track. Major atmospheric (white arrows) and oceanic (blue arrows) circulation systems and the austral summer positions of the Inter-Tropical Convergence Zone (ITCZ) and the Congo Air Boundary (CAB) are indicated. The location of the study site in the transitional southern Cape region is shown. (b) Map of southwest African coastal region with the Seweweekspoort sites and other key paleoenvironmental and archaeological sites indicated (shading as for panel ‘a’). (c) Topographical map of Seweweekspoort, with the SWP-1 and SWP-3 sites indicated. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)