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Late Quaternary palaeoclimates and human-environment dynamics of the Maloti-Drakensberg region, southern Africa

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A B S T R A C T

The Maloti-Drakensberg Mountains are southern Africa's highest and lie at a crucial interface between the sub-continent's drier, colder, more seasonal interior and its perennially productive sub-tropical coastal belt. Their location, high elevation, and topography make them ideal for exploring human responses to late Quaternary climatic change. This paper reviews and synthesizes palaeoclimatic and palaeoenvironmental data from the Maloti-Drakensberg region over the past 50,000 years. It then employs 325 calibrated radiocarbon dates to examine human occupational trends across the region and its component parts, discuss human-environment dynamics over this time-span, and explore patterning between particular phases of climatic change and the timing, mode, and motives of its exploitation by people. Key findings are that the region's Lesotho core may have served as a refugium for human populations during drier, more unstable climatic periods and that intensified exploitation of freshwater fish likely helped address resource stress in cooler ones. An agenda for future palaeoenvironmental and archaeological research is also mapped out.

1. Introduction

The Maloti-Drakensberg Mountains are among Africa's highest and topographically most diverse regions and an important centre of plant and animal endemism (Kingdon, 1989; World Wildlife Fund, 2017). They also preserve a rich archaeological record that includes one of Africa's best-understood concentrations of rock art (Lewis-Williams, 2003). This combination was instrumental in part of the region being designated a World Heritage Site (UNESCO, 2018).

From a palaeoclimatic and palaeoanthropological perspective, the Maloti-Drakensberg's significance is twofold. First, they lie at a crucial interface between southern Africa's perennially productive sub-tropical coastal forelands and its more seasonal, colder, drier interior. Second, their elevation and topographic diversity are likely to have reinforced their susceptibility to late Quaternary climatic shifts (Kohler and Maselli, 2009). They therefore offer an excellent opportunity for exploring human responses to changing environmental conditions along such dimensions as technology, subsistence, demography, settlement and mobility decisions, and the structures used to maintain social connectivity over distance. Current archaeological data allow us to investigate these questions across the last 80,000 years (Stewart et al., 2012, 2016).

A wide range of palaeoenvironmental proxies exists with which to do this, many recovered from archaeological excavations, others from contexts such as peat bogs where human input can be excluded. These archives have not previously been coherently summarized on a regional scale with a view to assessing their potential for understanding late Quaternary climatic change or the latter's implications for human behaviour.

We do this here by first discussing the Maloti-Drakensberg's current climate and ecology and the main controls on these. Next, we critically consider the sources available for understanding their

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climatic history, emphasizing the importance and challenges of integrating information from as many proxies as possible. The main part of our paper then reviews current knowledge of Maloti-Drakensberg palaeoclimates and palaeoenvironments over the last ~50 kyr. Following strategies trialled elsewhere (e.g. Crema et al., 2016; Manning and Timpson, 2014; Méndez et al., 2015; Williams et al., 2015), we draw upon a database of archaeological radiocarbon dates that we are developing to examine human occupational trends across and within the region. Finally, we discuss human-environment dynamics over this time-span, searching for patterning between particular phases of climatic change (relative stability and instability, cooling and warming, greater or lesser precipitation), and the timing, mode, and motives of the region's exploitation by people. In our conclusion we identify key topics for future palaeoenvironmental and archaeological research in this highest region of southern Africa.

2. Defining the Maloti-Drakensberg: climate and ecology

The Maloti-Drakensberg Mountains lie at the heart of the region that takes their name (Fig. 1). Collectively, they form a deeply dissected plateau, anchored in the east by the uKhahlamba-Drakensberg Escarpment, the watershed between the Indian and Atlantic Oceans. This is one of three sub-parallel ranges that collectively fill out a roughly quadrangular 55,000-km^2 massif and consist of Drakensberg Group flood basalts capping Karoo Supergroup sedimentary strata. Intense fluvial erosion of these strata has produced an intricate network of drainages feeding into southernmost Africa's largest river, the Orange, known in Lesotho as the Senqu.

The Senqu and its immediate tributaries flow west of the Escarpment. Numerous other rivers drain east into the Indian Ocean. West of the Senqu, the Central and the Front Ranges of the Maloti intervene before one reaches Lesotho's lowlands. Two important tributaries of the Senqu, the Senqunyane and the Makhaleng, run southward between them. The Caledon River, which forms Lesotho's western border, draws almost all its water from precipitation falling on the Front Range, only joining the Orange after both rivers enter the highveld grasslands that occupy most of South Africa's Free State province. Finally, to Lesotho's south the Drakensberg Mountains extend into South Africa's Eastern Cape Province. To facilitate our discussion we divide the Maloti-Drakensberg into six sub-regions: (1) the northern KwaZulu-Natal Drakensberg; (2) the southern KwaZulu-Natal Drakensberg; (3) the Eastern Cape Drakensberg; (4) highland Lesotho; (5) lowland Lesotho; and (6) the eastern Free State (Figs. 2 and 3).

The Maloti-Drakensberg's climate is continental, with cold, dry winters and warm, humid summers. Lying in southern Africa's summer rainfall zone (SRZ), over 75% of its rainfall falls between October and March, mostly as a result of easterly airflow from the Indian Ocean (Schulze, 2008). Precipitation totals vary tremendously with altitude and locality, decreasing from east to west because of the pronounced rain-shadow cast by the uKhahlamba-Drakensberg Escarpment. Thus, while mean annual precipitation for the latter typically exceeds 1500 mm (Schulze, 2008), values of 580–700 mm are recorded in the upper Senqu and Caledon Valleys (Bawden and Carroll, 1968). Temperatures vary drastically by altitude, as well as seasonally and diurnally, with mean annual values of ~15 °C in the Caledon Valley (~1600 m a.s.l.) but $\leq$6 °C on the highest mountains ($\geq$3000 m a.s.l.) (Grab, 1997). Corresponding mean mid-summer maxima are respectively 29 °C and 17 °C, with mean mid-winter minima of 4.3 °C and −6.1 °C (Grab and Nash, 2010). Snow can fall at any time, but especially between May and September, persisting on south-facing slopes for up to six months, while frost is also widespread (Bawden and Carroll, 1968).

Ecologically, the Maloti-Drakensberg lies within southern Africa's Grassland Biome (Mucinda and Rutherford, 2006). As this implies, grasses dominate its vegetation, with trees rare except in protected locations such as valleys. Plant communities are significantly differentiated by altitude, with aspect locally significant and differences in rainfall producing further contrasts between areas below the Escarpment to the east and those west of the Front Range. The highest elevations (~2900–3482 m a.s.l) support an Afroalpine short shrubland that includes ericaceous taxa, Asteraceae, and shorter, less palatable, C_3-photosynthesizing *Festuca*- and *Merxmuellera*-dominated grasses (Killick, 1978; Mucinda and Rutherford, 2006). Numerous alpine bogs help regulate rainwater flow into the Orange-Senqu river system (van Zinderen Bakker and Werger, 1974).

Lying between ~1900 and 2900 m a.s.l. the rest of highland Lesotho, plus adjacent areas of the Eastern Cape Drakensberg, is covered by C_4-dominated *Themeda-Festuca* grassland with patchy shrublands where *Passerina montana* is common (Mucinda and Rutherford, 2006). Due to its large altitudinal range it contains several altitude-specific vegetation belts with *Themeda triandra*, a C_4 grass that provides excellent pasture (Jacot Guillarmod, 1971), dominating at lower elevations (up to ~1900–2100 m a.s.l. on northern (cooler) slopes, but reaching ~2700 m a.s.l. on southern (warmer) ones). Note that the susceptibility of much of the Maloti-Drakensberg to tracking this altitudinal variation between predominantly C_4 and higher C_3 grasslands in response to shifting temperatures (Fig. 4) provides the basis for using $\delta^{13}C$ analysis of ungulate remains, rockshelter sediments (partly built up via introduction of grass bedding), and offsite sedimentary sequences to track late Quaternary climate changes (Parker et al., 2011; Roberts et al., 2013). The same approaches have also been followed in the Caledon Valley (Smith, 1997; Smith et al., 2002), which is characterized by a *Cymbopogon-Themeda-Eragrostis* C_4 grassland with numerous trees and evergreen shrubs that also intrudes along the lower reaches of the Senqu and its principal tributaries.

East of the Escarpment, Acocks' (1975) highland sourveld extends between 2150 and 1350 m a.s.l. *Themeda triandra* occurs frequently here too, but forbs are particularly noteworthy. *Protea* spp. (otherwise strongly associated with the Fynbos Biome of southwestern South Africa) may be common on mountain slopes, while montane forest dominated by *Podocarpus latifolius* characterizes protected gorges and south-facing slopes. Areas of southern tall grassveld — an open savanna of *Acacia sieberanna* in a mixed grassland dominated by *T. triandra* and *Hyparrhenia* spp. — occur along valleys and at lower elevations below this, particularly in areas draining northeast toward the Thukela River.

Unsurprisingly, grazers were common in precolonial times, especially black wildebeest (*Connochaetes gnou*), red hartebeest (*Alcelaphus buselaphus*), plains zebra (*Equus quagga*), blesbok (*Damaliscus pygargus phillipsi*), mountain reedbuck (*Redunca fulvorufula*), springbok (*Antidorcas marsupialis*), and the now extinct blue antelope (*Hippotragus leucophaeus*). Eland (*Taurotragus oryx*), a mixed feeder, was also common, with two small-medium species — oribi (*Ourebia ourebi*) and klipspringer (*Oreotragus oreotragus*) — some of the few antelope present in the Afroalpine belt (Plug, 1997; Plug and Mitchell, 2008). As well as geophytes like *Watsonia* spp. and *Moraea* spp., people also consumed a wide variety of fruits, seeds, and grasses (Carter, 1978). Along the Senqu (and probably other major rivers too) fish formed another important resource (Mitchell et al., 2011).

3. Sources of palaeoclimatic and palaeoenvironmental evidence

Initial studies of Maloti-Drakensberg palaeoenvironments focused overwhelmingly on how far its highest mountains