Extending the aridity record of the Southwest Kalahari: current problems and future perspectives

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Abstract

An extensive luminescence-based chronological framework has allowed the reconstruction of expansions and contractions of the Kalahari Desert over the last 50 ka. However, this chronology is largely based on near-surface pits and sediment exposures. These are the points on the landscape most prone to reactivation and resetting of the luminescence dating ‘clock’. This is proving to be a limiting feature for extending palaeoenvironmental reconstructions further back in time. One way to obviate this is to sample desert marginal areas that only become active during significant arid phases. An alternative is to find and sample deep stratigraphic exposures. The Mamatwan manganese mine at Hotazel in the SW Kalahari meets both these criteria. Luminescence dating of this site shows the upper sedimentary unit to span at least the last 60 ka with tentative age estimates from underlying cemented aeolian units dating back to the last interglacial and beyond. Results from Mamatwan are comparable to new and previously published data from linear dunes in the SW Kalahari but extend back much further. Analysis of the entire data set of luminescence ages for the SW Kalahari brings out important inferences that suggest that different aeolian forms (1) have been active over different time scales in the past, (2) have different sensitivities to environmental changes and (3) have different time scales over which they record and preserve the palaeoenvironmental record. This implies that future optically stimulated luminescence work and palaeoenvironmental reconstructions must consider both site location and its relationship to desert margins and sediment depositional styles, so that the resolution and duration of the aridity record can be optimally understood.

1. Introduction

The Mega Kalahari of southern Africa covers an area of approximately 2.5 million km² (Cooke, 1958; Thomas and Shaw, 1991). Spatially the Mega Kalahari extends from the Northern Cape Province of South Africa to the Congo in the north and from Namibia in the west to Zimbabwe in the east. The geomorphic processes operative within the Mega Kalahari have varied in response to climate changes through time (e.g. Thomas and Shaw, 2002) and holds the potential to provide a long and detailed record of southern hemisphere Quaternary changes. From a Quaternary palaeoenvironmental perspective its significance accrues from its geological origins and its location at the juxtaposition of central southern African climatic systems. At present, relatively limited palaeoenvironmental data are available, principally due to the paucity of organic material that can be radiocarbon dated.

The Kalahari is principally formed in the structurally downwarped basin of interior southern Africa which has acted as a sedimentary sump since the Tertiary period. In places, these sediments, collectively known as the Kalahari Group, have significant thicknesses. In Etosha Basin, Northern Namibia, more than 450 m of sediments exist (Haddon, 1999). The Kalahari Group is dominated by sands principally of aeolian derivation. However, the evolving endoreic drainage, of which the Okvango is the last major vestige, coupled with its generally flat surface at 900–1200 m a.s.l. has allowed the redistribution, primarily by fluvial and lacustrine processes, of material eroded from the basin rim. Geomorphically the landscape of the northern and southwestern Kalahari is dominated by linear dunes, which in the case of the latter indicate a net sediment transfer from NW to SE (Fig. 1).

The Kalahari region currently experiences a marked southwest–northeast rainfall gradient and only the