Developing luminescence chronometers to establish the timing of Late Quaternary environmental changes in South Africa

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Project Summary

In South Africa, dryland regions are typically characterised by dongas (extensive gullies and badland-type terrain) which have eroded up to 30 m into Quaternary alluvium and colluvium. In some areas donga formation has been attributed to human disturbance (Boardman *et al.*, 2003) whilst in others it has been suggested that donga initiation, formation and incision may be linked to abrupt climatic changes (Lyons *et al.*, 2013). This project aims to explore long-term climate change in South Africa as far back as the last interglacial by dating sedimentary successions exposed by dongas.

Fieldwork

The BSG Postgraduate Research Grant was used towards international travel costs during the second field season in South Africa. Over two field seasons in 2014 and 2015, 49 samples were collected for luminescence dating from 5 donga sites across South Africa (Figure 1). These sites were selected to represent a variety of geographical conditions, including different geologies, climates, vegetation covers and land use histories. At each site, sampling extended across the entire stratigraphic exposure; however particular emphasis was placed on collecting (i) basal sediments to constrain the timing of sediment initiation and (ii) current land surface sediments and donga infill to constrain the onset of erosion.

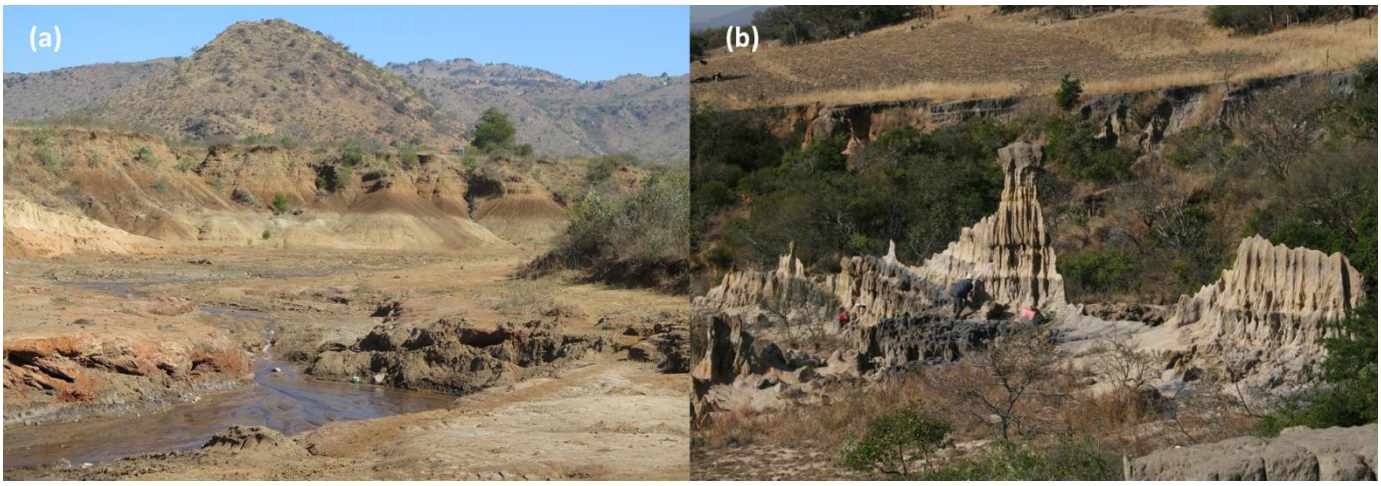

Figure 1 Two of the donga sites sampled during fieldwork showing the different environments, geomorphology and vegetation cover. (a) The donga site along the unnamed tributary of the Moopetsi River, Limpopo Province (view looking upstream) and (b) the Voordrag donga system in Kwa-Zulu Natal (view looking across the width of the donga).

Methods

Preliminary luminescence ages using quartz optically stimulated luminescence (OSL) and K-rich feldspar post-infrared infrared stimulated luminescence (post-IR IRSL) have been calculated for a donga site along an unnamed tributary of the Moopetsi River, Limpopo Province, South Africa. The combined approach of using OSL to date the younger sediments and post-IR IRSL to date the older sediments has proven to be feasible, thus this same technique is being applied to date sediments collected from Voordrag, Kwa-Zulu Natal. The luminescence chronology will be compared to existing radiocarbon dates and success at this second site will lead to the same approach being applied to the remaining sites. Chronologies from all five sites will be combined to produce a regional comparison for the onset of sedimentation and erosion in South Africa. The regional comparison, in conjunction with existing proxy records, will be used to determine environmental change at least as far back as the last interglacial and to better constrain the natural drivers of donga initiation, formation and incision.

Outputs

To date preliminary OSL and post-IR IRSL chronologies from this work have been presented at international and local conferences, including the BSG Annual Meeting at Southampton in 2015. The luminescence equivalent dose (D_e) distribution data and a comparative quartz-feldspar chronology for the unnamed tributary of the Moopetsi River have been published in Quaternary Geochronology (http://dx.doi.org/10.1016/j.quageo.2015.02.015).