Do alluvial fans on the Cape Verde volcanic islands record Pre-Holocene African Humid Periods?

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Introduction

In March 2017 12 days of fieldwork were conducted in the Cape Verde islands (Atlantic Ocean, offshore West Africa), focussing on Santo Antao island, in the northwestern part of the archipelago. The fieldwork focussed on a large coastal alluvial fan sourced from the volcanic edifice margin. Previous work on Santo Antao island in 2013 and 2014 had sampled fan boulder surfaces for 3He cosmogenic exposure dating from proximal, distal and mid fan locations down a fan axial transect on what appeared to be a single fan surface. The dating results yielded clusters of ages: 10-20ka (proximal). 80-90ka and 50-60ka (fan) and 160ka (distal). The purpose of the BSG funded fieldwork was to collect a larger suite of samples to complement and enhance the existing pilot dating study. We also took the opportunity to conduct some detailed cross fan field surveying. The surveying allowed us to explore whether the fan was built as a single surface, or whether it was a composite form of different lobes.

Fieldwork

Our new sampling efforts and surveying were conducted along a series of cross fan profiles in proximal (x2), mid (x2) distal (x4) fan locations (Fig. 1). We hand levelled the surveying using a Truplse laser range finder and used the resulting profiles to target new sampling sites across the fan. We also took the opportunity to drone map the broader sampling areas to provide improved fan surface characterisation. Although our focus was on Sanot Antao island, we also took the opportunity to undertake sampling and surveying of fans from the adjacent Sao Vicente island to

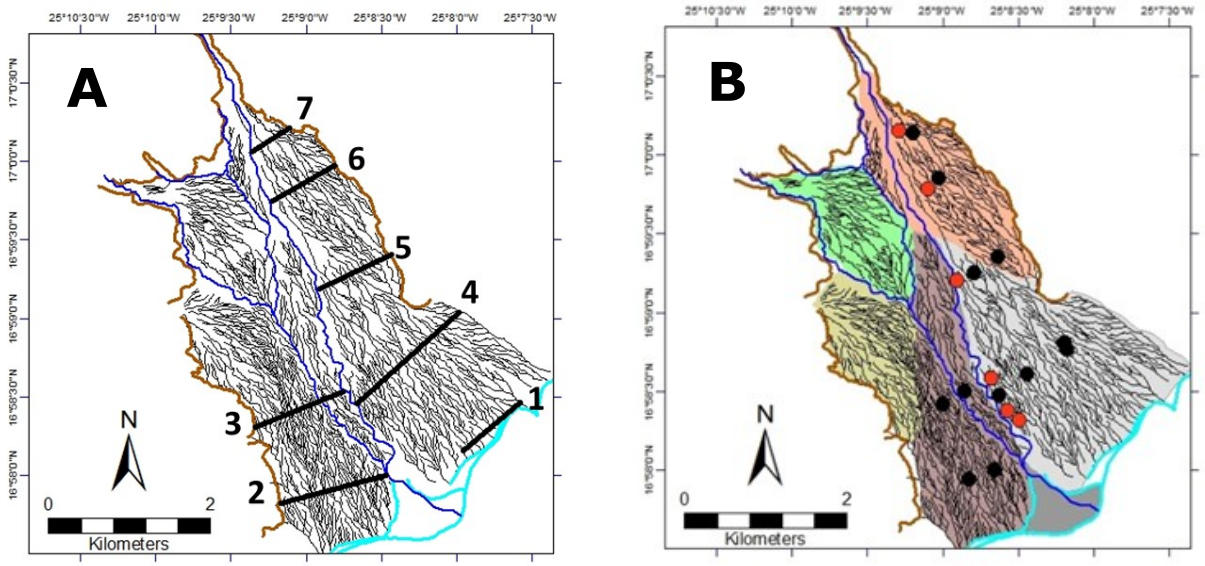

Figure 1 A: Cross fan surveys conducted in 2017 fieldwork. B: 2014 sampling locations (red dots) and 2017 sampling locations (black dots). Coloured surface regions depict different fan lobe segments that were interpreted as a consequence of the 2017 fieldwork.

Results

We collected x12 new samples from across the fan surface (Figure 1B). These samples have been prepared (crushed, cleaned, picked) and are awaiting an opportunity for AMS measurement at the SUERC laboratory (University of Glasgow). The cross-surface profiles were helpful in solving whether the fan was built as either a single lobe or as a composite feature of multiple lobes. In this case a multiple lobed fan seems to be the best explanation that links the surface morphology and preliminary age dataset. The new samples when finally measured will help test / clarify this model. The emerging story is one where the fan is being build by large magnitude flood events that are coincident with the elevated hydrological conditions experienced at the onset of African Humid Period. These AHP events cause the fan to avulse, switching its activity to different locations of the fan surface. The drone mapping conducted alongside the surveying and sampling was surprising very successful. We have

gained high resolution maps of flood bars and channels (Figure 2) that we are now beginning to use for flood palaeohydrological analysis using competency and regime-based flood reconstruction / quantification approaches.

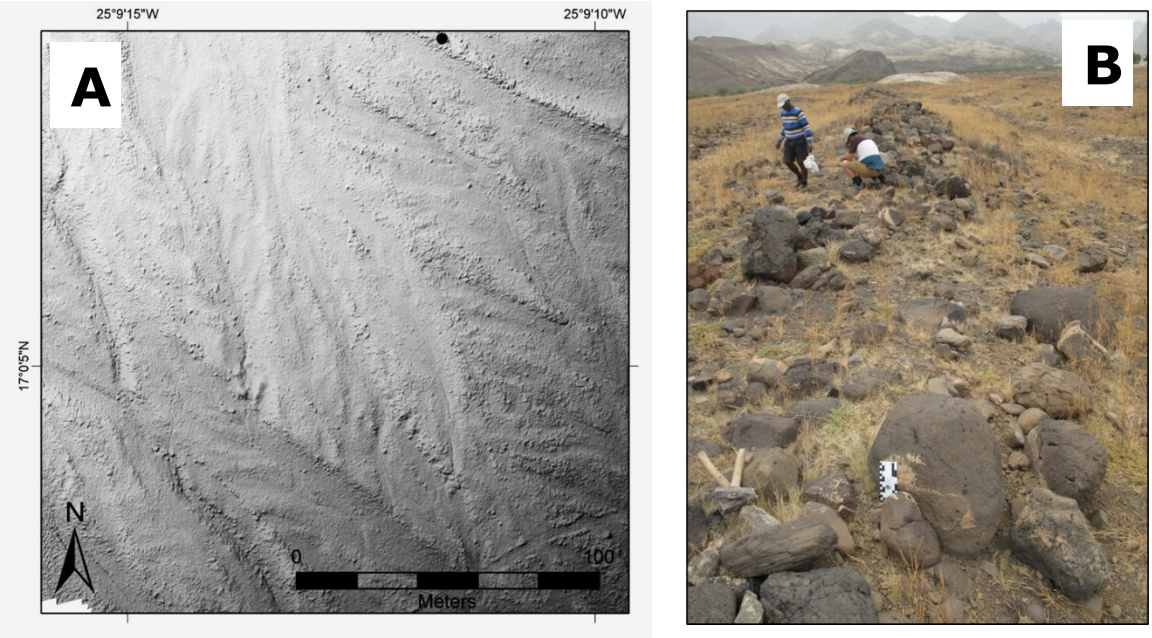

Figure 2 A: 200x200m drone map of proximal fan surface bars and channels. Black dot (top right) depicts a dating sampling site depicted in Figure 2B. B: Field image of sampling site.

Further developments

Since the 2017 BSG funded fieldwork, I have secured further funding from the Quaternary Research Association and Geological Society to conduct additional fieldwork in Cape Verde and southern Morocco. The work has been presented at the 2017 International Geological Congress (Delhi) and the 2019 INQUA meeting, with full acknowledgement of BSG. We have also recently published a paper on volcanic island alluvial fan geomorphology (Stokes and Gomes, 2020) which was indirectly helped by the BSG funding. I am still waiting for the geochronological measurements to be undertaken of the 2017 samples, noting that this is being undertaken 'in kind' by the SUERC laboratory.

Stokes, M. and Gomes, A., 2020. Alluvial fans on volcanic islands: A morphometric perspective (São Vicente, Cape Verde). Geomorphology, p.107356. https://doi.org/10.1016/j.geomorph.2020.107356