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Using multiscale geoproxies to improve quasidecadal flooding record resolution

Robert A. Bean, Kelley A. Crews, Thoralf Meyer, and Timothy Beach
Department of Geography and the Environment, The University of Texas, Austin, United States (beanr@utexas.edu)

This study uses multi-scale geoproxies to distinguish factors of sedimentation (such as climate flux)—in the Late Holocene Okavango region. Our focus is on the Makgadikgadi-Okavango-Zambezi basin (MOZ), which includes the Upper Zambezi, Cuando/Chobe, Okavango Rivers, the Okavango Delta, and several megafans, as well as other areas of importance for their water resources in the present (e.g., Zambezi, Cuando, Okavango Rivers, Lake Ngami and Boteti River in Botswana). The system as a whole has been connected in the past when mega-lakes dominated the landscape, including Lake Deception (McFarlane and Eckardt, 2006) and mega-Lake Makgadikgadi (recurring multiple times over the last 280 ka YBP). Climatic variability not only plays an important role in the development of megafans regionally, but also interacts with tectonics to provide first order controls on landscape processes.

This study clarifies the nature and source of variability of sedimentary landforms left behind at multiple spatial and temporal scales. The methods include remote sensing and GIS analysis using new, higher resolution SRTM 30 spatial meter resolution DEMs, data from the Sentinel-1 mission (approximately 12 m resolution) and geomorphic mapping, as well as refined *in situ* sampling focused on Lake Ngami and the upper Boteti River. Both areas are outlets for the Okavango Delta (in the MOZ) and have experienced periodic switching between wet and dry conditions. Several factors can account for these changes including quasi-decadal climate cycles, recent and longer term changes, human impacts, and neotectonics. This study examines core samples from Lake Ngami's sediments that have microlaminations we hypothesize to correspond to seasonal flood pulses. We will also test the idea that the micromorphology and climate record provide a clearer picture of the variability over longer timescales than previously reported (c.f. McCarthy, 2013). In addition, new carbon dates will establish the times a much larger Lake Ngami existed. These results are combined with stable isotope analysis for moisture conditions during that time and the $\delta^{13}C$ of sediment humin to infer changes in dominance of C_3 to C_4 vegetation. From these multiproxies over a new chronology, we aim to present a fine scale reconstruction of conditions in this part of the MOZ. The use of geoproxies at both macro and micro scales improves our current understanding of the seasonal variability of multitemporal climatic pulses in the recent past to present day, which is critical because our current understanding of climate for a large portion of the Kalahari is through limited geoproxies. This work may also provide improved understanding of similar systems with megafans that may also have gone through similar phases and thus would explain their formation. Implications of this work suggest the Okavango Delta, taken in the larger context, is not an atypical landscape feature but part of a larger regional system that reflects climatic teleconnections found globally in legacy landscapes. Improvement of our understanding of this system as a reflection of climatic processes in the past and present may then improve and contribute to understanding comparable systems in South America or Australia that are no longer active.