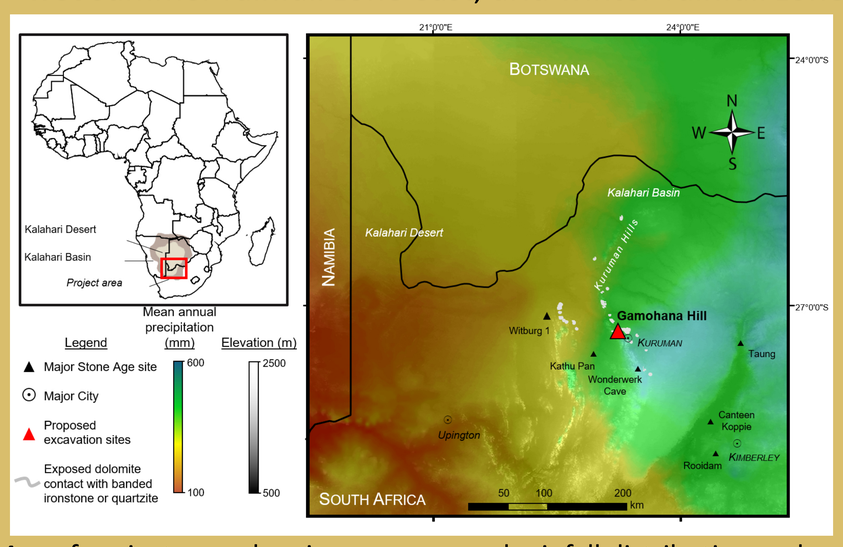
U-series dating tufa: a new palaeohydrological tracer for MSA archaeological sites in the Northern Cape, South Africa

Jessica von der Meden[1], Robyn Pickering[1&3], Benjamin J. Schoville[2&3], Jayne Wilkins[3&4] , Kyle S. Brown[4] and Simangaliso Makalima[4]

[1] Department of Geological Sciences, University of Cape Town, South Africa [2]School of Social Science, University of Queensland, Australia [3]Human Evolution Research Institute, University of Cape Town, South Africa [4]Department of Archaeology, University of Cape Town, South Africa

Gamohana Hill, Kuruman

- Gamohana is situated in the Kuruman Hills, a semi-arid region bordering the Kalahari desert in the Northern Cape of South Africa. The Kuruman Hills are dolomitic, capped with Banded Iron Formation and act as an orographic barrier: wet summer rainfall zone east, arid winter-rainfall zone west



Map of project area showing mean annual rainfall distribution and archaeological sites in the region, and zoomed in satellite image showing carbonate sample locations

- Wealth of **Middle Stone Age (MSA) archaeology** at Wonderwerk Cave and Kathu Pan[2], and new Gamohana Hill site: present an opportunity to challenge the coastal bias hypotheses of early human adaptation
- Carbonate deposits on the landscape are valuable archives of palaeo-climate information, they are datable and thus are important proxies for deciphering the environmental context of associated archaeological deposits[1]

Tufas

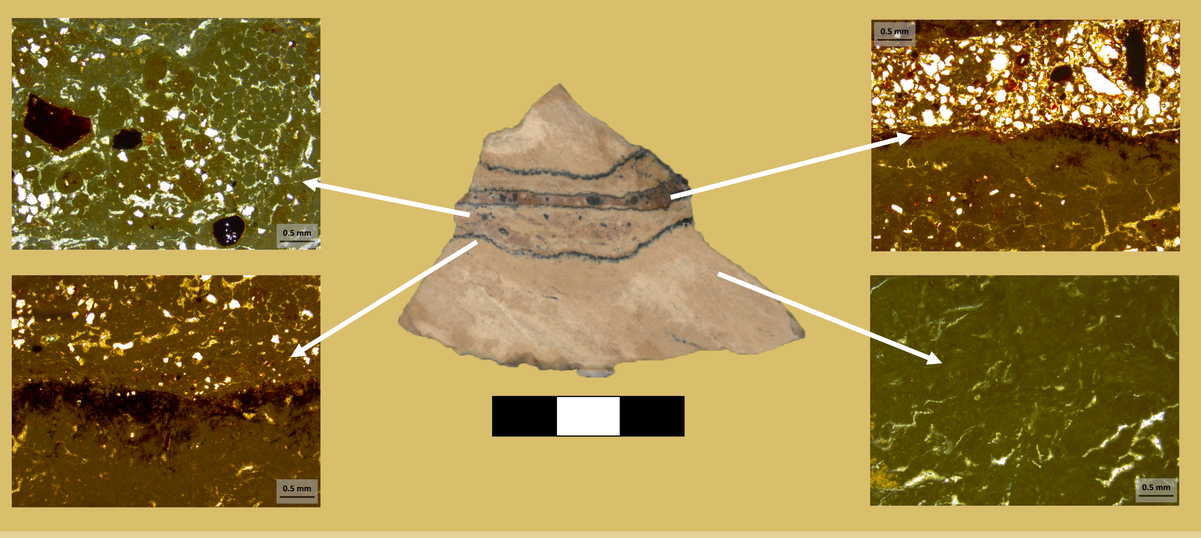
terrestrial carbonate formed in ambient temperature, freshwater conditions through physiochemical and biologically mediated precipitation processes[1]

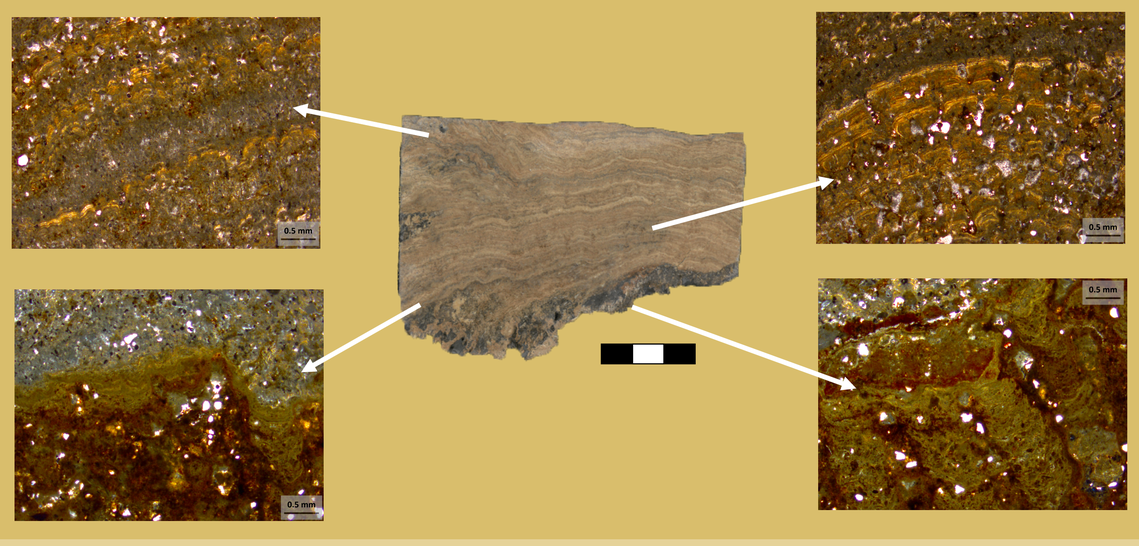
Gamohana Hill North shelter (top) with the three different expressions of tufa on the landscape (L-R): stalagmite-like tufa mound, terraced breccia deposit and tufa flow on the face of the rock shelter

- Palaeoclimate proxies: represent a period **wetter than present-day climate**, record details of landscape evolution and palaeohydrological dynamics, and in some instances preserve archaeological material
- Tufa deposits are reliable chronometers, U-series dating has yielded preliminary **age data: Tufa flows 7 – 10 ka and breccia deposits around 40 – 60 ka**

Micromorphology

- Analysis of tufa fabrics under a petrographic microscope allows for details of formation to be deciphered, and aids in facies model development[3,4,5]
- Thin section images below of samples from Gamohana Hill north talus slope: evidence for microbially induced precipitation, and wet/dry cycles





Archaeology

- Aim to establish **Pleistocene** hunter-gatherer land use and adaptation in the Kalahari basin
- Excavations in the Gamohana Hill rock shelter have revealed an assortment of *in situ* MSA lithic and faunal artefacts
- Preliminary radiocarbon ages suggest top of the assemblage is late MSA, younger than Wonderwerk Cave and Kathu Pan deposits, but similar in age to White Paintings Shelter, Northern Botswana[2]
- Opportunity to compare and chronicle MSA adaptations in response to changing palaeoenvironments at sites on either side of Kalahari margin

L-R: Excavation at Gamohana Hill North shelter, large MSA point with prepared platform, MSA blade with prepared platform and ungulate tooth, preliminarily identified as extinct *Megalotragus*

Summary and ongoing work

- More extensive U-Th dating on tufa samples collected in 2017 and 2018
- Stable C and O_2 isotope analysis to reconstruct palaeoclimate: $\delta^{18}O$ reflects relative temperature change, $\delta^{13}C$ reflects moisture availability and recharge
- Scanning Electron Microscopy (SEM) to obtain 3D images of tufa internal structure
- Continued excavations and dating analyses (OSL) at Gamohana Hill and Witberg site, Tswalu
- Rain and ground water sampling and analysis, improve understanding of hydrological dynamics in Kalahari region
- Survey work for new archaeological sites and carbonates, as well as to gain a landscape view of early hominin land and resource use in the Northern Cape

References

[1]Andrews, J.E., Pedley, M. and Dennis, P.F.2000. *Sedimentology*. 47: 961-978
[2]Beaumont, P.B. & Vogel, J.C. 2006. *South African Journal of Science*. 102: 217-228
[3]Carthew, K.D., Taylor, M.P. and Drysdale, R.N. 2006.
[4]Ford, T.D. & Pedley, H.M. 1996. *Earth Science Reviews*. 41: 117-175
[5]Pentecost. A. 2005. Springer
[6]Viles, H.A. & Goudie, A.S. 1990. *Progress in Physical Geography.* 14: 19-41

Acknowledgements

Thank you to University of Cape Town Archaeology students for their volunteer excavation and lab work: Navashni Naidoo, Jani Louw, Leesha Richardson, Nathan Bickerton, Alyssa Eltzholtz, Josh Giesken, Amy Hatton, Tamara Jeggels, Mabeth Crafford, Khumo Matlhoko, Ayanda Mdludlu and Alicen Munn. Thanks to **Baga Motlhware Traditional Council** for permission to work at Gamohana Hill. Thanks **John Hellstrom and Petra Baja** at the University of Melbourne for U-Th dating, and to **Rene Van Der Merwe** at the University of Cape Town for making the thin sections. We acknowledge funding from the **Center of Excellence in Palaeosciences,** the **National Research Foundation - African Origins Platform Grant** and the **National Geographic Society - Waitt Grant**

@NorthofKuruman

DST-NRF CENTRE OF EXCELLENCE IN PALAEOSCIENCES