Permit Application for Continued Scientific Investigations at the Taung World Heritage Site.

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Research to Date (2010-2018)

In 2010 a team led by Dr. Kuhn under permit 80/09/10/028/51 began conducting scientific investigations at the Taung World Heritage Site. The 2010-2013 (80/09/10/028/51) permit allowed for mapping of breccia's etc., as well as sampling of breccia pockets, speleothems, tufas and of faunal material in the collections, for dating by U-Pb and palaeomagnetic methods; as well as for test excavations at Dart, Hrdlička and Equus sites. During this time two field seasons were conducted which resulted in new interpretations of the two pinnacle sites (Hopley et al., 2013), the estimation of a preliminary age for the Taung Child (Herries et al., 2013) and revealed flaws in the previous research conducted at Equus Cave. These initial seasons were funded by National Geographic and PAST.

One aspect of the research indicated that the separation of the Dart and Hrdlička deposits into separate 'sites' is erroneous and we have suggested a new name for these combined sites being the Type-Site (Kuhn et al., 2016). The main work at the *Australopithecus africanus* (Taung Child) 'Type Site' consisted of taking further geological samples for palaeomagnetic, uranium-lead and micromorphological analysis. Preliminary results illustrate that the sediments commonly associated with the Taung Child are actually landscape deposits and not cave fill, and that three different sedimentary deposits occur at the type site; the tufa itself, the pink micrite (PCS) which is interlayered within the tufa and the red sandstone (YRSS) deposits which infill fissure caves eroded through both the older PCS and tufa (Hopley *et al.,* 2013). Palaeomagnetic analysis indicates that the PCS and tufa deposits record normal polarity throughout the Type Site and the YRSS deposits record reversed polarity no matter where they are sampled across the two pinnacles that make up the type site (Hopley et al., 2013; Herries et al., 2013). This was used to suggest a tentative age of between 3.03 and 2.58 Ma for the Taung Child, contemporary with the Makapansgat Limeworks (Herries et al., 2013).

Further to the 2010 field season, in 2012 one drill core was taken from the base of the Dart Pinnacle and second one through the Hrdlička Pinnacle, with the aim of resolving the stratigraphy of the tufa at the Type-Site and date the geological sequence. In 2017 the Dart core was mapped and sampled as part of an Honours project at the Department of Geology, University of Johannesburg.

The field season in 2012 saw team members conduct a test excavation at Equus Cave. Our aims for conducting test excavations at Equus Cave were threefold:

1. To take in-situ samples for dating since previous methods did not provide consistent results and it aided our overall aim at the limeworks of understanding its evolution and the formation of the various tufa flows and cave in-fills.

2. To collect fossils that have been eroding out of the previous excavations for the last 30 years or so as they were not in-filled or protected in any way. We wanted to do this before their provenience information was lost forever.

3. During our initial survey we noted a large number of fossils on what appeared to be the excavation dumps from the 70s and 80s excavations. To establish potential bias in the published sample from the site we undertook controlled excavations of the dump left behind from the late 70's and early 80's excavations.

This work established a number of very important issues that we want to investigate with further excavations:

1. Despite being interpreted as a hyena den (Klein et al., 1991) our initial excavations identified a wealth of archaeological material such as Later Stone Age stone tools and utilized ochre that suggest that the part of the cave we excavated was occupied by humans. While the 70s and 80s excavations concentrated on the rear of the cave our work was into the talus cone at the cave entrance and so the formational history of the site is likely more complicated than previously suggested. This site is crucial for understanding human occupation of this interior region, an area of less focus than the coastal Middle to Later Stone Age sites in South Africa. MSA stone tools have been suggested to occur at Equus and as such it is important to establish this and their chronology with certainty, as no MSA sites have yet been positively identified along the Ghaap Plateau Escarpment, despite MSA sites occurring on the northern side of the Plateau at Wonderwerk Cave and Kathu Pan (Beaumont and Vogel, 2006).

2. The excavation indicated that a wealth of charcoal occurs in the deposit that is amenable to AMS radiocarbon dating and could provide a much more accurate chronology than what currently exists for the site based on the radiocarbon and amino acid dating of ostrich eggshell (OES) and bone (Johnson et al., 1997). This work will aim to finally establish the age of the human fossils from the site.

3. The excavation of the 70/80s excavation dumps showed that a large quantity of fossil material, charcoal, ochre and other archaeological remains were missed during the sieving process and as such the published record of the site is likely biased

towards the smaller elements and juvenile remains. Further work needs to be undertaken to confirm this and assess the extent to which the published record is biased.

See the final report for the 2010-2013 permit for details of the 2010 and 2012 field seasons.

In 2013 a permit (also numbered #80/09/10/028/51) was issued to excavate Black Earth Cave (Peabody, 1954) and rescue the dumps left behind from the 1988-1994 excavations. This work was funded by the Australian Research Council under Future Fellowship FT120100399. The material from the dumps has been recovered and is now with the DITSONG museum of natural history and under study. From April 29th to the 4th of May 2014 a small team of five scientists went to the Taung World Heritage Site to rescue the remainder of the dumped material and do a test excavation at Black Earth Cave. See the 2014 final report for details of the Black Earth Cave excavations.

In May of 2015 Permit #: 9/2/036/0003 was issued for continued work at the Type Site, Equus Cave and Black Earth Cave, as well as the surrounding tufa and flow stones for dating and isotope studies. Unfortunately little was accomplished during this research cycle. Student unrest in 2015 forced the cancellation of fieldwork. In July of 2016 a small team comprised of scientists from the University of Johannesburg and Latrobe University (Australia) visited the site for a short period of time; for two days the team managed to obtain data from ground penetrating radar at the type-site, which will be used to augment data collected from the previously drilled cores. In addition, 3D scanning and photogrammetry were completed at the type-site as well. This will enable us to produce very precise 3D models of the type-site and surrounds.

Plan for next 36 months of research at the Taung World Heritage Site

Much has changed since 2010, including the team of international and local scientists planning to work at the site. Both Professor Herries and Dr. Caruana have moved on to other projects, and while still maintaining an interest in Taung, will no longer have an active role in fieldwork. It is for this that Prof. Herries and Dr. Caruana have been removed as co-permit holders. Dr. Mirriam Tawane, curator of Plio-Pliestocene Paleontology at the Ditsong National Museum of Natural History has voiced an interest in research at Taung and will be added as a co-permit holder for the next three-year cycle of research. Dr. Phil Hopley will continue his work and add geological mapping beyond the Type Site. Dr. Hopley continues to attempt dating via uranium-lead and will coordinate further geological dating with Professor Kramers.

During the next three years Professor Jan Kramers of the University of Johannesburg will lead geological research. He has already supervised one Honours project based upon the Dart core and is planning further research on said core, while an MSc project to start in 2019 will be dedicated to research on the Hrdlička core in particular. The

development of the uranium-thorium-helium dating method for speleothems and travertines at UJ (Makhubela and Kramers, 2016) is unique, and this method will probably be well suited to dating the pink calcrete, which has proved very difficult to date using uranium-lead method, due to common lead being present in it. Using helium to date samples throughout the length of the Hrdlička core should thus enable us to get a more precise date for the Taung Child. Further, palaeomag analyses on the Dart and Hrdlička core material can be done at UJ, which has the only palaeomagnetics laboratory on the African continent, and the work will be extended to palaeoclimatic studies via oxygen and carbon stable isotope studies, which can be carried out at the iThemba Labs in Johannesburg and alternatively at the University of Cape Town. Thus this work can be carried out within South Africa in the framework of a postgraduate program, thereby ensuring an important capacity building component.

Professor Patrick Randolph-Quinney of the University of Central Lancashire (UCLAN) will be joining the team for the next cycle as well. It will be a return to the site for him as he worked at Taung in the early 1990's under the permit of Professor Philip Tobias. His primary focus will be on investigation of the palaeo-archaeology and landscape processes within the environs of the Limeworks and the contextualization of this locale against the wider Ghaap Escarpment; landscape-based approaches are critical given the realization that the primary Taung site is not indeed a cave, but a node within a much larger palaeo-landscape spanning the Ghaap Escarpment and Thabaseke and Harts drainage basins. Temporally, Randolph-Quinney and his team's primary interest is the transition between Earlier and Middle Stone Age hominins and their technologies in the Northern Cape, from c. 500 ka to 130 ka, in the light of landscape studies elsewhere in South Africa which have forced a reappraisal of the nature of early hominin landscape use and economy (Sinclair et al., 2003).

Much of the reappraisal has focussed on the nature of the inland versus the coastal model of Middle Pleistocene cultural evolution. In particular, the transitional Early-Middle Stone Age (MSA) research has provided behavioural insights into reconstruction the origins of modern humans in terms of technological adaptation to rapidly changing environments (Wurz 2013). The typology of the MSA reveals transitions in hunting and symbolic activities, which are traced through technological changes such as the Still Bay and Howieson's Poort industries. The archaeological record for the MSA period has largely been defined by sites in South Africa including Klasies River Mouth, Blombos Cave and Sibudu Rock Shelter (Henshilwood & Lombard 2014). However, there is a distinct geographical bias of MSA localities along the eastern and southern coastal regions, with little information on sites within the interior. This bias has fueled arguments for population bottlenecking and refugia in coastal regions during periods of climate change and harsh environmental conditions within the MSA (Marean 2010). Moreover, some research suggests that the evolution of modern humans may have occurred in southern Africa because of these pressures (Compton 2011).

While only four well-publicized MSA sites have been reported from the South African

interior (i.e. Cave of Hearths, Rose Cottage Cave, Bushman's Rock Shelter and Florisbad), the possibility of geographical bias affecting our understanding of the MSA has never been tested. This is imperative for challenging interpretations of environmental, technological and cultural change during the MSA in relation to modern human evolution.

The uncertainty of how MSA sites and technologies from the South African interior compare to a coastal-site-dominated perspective highlights a need to better understand this relationship. The Taung area and Ghaap Escarpment presents an ideal area for the foundations of constructing a South African interior perspective of the MSA because of its relation to the archaeological landscapes of the Kuruman region and Kathu Pan. Thus, comparisons can be made with a landscape-scale perspective that might interrelate technological and subsistence patterns that might inform the current models of the ESA-MSA transition in South Africa.

Fieldwork will be focused around in-situ excavations of Equus and Black Earth caves, coupled with systematic landscape survey and remote sensing. The following activities will be undertaken: (1) The establishment of a systematic spatial framework using LIDAR aerial survey and GIS landscape modelling; (2) systematic fieldwalking and GPS spatial survey of superficial deposits; (3) high-resolution excavation of Equus and Black Earth caves, with collection of a) all artefactual residues, b) bioarchaeological and environmental samples, c) geological and sedimentary samples, d) suitable radiometric dating samples as deemed appropriate, e) development of high-resolution sampling regime for palaeoenvironmental proxies; (4) the instigation of a geomorphological/geological survey of the region; (5) the initialisation of an ArcView GIS database including local topography and geology, as well as sites and find spots located during the season; systematic dating of suitable open localities using Optical Luminescence methods; (7) post-project analysis, write-up and publication.

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