

Malapa Annual Report 2012-2013

Prepared by Prof. Lee R. Berger

The Malapa project is now in its fifth year the initial permitting of the site being September 2008. Initial work at the site involved detailed mapping, the removal of the majority of loose blocks from early twentieth century mining activity and the removal of small amounts of overburden, where miners had used some of the original cave infill as “road steel”. In addition, a small area of *in-situ* material was removed that was associated directly with the MH-1 and MH-2 skeletons. In addition, a number of geological samples were taken across the site in order to resolve stratigraphy and dating. Over the last 18 months (during the period pertaining to this report), little active excavation has occurred at the site, though continued activities directed as specific scientific questions have continued (detailed below). The reasons for this lowering of activity at the site during the period reviewed is fourfold: First, the previous excavations exposed underlying fossiliferous material rich in well preserved fossils including hominins; secondly, laboratory activities demonstrated the presence of organic remains associated with the circa 2Ma fossils, requiring a re-evaluation of excavation, handling and preparation methods to preserve this sensitive material; thirdly, it was clearly desirable to protect and preserve the deposit with some form of structure and the design and funding of this field laboratory was done during this period; and finally the research plan concentrated on analysis and publication of the material recovered to date so that hypotheses could be formulated that would be tested once larger scale work resumed. It was also necessary to establish clear laboratory protocols for processing, cataloguing and curating the remains. We are presently creating a searchable online digital database of all fossils to compliment the digital and physical catalogue of fossils, a copy of which is attached to this report. During the period under review, near weekly visits to the site were made for both scientific work and to monitor the security of the site and the fossils. A permanent photographic record of the site is also maintained and regularly updated.

During the period under review a number of small samples were taken for geological analysis. Each of these specimens was documented and processed according to Malapa laboratory protocols that exceed those presently required by the host institution. On site, we excavated ten small test holes, which were refilled, in order to establish the probable extent of the deposit, all less than 30 cm in depth and all in un-fossiliferous overburden. In addition, these holes were used to establish potential footing sites for the proposed structure (applied for under separate permit). A small number of ex-situ blocks were removed during the period that were found on the surface of the site and catalogued into our collections. As a note, all blocks from Malapa are housed in a separate facility at the Evolutionary Studies Institute and individually catalogued and numbered. These blocks are in the process of being scanned as part of an ongoing project to analyse the contents of these blocks for preparation prioritization.

It is anticipated that active excavations will begin in November of 2013 once the temporary on-site laboratory structure is in place.

Laboratory activities

Fauna

The faunal material that has been recovered from the site ranges from well-preserved articulated remains to more fragmentary isolated remains. It presently comprises 654 prepared specimens and

a number of other partially prepared specimens (articulated remains are left in the blocks from which they are recovered). The fauna is diverse comprising most Orders of mammals as well as some limited herpetological and avian material as well as invertebrate remains. The carnivore fauna has been published in some detail and include a novel species of fox (Hartstone-Rose et al., 2012). The remaining fauna, with the exception of the small mammal material, is presently being described and will be published in 2014. The fauna is curated by Order, family, taxa and where possible individuals are identified and related skeletal material stored together. Presently it is held in a dedicated Malapa laboratory on the second floor of the PalaeoSciences Centre at the University of the Witwatersrand. Space has been allocated in the permanent stores of the same building for future storage once analysis and description is completed. Detailed catalogues of the material are kept in hard copy, with backup digital copies held in fireproof safes as well as online. An excel spreadsheet of the fauna is held by the curator of collections.

Hominin material

There are presently more than 200 numbered and catalogued hominin elements attributed to four positively identified individuals (labelled MH-1 to MH-4 (MH stands for Malapa Hominin), with an additional two probable other individuals represented by more fragmentary remains that cannot be positively associated with these four individuals. The material is curated as the fauna, though all of the remains are kept in fireproof safes in the Malapa laboratory. MH-1, MH-2 and MH-4 have been well described in the literature.

Analyses undertaken

During the period under review, sampling has included phytolith sampling of dental calculus, sampling of fauna and hominin material for ancient DNA at the Max Planck Institute in Leipzig Germany (under separate permit), synchrotron imaging of the mandible of MH-1 in Grenoble France (under separate permit), laser isotopic studies of the enamel of an incisor of MH-1 at Johns Hopkins University, USA (under separate permit) and a large number of non-invasive and minimally invasive chemical and geochemical techniques on rock samples and potential organic remains done in various laboratories of the University of the Witwatersrand. In addition, micro-Ct and conventional CT of large numbers of faunal and hominin material has been undertaken.

Laser isotopic sampling of enamel of MH-1

Sampling and preparation of dental calculus from MH-1 and MH-2 for phytolith and protein analysis

Fourier Transform Infrared (FT-IR) (five specimens of potential organic origin)

Optical Coherence Tomography (OCT) (five specimens of potential organic origin)

Raman Spectroscopy (five specimens of potential organic origin)

Micro-CT (two specimens of potential organic origin and elements of MH-1 and MH-2)

Medical CT (numerous blocks)

Light Microscopy ((five specimens of potential organic origin and large numbers of faunal and hominin elements for various studies)

3-D surface scanning (five specimens of potential organic origin; elements of MH-1 and MH-2)

2012-2013 Publications

31 publications have been published on the Malapa site and fossil fauna since the first publications that appeared in April 2010. 13 refereed papers were published during the period under review. One thesis was completed. PDF copies of the refereed papers are attached.

Refereed Publications appearing during the period under review

1. Berger, L.R. (2012) Building a nation one project at a time: Reply to 'On human evolution, Australopithecus sediba and nation building' *S. Afr. J. Sci.* 108 (1/2)
2. Henry, A., Ungar, P., Passey, B., Sponheimer, M., Rossouw, L., Bamford, M., Sandberg, P., de Ruiter, D. and Berger, L.R. (2012) The diet of Australopithecus sediba. *Nature*. (Contribution 25% - discovered material, conceptualized project, managed process, contributed to scientific discussion and design, wrote aspects of the paper, acted as final editor.)
3. Berger, L.R. (2012) *Australopithecus sediba* and the earliest origins of the genus *Homo*. *J. Arch. Sciences*. Vol. 90, 1-16.
4. DE Roberts, A du Plessis, J Steyn, LR Botha, S Pityana, LR Berger (2012) An investigation of Laser Induced Breakdown Spectroscopy for use as a control in the laser removal of rock from fossils found at the Malapa hominin site, South Africa. *Spec. Acta Part B: Atomic Spectroscopy*. 73. 48-54.
5. Dirks, P. and Berger, L.R. (2012) Hominin bearing caves and landscape dynamics in the Cradle of Humankind, South Africa. *J. of African Earth Sciences*. doi: <http://dx.doi.org/10.1016/j.jafrearsci.2012.09.012> (contribution 40%. Undertook discovery of caves, formulated hypotheses, wrote aspects of paper relating to Palaeoanthropology).
6. Hartstone-Rose, A. , Brian F Kuhn, Shahed Nalla, Lars Werdelin, Lee R Berger (2013) A new species of fox from the Australopithecus sediba type locality, Malapa, South Africa. *Trans. R. Soc. S. Afr.* 10.1080/0035919X.2012.748698
7. De Ruiter, D., DeWitt, T.J., Carlson, K., Brophy, J., Schroeder, L., Ackerman, R., Churchill, S.E. and Berger, L.R. (2013) Mandibular remains support taxonomic validity of Australopithecus sediba. *Science*. (Contribution 25% - conceptualized project, managed process, contributed to scientific discussion and design, wrote aspects of the paper, acted as final editor.)
8. Williams, S., Ostrofsky, K.R., Frater, N., Churchill, S.E., Schmid, P. and Berger, L.R. (2013) Numerical Composition and hyperlordosis in the vertebral column of Australopithecus sediba. *Science*. (Contribution 25% - conceptualized project, managed process, contributed to scientific discussion and design, wrote aspects of the paper, acted as final editor.)
9. DeSilva, J., Holt, K.G., Churchill, S.E., Carlson, K., Walker, C., Zipfel, B. and Berger, L.R. (2013) The lower limb and the mechanics of walking in Australopithecus sediba. *Science*. (Contribution 25% - conceptualized project, managed process, contributed to scientific discussion and design, wrote aspects of the paper, acted as final editor.)
10. Irish, J. , Gautelli-Steinberg, D., Legge, S., de Ruiter, D. And Berger, L.R. (2013) The dental morphology and the phylogenetic place of Australopithecus sediba. *Science*. (Contribution 25% - conceptualized project, managed process, contributed to scientific discussion and design, wrote aspects of the paper, acted as final editor.)
11. Peter Schmid, Steven E. Churchill, Shahed Nalla, Eveline Weissen, Darryl J. de Ruiter, and Lee R. Berger. Mosaic Morphology in the Thorax of *Australopithecus sediba* (2013) *Science*. (Contribution 25% - conceptualized project, managed process, contributed to scientific discussion and design, wrote aspects of the paper, acted as final editor.)
12. Steven E. Churchill, Trenton W. Holliday, Kristian J. Carlson, Tea Jashashvili, Marisa E. Macias, Sandra Mathews, Tawnee L. Sparling, Peter Schmid, Darryl J. de Ruiter, and Lee R. Berger. (2013) The upper limb of *Australopithecus sediba*. *Science*. (Contribution 25% - conceptualized project, managed process, contributed to scientific discussion and design, wrote aspects of the paper, acted as final editor.)
13. Berger, L.R. (2013) The Mosaic Nature of *Australopithecus sediba*. *Science*

Theses

Val, A. (2013) A 3D APPROACH TO UNDERSTAND THE TAPHONOMY OF THE EARLY HOMININS FROM THE PLIO-PLEISTOCENE CAVE SITE OF MALAPA. Ph.D. Thesis, University of the Witwatersrand.