

Applicant (name and affiliation): this is usually the museum curator:

David Morris, McGregor Museum

Applied for (principal researcher):

Michael Chazan, University of Toronto, University of the Witwatersrand

Participants with affiliations, email addresses, phone numbers (& their role):

Paleomagnetic Dating-- Dr. Ron Shaar, Institute for Earth Science, Hebrew University, Givat Ram, Jerusalem.

Uranium Lead Dating—Dr. Don Davis, Department of Earth Science, University of Toronto, 22 Russell Street, Toronto, Ontario, Canada.

Microfauna analysis—Dr. Yolanda Fernandez Jalvo, Museo Nacional de Ciencias Naturales (CSIC), Jose Gutierrez Abascal, 28006 Madrid, Spain

OSL dating—Dr. Naomi Porat, Israel Geological Survey, 30 Malkhe Israel St. Jerusalem and Dr. Marine Frouin, Research Laboratory for Archaeology and the History of Art, Oxford University, 1-2 South Parks Road, Oxford, OX1 3TG, United Kingdom

U-Th dating—Dr. Norbert Mercier, Institut de Recherche sur les Archéomatériaux

UMR 5060 CNRS - Université Bordeaux Montaigne Centre de Recherche en Physique Appliquée à l'Archéologie (CRP2A), Maison de l'archéologie, 33607 Pessac Cedex, France.

Fauna- Katerina Douka, Research Laboratory for Archaeology and the History of Art, 1-2 South Parks Road OX1 3TG, Oxford, United Kingdom.

The material will be couriered to the appropriate institutions in October 2018 by Michael Chazan.

Return:

Paleomagnetic samples (sediment samples) will be curated permanently in the Paleomagnetic laboratory at the Hebrew University .

Uranium Lead (speleothems) will be returned by Michael Chazan before August 2019 to the McGregor Museum Kimberley.

Microfauna samples will be couriered to Margaret Avery (IZIKO) for taxonomic analysis by August 2019 and then returned to the McGregor Museum Kimberley.

OSL samples (sediment) will be curated permanently in the laboratories in Oxford and Jerusalem.

U-Th samples (Ostrich Eggshell) will be returned to the McGregor Museum Kimberley by August 2019.

Faunal samples will be returned to the McGregor Museum Kimberley by August 2019.

Institution incl. address that currently hosts the object:

McGregor Museum, Kimberley

Facility incl. address at which the experiment will be done:

See listing above

Table of objects or upload file:

Paleomagnetic dating: 150 sediment samples (1 cubic cm. each, spatial coordinates recorded in Wonderwerk excavation database)

Uranium Lead dating (Speleothem): List attached

Microfauna: List attached

OSL samples: Four samples (sediment, spatial coordinates recorded in Wonderwerk excavation database)

Fauna: List attached.

U-Th (OES): List attached

Site including age at which object was found:

Wonderwerk ESA

Time frame:

Transport to ___List of facilities above: October 2018

Return date: ___August 2019 except for sediment samples that will be curated in the foreign labs.

Aim/rationale:

Excavation 1 at Wonderwerk Cave preserves a unique sequence spanning the entire Earlier Stone Age. Developing a robust absolute chronology for this sequence will provide an essential timescale for the region. Research on faunal materials provides an opportunity to develop insight into the ecological context of human evolution

Methodology (short):

1. Paleomagnetic samples (150 samples). These are 1 x 1 cm. cubes collected in quartz boxes. The provenience of each sample is recorded photographically and in the GIS database for the site. All samples will be analyzed by Dr. Ron Shaar at the Institute of Earth Sciences at the Hebrew University. Samples will be maintained in the reference collection in Dr. Shaar's lab and will be made available to other researchers upon request.
2. Optically stimulated luminescence: Optically stimulated luminescence offers a method of dating sediments and is usually applied to contexts younger than 500,000 years ago. Dr. Marine Frouin, Oxford University, is developing a new luminescence technique, called radiofluorescence, to date K-feldspar grains contained in sediments or tuffs. In laboratory, the limit of the technique reaches ~3 Ma (maybe even 4 Ma), but it has never been tested on archaeological/geological context of this time period. If it works on real samples, of course, it would be possible to date any sites containing sediments where argon-argon and tephra correlation are not possible. Four samples were collected by Dr. Naomi Porat that will be used by Dr. Frouin to test this new method. Matching samples will be analyzed by Dr. Porat using standard protocols.
3. Uranium/Thorium-- U-series dating of ostrich eggshells (OES) using fs-LA-ICPMS techniques. When an egg forms, a small amount of Uranium (U) is incorporated in the calcitic eggshell structures. Conversely, Thorium (Th) is not metabolized and the shell is then free of it. Because of this disequilibrium between U and Th, eggshells are materials potentially datable with the U/Th method. The classic approach consists in dissolving with acids a fragment of a shell and measure the U and Th isotopic ratios. However, doing that makes difficult to quantify extra radioisotopes which may have been incorporated

in the shell during its burial (because of post-depositionnal processes) and may lead to biased U-series ages. The alternative approach we are developing consists in analysing the shell without making any chemical pre-treatment and measure directly the U and Th isotopic ratios on polished sections perpendicular to the egg surface. Femto-second (fs) laser-ablation (LA) techniques coupled to high-sensitive ICP-MS allow performing this kind of analyses with a high spatial resolution (typically 30 µm) : a map of the U and Th isotopes can then be acquired, allowing the identification of areas not affected by post-depositionnal processes or diagenesis. Uranium-Thorium will be carried out by Norbert Mercier and Chantal Tribolo at the University of Bordeaux Montaigne. Six samples will be exported for this analysis. Following analysis all samples will be returned to the McGregor Museum.

4. Uranium/Lead-- Uranium/Lead dating is effective in dating the age of formation of speleothems. Preliminary research by Robin Pickering demonstrates that this method works at Wonderwerk. Following up on Pickering's results the goal is to analyse a robust sample from well provenienced samples from the new excavations at Wonderwerk. Twenty eight samples will be exported to the University of Toronto, Department of Earth Science, Jack Slatterly lab. Following analysis all samples will be returned to the McGregor Museum for permanent curation.

5. Fauna-- Seventeen samples of unidentified bone fragments (total number of fragments 165) will be analysed as an exploratory project aiming to screen faunal assemblages for potential human remains. It is a collaboration between several institutions, the Crick Institute and Oxford in the UK and the Max Planck Institute for the History of Human Science. The first step will be to establish whether there is collagen and aDNA preservation at any of the bones in Wonderwerk using %N and ZooMS, at least for collagen preservation. Only need 20-50mg of bone is required, so the analysis is minimally destructive. Analysis will be carried out at Oxford by Katerina Douka. Following analysis all bones will be returned to the McGregor Museum for curation.

6. Microfauna-- Eight samples of microfauna from from square K488 from the new excavations. This is a 0.25 sq. meter unit at the eastern end of the south profile of excavation 1. It is from units equivalent to Peter's St. 6/7. There are three stratigraphic units represented in this sample that are in order from top to bottom SR/MM/TS. MM is particularly rich in microfauna. This sample will be sent to Dr. Yolanda Fernandez Jalvo (National Museum of Natural Sciences, Madrid) for taphonomic analysis following protocols described in Ferenandez Jalvo and Avery 2015. Following taphonomic analysis the sample will be sent to Dr. Margaret Avery (IZIKO) for taxonomic analysis and then returned to the McGregor Museum for curation.

Confirmation/permit by museum: Attached

Damage/destructive analysis?

Paleomagnetic dating: No

Uranium Lead dating: Samples cleaned and sectioned, otherwise nondestructive.

U-Th dating: Samples sectioned and polished

Microfauna: No

OSL samples: Quartz and feldspars separated from sample.

Fauna: No.

Statement why this study cannot be done in South Africa: Lack of necessary equipment and expertise.