**Export/sampling permits**

Please note an export permit must be linked to an objectthat has to be created on SAHRIS! If the object you want to work on has not been created yet, you would need to **create an ObjectID**.

Required documents:

* For export of material from KZN, Eastern Cape or Western Cape that involves destructive analysis, the **destructive sampling permit** from the respective Heritage Authority must be submitted;
* A consent letter from the accessioning institution.

The proposal should include (you can fill these in below):

* a list of participants (name, affiliation, phone no, email addresses) and how they are involved;
* the name and address of the facility, including address, it is being analysed at;
* name and address of the museum/university department that currently hosts the object;
* names of the responsible person(s) during transport and while the fossil is at the facility;
* the period/time frame during which the fossil(s) will be outside the country;
* detailed information on the fossil(s), especially as it is a "unique" specimen;
* detailed information on the research project behind it & methodology including expected outcomes (i.e., the reason for export);
* the written confirmation of the institution that currently hosts the object that the object may be used as proposed and be returned in good condition;
* should there be any damage/destructive analysis (e.g., coating for higher resolution) undertaken, this needs to be stated in detail;
* Statement why this study cannot be done in South Africa.

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

Dr. Gerrit Dusseldorp

University of Johannesburg and Leiden University

Faculty of Archaeology, Leiden University

2300 RA Leiden, The Netherlands

+31715272428

g.l.dusseldorp@arch.leidenuniv.nl

**Applied for (principal researcher):**

Andrew Carr, School of Geography, Geology and the Environment, University of Leicester, University Road, Leicester, LE1 7RH, UK

Role: Luminescence dating analysis

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

1) Dr. Gerrit Dusseldorp

University of Johannesburg and Leiden University

Faculty of Archaeology, Leiden University

2300 RA Leiden, The Netherlands

+31715272428

g.l.dusseldorp@arch.leidenuniv.nl

Role: Project leader

2) Andrew Carr, School of Geography, Geology and the Environment, University of Leicester, University Road, Leicester, LE1 7RH, UK

Role: Luminescence dating analysis

3)

Role:

The material will be **Couriered with DHL** to the School of Geology, Geography, and Environment, University of Leicester (facility/institution) in November 2018 (month, year) by Gerrit Dusseldorp (name of person responsible for transport) and brought back by \_\_\_\_\_\_\_\_\_\_\_\_\_ (leave blank if same person as above).

Dr. Andrew Carr (name) will be involved with the Sample preparation and analysis (e.g., transport/scanning) of objects and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (whatever else).

**Institution incl. address that currently hosts the object:**

KwaZulu-Natal Museum 237 Jabu Ndlovu Street

Pietermaritzburg South Africa

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

School of Geography, Geology and the Environment, University of Leicester, University Road, Leicester, LE1 7RH, UK

**Table of objects or upload file:**

See attached table.

**Site including age at which object was found:**

Umhlatuzana rockshelter

The samples derive from the terminal Pleistocene and cover the sequence to around 60 000 years ago.

**Time frame:**

Transport to School of Geology Geography and Environment: November 2018

Return date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (date)

**Aim/rationale:**

The age of much of the Pleistocene stratigraphy at Umhlatuzana rockshelter is unclear. OSL ages have only been published for the lowest part of the sequence. Beyond the Holocene sediments, charcoal is badly preserved and in many layers virtually absent. In addition, a large part of the sequence likely is at or beyond the limit of Radiocarbon dating. Hence Luminescence dating appears the best method to obtain ages for the Pleistocene parts of the sequence.

8 samples will be taken to the UK for luminescence dating analysis, which will provide critical chronological information for this excavation. The samples have been taken from units 15-9 and 48 and will provide age estimates for the final Middle Stone Age, the transition to the Later Stone Age, the Robberg and the terminal Pleistocene occupation of the site.

**Methodology (short):**

Samples have been obtained by hammering small metal/plastic pipes into the section to obtain sediment that has not been exposed to light. Additional sediment samples adjacent to the OSL samples have been collected to support dose rate determination. Under dark room conditions the tubes are opened and the material inside is subject to two sets of analysis. Firstly, the outer ends of the tubes, which may have been exposed to light during sampling are removed. These tube end sediments are used to provide an estimate of sample water content (i.e. they are dried), then they are homogenized in a rotary mill. A sub-sample of the milled tube ends is submitted for analysis via inductively-coupled plasma mass spectrometry (ICP-MS), which provides elemental concentrations for the relevant radioactive elements (U, Th, K, Rb). This is required to estimate the annual dose rate to the sample (part of the luminescence age equation). The other sub-sample is submitted for beta counting, which provides further verification of the sample dose rate. This is not as destructive in the manner of ICP-MS, which requires a wet chemical digest, but does require the material to have been homogenized via milling.

The materials in the inner parts of tubes are used determine the burial (radiation) dose that the sample has received, which is the other part of the luminescence age equation. This involves isolating sand-sized quartz and/or feldspar grains from the samples. In brief this involves: treatment with dilute acid to remove carbonates, treatment with hydrogen peroxide to remove organic matter, wet sieving to isolate the sand size fraction of interest (usually 180-212 µm), heavy liquid separation to remove heavy minerals and to separate the quartz and K-feldspar fractions. The resulting material is then etched in hydrofluoric acid (1 hour in 45% HF for quartz, 10 minutes in 10% HF for K-Feldspar). The dose acquired by these mineral fractions is determined by the measurement of the sample’s luminescence (either the optically stimulated luminescence (OSL) signal from quartz, or the infra-red stimulated luminescence (IRSL) signal from K-Feldspar), following the methods of (e.g.) Murray and Wintle (2000). In brief this comprises the measurement of the natural OSL/IRSL signal followed by a sequence of artificial dosing of the sample to construct a dose-response curve (DRC). Using the DRC created in the laboratory the equivalent dose can then be determined, which corresponds to the dose the sample received in natural. Dividing this “equivalent dose” by the dose rate (from the ICP-MS and beta counting) provides an estimate of sample age.

**Confirmation/permit by museum (**Attached?):

See letter from museum attached.

**Damage/destructive analysis? (if yes, explain in detail)**

Yes – as detailed above. Part of the sample subject to ICP-MS is destroyed by acid digestion in order to get all relevant minerals into solution. The remainder of the sample for equivalent dose measurement is largely destroyed by the chemical treatments used to isolate the sand-sized quartz /K-Feldspar, which is often a relatively small fraction of the original material (though this depends on the lithology and composition of the original sample)

**Statement why this study cannot be done in South Africa:**

Effective use of / interpretation of the luminescence method requires detailed knowledge of site/sample context, which as a member of the project excavation team Carr has acquired. Carr was instrumental in developing the dating sampling strategy during excavation. The Leicester facility is a high-quality establishment with a proven track record in publication, including analysis of sites in which there is good correspondence with independent dating methods. Additional support from the Leicester lab has also already included in-situ dose rate measurement during the excavation process, which will be integrated into the final data reports.