SAHRA Research Proposal

Bolt's Farm-Greensleeves
Permit renewal (2013-2016).

D. GOMMERY[1] & S. POTZE[2]
(in collaboration with F. Sénégas and L. Kgasi)

HOPE RESEARCH UNIT
Plio-Pleistocene Section,
Ditsong National Museum of Natural History,
Pretoria,
SOUTH AFRICA

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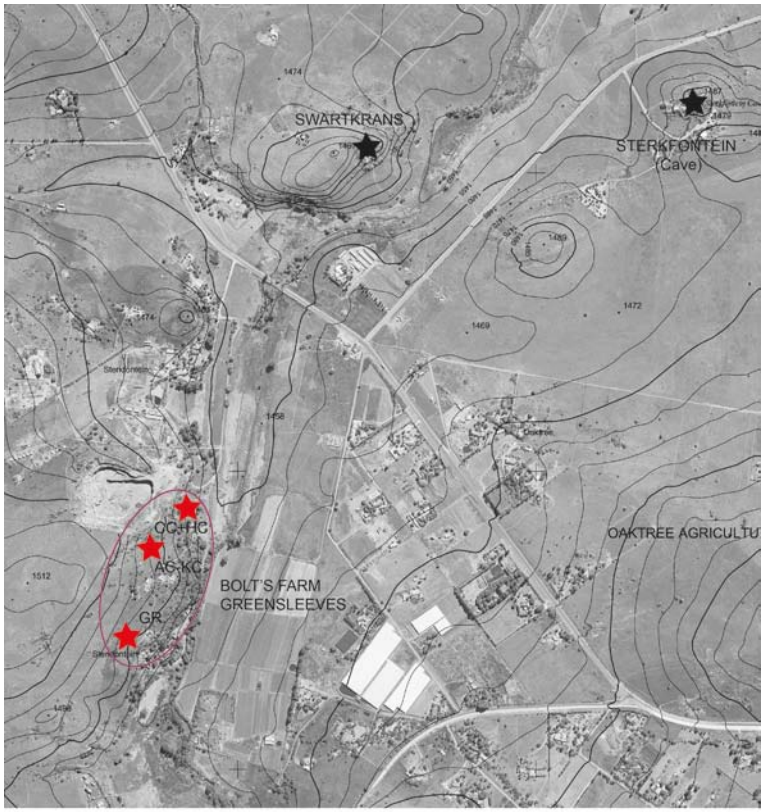
[1] UPR 2147 CNRS, 44 rue de l'Amiral Mouchez, 75014 Paris, FRANCE.
☎ +33 (0)1 43 13 56 19
dominique. gommery@evolhum.cnrs.fr

[2] Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, SOUTH AFRICA.
☎ +27 82 470 0369
stephany.potze@gmail.com

PLAN FOR BOLT'S FARM –GREENSLEEVES.

The main scientific goal for the HOPE Research Unit team or HRU team concerning Bolt's Farm-Greensleeves, as well asfor Bolt's Farm-Kinklert, is to develop the fossil collection for this area which is not as well-known as the other fossil localities from the Cradle of Humankind. The more fossil specimens and data recovered, the better our understanding of the Cradle of Humankind World Heritage Area.

The fossiliferous area of Bolt's Farm is located on the East part of a large flat hill. Contrary to the Klinkert part of Bolt's Farm, all the karstic deposits in the Greensleeves property are situated on the lower slope of the hill. Greensleeves presents 3 main fossiliferous karstic complexes: **1-** Cobra Cave (CC) + H Cave (HC), **2-** Aves Cave karstic complex[1] and **3-** Garage Ravine Cave (GR). Except for GR, the loci (cave or deposit) are very close to each others, making it difficult to identify them clearly from the map elaborated by Camp between 1947 and 1948 (Cooke, 1991). The actual caves or deposits are only the remnants of a **single karstic system**. We plan to focus on the most interesting and promising deposits (in term of age and/or palaeoenvironmental information) namely the Aves Cave karstic complex. At the same, we will continue the acid preparation of the backlog from GR, CC and HC as requested by SAHRA.



Location of Bolt's Farm -Greensleeves
Map 1:10 000
(CC = Cobra Cave, HC: H Cave, AC-KC: Aves Cave Karstic complex,
GR: Garage Ravine cave)

As yet, there is no systematic work undertaken on the geology of the Plio-Pleistocene sites in this north-western part of the Sterkfontein Valley. J. Hancox joined the project last year to do such a task in collaboration with F. Thackeray for the chemical analysis of the breccias, with A. Herries for palaeomagnetism and with R. Pickering for speleothems datation. Our main

[1]With our present knowledge of this area, the different pits recognized by Camp seem to represent the different remnants of a unique karstic network (see report). To prevent the confusion between the old and the new collection, we used the name of Aves Cave karstic complex which is is represented by: Aves Cave I with the collection prefix AC (= pit 14 of Camp (Bench Mark Pit) or pit 15) ; Aves Cave II with the collection prefix ACII (= east part of pit 8 (Rodent Cave) ; Aves Cave III with the collection prefix ACIII (could also represent pit 14 of Camp (Bench Mark Pit) ; Aves Cave IV with the collection prefix ACIV (entrance of pit 5 or was pit 5 (Smith Cave) ; Aves Cave V with the collection prefix ACV (pit 5 (Smith Cave) or pit 13).

goal is to study the palaeoenvironment and the evolution of the fauna from the end of the Lower Pliocene (around 4.5-4 My), period barely known in Southern Africa, to the Middle Pleistocene (around 0.9 My) in order to allow bigger scale comparison, especially with East Africa.

LOCATION OF GREENSLEEVES

Map 1:10 000 n°2627 BA 5 Sterkfontein
Map 1:50 000 n°2627 BA Randfontein (Sixth edition 2006)
Landowner: J. Gaylord

LOCI Name	GPS location (grid used: WGS 84)
AC I	S26°01'44.7"; E27°42'58.0"
ACII	S26°01'45.1"; E27°42'58.5"
ACIII	S26°01'44.6"; E27°42'58.5"
ACIV	S26°01'43.7"; E27°43'00.2"
ACV	S26°01'43.3"; E27°42'59.4"
GR	S26°01'54.8"; E27°42'56.3"
CC	S26°01'41.3"; E27°43'01.4"
HC	S26°01'41.6"; E27°43'02.7"

FIELDWORK METHODOLOGY

We will continue to develop our specific methodology based on 4 main steps (cf. report): **1)** work on the dumps, **2)** cleaning of the site (grass and superficial sediment are removed), **3)** excavation of the *ex-situ* and decalcified breccia and **4)** excavation of the *in situ* breccias with the help of a hammer-drill Hilti TE60 ATC 1200W. All the *in situ* blocks will be mapped before removal (use of a grid system for the X and Y coordinates + theodolithe for the Z coordinate). But the step 4 will start only once the geological study will be finished.
Sometines, several steps are carried out simultaneously according to the scientific needs. We will continue to work intensively two fieldwork seasons per year (april-may and october-november or november-december), 1 month to 1 and 1/2 month each. In between, maintenance work will be organised at the site.

In the future, depending of additional funding and in addition to the traditional mapping of the site, we would like to acquire a Drone in order to get HD aerial view of the excavation. These images will help us for the comprehension of the complex deposition of the karstic network.

FIELDWORK ACTIVITIES

ACI (previously Aves Cave). During our last fieldwork (April-beginning of May 2013), we continued to clean the site and to excavate the decalcified breccia mainly in the northern, the north-eastern and the south-western parts of the deposit. J. Hancox asked us to remove as much decalcified breccia and sediment we can to get access to more *in situ* breccia and dolomite. For now, the extant hypothesis is that there are two detritic cones, one in the North/North-Eastern part of the locus and the other one in the South/South-Eastern part. For the next 3 years, we would like to continue to clean and excavate the decalcified breccia, cto ontinue the mapping of the locus, to study the geology of the deposit, to proceed to chemical

and isotopic analyses of the breccias and, if possible, to start palaeomagnetig and radio-U-Pb isotopic dating on speleothems and limestone:
1. During the last visit of J. Hancox for the geology, he requests that we excavate in priority the central part of the site (the deeper part). The purpose of this activity is to have the basal contact between of the deposit and the dolomite (floor of the cave).
2. In the same time, we will excavate the decalcified breccia pockets at ACI. These pockets are very rich in fossil remains as we noticed during our last two fieldwork seasons. All the fossils are reported on the map of the excavation.
3. We would like to extend the excavation in its North-Eastern corner to connect with ACII (previously Rodent Cave).
4. We will sample the *in situ* breccia for chemical and other analyses, but also in goal to compare the faunal composition from the *in situ* breccia with of that of decalcified breccia.
5. We would like to sample a little bit more some breccia blocks from the dump, a quantity reasonable enough to be prepared within a year or two maximum in order to avoid backlog.
6. We would like to check the actual presence of the detritic cone in the South/South-Eastern part of the locus. For that purpose, we will have to remove an important dump which is sitting on top of it.
7. The third year of the permit, more probably for the next SAHRA permit, we would like to start to excavate the *in situ* breccia.

ACII (previously Rodent Cave). We want to collect more breccia blocks inside the open trench of this locus, especially in the East part. We need more samples of faunal material for dating purposes and palaeoenvironmental interpretation. This "cleaning" will, in turn, give us access to the *in situ* breccia and dolomite in this part of the locus. The West part is more accessible for geological study. Our hypothesis is that ACII is the continuation of ACI. The faunal content, the geology and the chemical analysis will help us to confirm this hypothesis.
ACIII (previously Bench Mark Pit). In the past, we collected some breccia blocks from the two dump along the trench which correspond to the locus. We want to clean this small trench for the geology and to collect some more breccia blocks. Our hypothesis is that ACIII is connected with ACII and ACI and that they belong to the same karstic complex. Geology, faunal content and chemical analysis will help to confirm it.

ACIV (previously the entrance of Smith Cave). Very few breccia blocks have been collected in the past. This locus is now distinguish from the main Cave of Smith Cave. By the mining activities, the two loci look like joined together but it was probably not the case in the past. ACIV is the southern spot of the actual cavity and no dump exists in the southern part to this locus where the miners would have store the material extracted from this locus. Rare breccia blocks are dispersed near the entrance of this locus. Some witness of the *in situ* breccia is visible but covered by the vegetation. The locus must be cleaned in order to expose more of this *in situ* breccia. Geology, faunal content and chemical analysis will be used to test the hypothesis that ACIV is part, along with ACIII, ACII and ACI, of the same karstic network.

ACV (previously the main cave of Smith Cave). It is a huge dump in the North side of this locus but it is made of mainly by chert and dolomite blocks extracted by the miners. We did not collect on this dump yet. We would do some geological study inside the cave represented this locus and take few *in situ* sample for the chimical analysis and the

microfauna. The macrofauna is represented by scrappy material. The deposit of this locus look like different of the other loci of Aves cave karstic complex, it is true?

Test trench. ACI, ACII and ACIII are next to each others. ACIV is a little bit further away. We would like to do an exploratory trench (about 1 m wide) between ACI and ACIV in order to check if and how these loci link up together.

PREPARATION OF THE MATERIAL.

In order to preserve the microfauna, as well as the smallest macromammal remains, the fossiliferous breccias will be prepared with acetic acid following the same protocol we used for several years now at the Ditsong Preparation Laboratory. The preparation laboratory has adopted a very accurate method of capturing as much data as possible related to the breccia blocks prior to and during preparation. The data collected prior to preparation are the block weight, the colour, a picture with a scale bar and a sample block stored in the Bolt's Farm collection. During preparation the data include the percentage of acetic acid, the type of consolidant and solvent used, pictures taken after every acid bath, weight loss after every bath and duration of preparation from start to finish. All the data will be available in hardcopy and electronic database format.

As we did before, we will try to prepare most of the breccia blocks collected during the year or the past two years. Our challenge will be to prepare 85% of the blocks collected. We will keep some breccia blocks as witness and for the new analyses that will be possible in the future.

PALAEONTOLOGY/BIOCHRONOLOGY

Even if we need more samples to refine our dating and palaeoenvironmental interpretation, we have already some information concerning ACI. The fossil suids seem to indicate the deposit is around 3.5 to 3 million years in age (Pickford, 2013) and could potentially be one of the oldest fossil sites in the Cradle of Humankind. ACI is probably the same age than MA (Bolt's Farm-Klinkert) but also than the oldest deposits at Makapansgat situated more north in South Africa.

For the first time in South Africa, our discoveries at Bolt's Farm-Greensleeves and Bolt's Farm-Kinklert prove that the Lower Pliocene (between 4.5 and 3.5 My) can be represented in the Cradle of Humankind, something that very few colleagues believe possible. All together, even if discontinuous, we have potentially the longest sequence in the Cradle of Humankind, from 4.5 to 0.9 million years. Such a sequence will allow large scale comparison with the other sites in the Cradle, with Makapansgat and with East Africa. We will use every tool at our disposal to get the most accurate dating and palaeoenvironmental reconstruction possible: geology, palaeomagnetism, chemical analysis, isotopic analysis (C, O but also trace elements) and the whole fauna (from the smallest vertebrate such as frogs to the birds to the largest mammals). This accuracy will allow us to better understand the chronological and environmental framework of hominid evolution, as well as the origin and setting of the modern biodiversity in Southern Africa.

PUBLICATION STRATEGY.

We plan to publish regularly (as we have been doing for several years now) on the new results on Bolt's Farm. The journals we have considered for publication so far includes the Annals of the Ditsong National Museum of Natural History, South African Journal of

Science, Palaeontologia Africana but also international journals such as Journal of Human Evolution, Journal of Vertebrate Paleontology, C. R. Palevol, Geobios,...
We also plan to participate to local and international congresses (if funding becomes available) where we can share our results on Bolt's Farm with the scientific community.

TRAINING AND FIELD SCHOOL.

The Ditsong Preparation Laboratory has been used as a training facility for students and interns interested in learning more about chemical preparation methods. For the past two years, three interns, funded by the National Research Foundation (NRF), are being trained in this method of breccia preparation. Their contract will come to an end in June 2013.
HRU is developing a collaboration with the Department of Anthropology and Archaeology of UNISA at Pretoria. Two of us (D. G. and F. S.) have been made associate researchers at this department. We plan to organize a field school at Bolt's Farm in April 2014 but some students of this department have already the possibility to participate of fieldwork activities as volunteers. Two of them joined us for the April/May fieldwork season. One if the main goal of this collaboration is to train students in palaeontology techniques and to supervise some of them, in the future, for Honors and Masters degrees.

EDUCATION AND OUTREACH.

Upon more specimens being recovered and the scientific information they provide, we plan to communicate our results to the public in the form of educational displays and outreach programmes. Displays will rotate between the Ditsong National Museum of Natural History, Maropeng, UNISA and hopefully also the University of the Witwatersrand. The aim of these displays is not only to bring a general information about the South African fossil heritage to the general public, but also to emphasize our results on the Bolt's Farm deposits and the importance of this fossiliferous area to understand a time period which is poorly preserved in the Cradle of Humankind in particular and in South Africa in general.

Collaborators

The scientific objective of the HRU team is to etablish a biochronology as precise as possible and to understand the evolution of the palaeoenvironment for the Late Pliocene and Plio-Pleistocene in the Cradle of Humankind. The HRU team present a strong pluridisciplinary approach with different specialists from South Africa, France and Australia.

Mammal macrofauna (Palaeontology)

Primates (human and non-human)

Dr. Dominique Gommery, UPR 2147 CNRS, Paris, France.
Stephany Potze, Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, South Africa.
Dr. Sandrine Prat, UPR 2147 CNRS, Paris, France.
Pr. John Francis Thackeray, IHE, University of the Witwatersrand, Johannesburg, South Africa.

Bovidae

Dr. James Brink, National Museum, Bloemfontein, South Africa.

Equidae

Dr. James Brink, National Museum, Bloemfontein, South Africa.

Suidae

Dr. Martin Pickford, Muséum National d'Histoire Naturelle, Paris, France.

Carnivores

Dr. Dominique Gommery, UPR 2147 CNRS, Paris, France.
Dr. Brian Khune, University of the Witwatersrand, Johannesburg, South Africa.
(+ call of collaborations for specific groups)

Hyracoidea

Dr. Frank Sénégas, UPR 2147 CNRS, Paris, France.

Lagomorpha

Dr. Frank Sénégas, UPR 2147 CNRS, Paris, France.

Others

Dr. Dominique Gommery, UPR 2147 CNRS, Paris, France.
Dr. James Brink, National Museum, Bloemfontein, South Africa.
Dr. Martin Pickford, Muséum National d'Histoire Naturelle, Paris, France.
(+ call of collaborations for specific groups)

Mammal microfauna (Palaeontology)

Rodents

Dr. Frank Sénégas, UPR 2147 CNRS, Paris, France.

Insectivores

Dr. Frank Sénégas, UPR 2147 CNRS, Paris, France.

Chiroptera

Dr. Frank Sénégas, UPR 2147 CNRS, Paris, France.
Dr. Teresa Kearney, Ditsong National Museum of Natural History, Pretoria, South Africa.

Macroscelides

Pr. Brigitte Senut, Muséum National d'Histoire Naturelle, Paris, France.

Birds

Greg Davies, Birds Section, Ditsong National Museum of Natural History, Pretoria, South Africa.
(+ call of collaborations for specific groups)

Amphibian

Dr. Thalassa Matthews, IZIKO Museums of South Africa, Cape Town, South Africa.

Reptiles

Chelonian

Dr. Julien Claude, UMR 5554 CNRS, University of Montpellier II, Montpellier, France.

Geology

Karstic system

Dr. John Hancox, University of the Witersrand, South Africa.

Chemical analysis of Breccia

Pr. John Francis Thackeray, IHE, University of the Witwatersrand, Johannesburg, South Africa.

Isopic analysis of palaeontological remains

Dr. Loïc Ségalen, University Paris 6 (Pierre et Marie Curie), Paris, France.

Dating

Speleothem

Dr. Robyn Pickering, School of Earth Sciences, University of Melbourne, Melbourne, Australia.

Palaeomagnetism

Dr. Andy Herries, Archaeomagnetism Laboratory, Faculty of Humanities and Social Sciences, School of Humanities, La Trobe University, Australia.

Survey

Lazarus Kgasi, Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, South Africa.
Stephany Potze, Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, South Africa.
Dr. Dominique Gommery, UPR 2147 CNRS, Paris, France.
Dr. Frank Sénégas, UPR 2147 CNRS, Paris, France.

Fossil preparation

Lazarus Kgasi, Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, South Africa.

Curation

Stephany Potze, Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, South Africa.

Casting

Dr. Dominique Gommery, UPR 2147 CNRS, Paris, France.
Lazarus Kgasi, Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, South Africa.
Amélie Chimènes, UPR 2147 CNRS, Paris, France.

Data-Base

Lazarus Kgasi, Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, South Africa.
Stephany Potze, Plio-Pleistocene Section, Ditsong National Museum of Natural History, Pretoria, South Africa.
Amélie Chimènes, UPR 2147 CNRS, Paris, France.