

Our Ref:



an agency of the
Department of Arts and Culture

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CaseID: 21544

Date: Monday June 26, 2023

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Letter

In terms of Section 32(19) of the National Heritage Resources Act (Act 25 of 1999)

Attention: Dr Julien Benoit

University of the Witwatersrand

Evolutionary Studies Institute (ESI); School of Geosciences, University of the Witwatersrand,
Braamfontein, 2050, Johannesburg, South Africa

This is a project to take 6 large therapsid skulls to the European Synchrotron Radiation Facility in Grenoble for CT scanning early in July 2023. The aim is to address their neurological adaptations to head-butting and deduce potential behavioural complexity among early therapsids. Details are available in the attached proposal (which has already been accepted by the ESRF, see at the end of this form). BP/1/5735, BP/1/7141 and BP/1/8125 are relatively small, and will be hand carried to the ESRF by Julien Benoit, Andrew Bolton and Luke Norton. BP/1/8656, BP/1/1370 and BP/1/1575 are too large and too heavy to be hand carried, and will have to be transported by air cargo to the ESRF using DHL Air Economy Aim/rationale: Evidencing intraspecific agonistic behaviours (male to male head-butting combat and sexual display) is the gateway to reconstruct gregariousness and social complexity in extinct species, as it implies the existence of a stratified and hierarchical society. In turns, behaviours like head butting and face biting not only leave visible injuries, but require crucial adaptations of the skull to be used as weapons and withstand these brutal encounters, such as reinforcement and reorientation of the capsules for the cranial nerves, brain, and inner ear. Evolution of these adaptations can be traced through times and the fossil record using SR μ CT. The skull of late Permian therapsids, the ancestors of mammals, display a remarkably wide variety of head weapons that remains to be investigated. This includes maxillary bosses (Pachydictes), a frontal horn (Struthiocephalus), a parietal shield (Tapinocaninus and Riebeeckosaurus), tabular bosses (Styracocephalus) and sabre-like canines (Anteosaurus). This diversity in ornamentations is reminiscent to that encountered in social mammals, thus strongly suggesting that the common portrayal of therapsids as solitary animals is an oversimplification. This project aims at documenting the diversity of agonistic behaviour in early therapsids by providing in depth descriptions and comparisons of the neurological and histological adaptations to social fighting in the above listed species, to find crucial evidence of a great variety of agonistic behaviours. This will, for the first time, demonstrate that therapsids were highly complex, social animals. This will be backed by the study of their encephalisation, as it has been hypothesised that social behaviour would have increased with brain size and intelligence. Special motivation for BP/1/5735: There is one holotype included in this

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project, BP/1/5735, the holotype of the biarmosuchian *Pachydictes elsi*. This specimen is the sole representative of this genus and species and thus is considered sensitive material. It is important to include this specimen in the sampling, however, as it uniquely displays paired pachyostotic maxillary bosses that were likely used for intraspecific combat. As no other therapsids (or even amniotes) display such morphological adaptations to head-butting, BP/1/5735 evidences a unique part of therapsid behavioural diversity. This is why studying its neurology (particularly the maxillary canals) of this specimen is of paramount importance to this project. Unfortunately, the specimen is too large for all the micro-CT lab in the country, and the large size also impedes good contrast. Medical scanners are large enough, but too low in energy to get through the dense sediment. Only the new beamline of the ESRF, BM18, has a stage large enough and enough energy to provide workable results.

Dear Dr Benoit,

Thank you for your application to temporarily export six fossil therapsid skulls from the Karoo for synchrotron scanning at the ESRF, Grenoble, France.

SAHRA has reviewed the application and has decided to approve it.

We wish you every success with this project.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Ragna Redelstorff, PhD
Heritage Officer
South African Heritage Resources Agency

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Phillip Hine

Manager: Archaeology, Palaeontology and Meteorites Unit
South African Heritage Resources Agency

ADMIN:

Direct URL to case: <https://sahris.sahra.org.za/node/618656>

Terms & Conditions:

1. This approval does not exonerate the applicant from obtaining local authority approval or any other necessary approval for proposed work.
2. If any heritage resources, including graves or human remains, are encountered they must be reported to SAHRA immediately.
3. SAHRA reserves the right to request additional information as required.