Date 17 February 2020

Request to Extend Project

I kindly request an extension on project CASEID 13718 on the osteohistology of specimens from the Elliot Formation, Karoo Basin South Africa. Significant progress was made in 2019 in terms of preparing the fossil bones. However, this was a time consuming process and very little of the thin sectioning has commenced. I thus request that the permit be renewed for another year to complete the thin sectioning of the fossil bones. I also request that the following three bones be added to the original list (images are attached). I have support letters from both institutions.

*Lesothosaurus* BP/1/6936 femur, tibia

Sauropodomorph BP/1/5202 humerus

Sauropodomorph NMQR 3314 tibia, fibula

Original Project Motivation

This research aims to investigate the underlying reasons for faunal turnover across the end-Triassic extinction event, as a means of understanding biotic responses to mass extinctions in general. Previous approaches have focused on a relatively narrow array of traits (e.g., body mass, discrete character evolution) that are relatively coarse proxies for biological variables. Here, we plan to use a multi-proxy approach, incorporating a novel set of life history variables as well as a tested suite of variables. The Elliot Formation in the Karoo Basin of South Africa preserves a complete sequence of uppermost Triassic and lowermost Jurassic strata and contains the best continental record of the end-Triassic extinction and the tetrapods living through this event. Life history and ecological data will be used in a biostratigraphic framework to assess the faunal turnover of Late Triassic and Early Jurassic taxa from the Elliot Formation.

Life histories can be assessed based on bone microanatomy and histology in vertebratesbecause these are known to reflect growth rates and patterns, ontogenetic stages, reproductive maturity, biomechanical adaptations, lifestyles and potentially the effects of significant environmental perturbation on growth. As high mortality rates affect populations in unstable, resource-limited environments such as those that form during mass extinction events, species exhibiting different life history strategies might be expected to respond differently to critical biotic or abiotic factors. Thus, a species’ potential to modify its life history strategy may be key to its survival.

The main aim will be to assess the osteohistology of latest Triassic and earliest Jurassic taxa from the Elliot Formation, Karoo Basin, South Africa, focusing primarily on two major clades that crossed the Triassic-Jurassic boundary, namely non-avian dinosaurs and non-mammaliaform cynodonts. Recent field work by co-investigator, Dr Choiniere, has produced two dinosaur bonebeds from the lower Elliot Formation (LEF) and one from the upper Elliot Formation (UEF). The two LEF bonebeds comprise sauropodomorph material, with one including non-mammaliaform cynodont bones as well, whereas that from the UEF comprises ornithischian material. All three bonebeds include multiple individuals of different sizes (and possibly ontogenetic ages) and their stratigraphic placement in the Elliot Formation has been carefully documented. The osteohistology of these individuals will be examined to determine if the skeletons in each bonebed represent a single taxon of different ontogenetic ages or multiple taxa. The life history information gained from the LEF bonebeds will be added to data obtained from other LEF sauropodomorph dinosaurs such as *Sefapanosaurus*, which is represented by material that includes limb bones. There are numerous UEF dinosaurs known from at least partial skeletons including sauropodomorphs such as *Massospondylus*, *Arcusaurus*, *Aardonyx*, *Ledumahadi*, *Antetonitrus* and *Pulanesaura*, theropods such as *Coelophysis* (previously *Syntarsus*) and an unidentified large theropod, and ornithischians such as *Eocursor*, *Lesothosaurus*, *Heterodontosaurus* and *Stormbergia*. Non-mammaliaform cynodonts include *Tritylodon* and *Pachygenelus.* This data will be added to that obtained from the new UEF ornithischian bonebed and several isolated theropod tibiae (permission to section already approved) of varying sizes. The information gained from both the LEF and UEF fauna will then be combined and assessed in a phylogenetic context to evaluate their life history strategies and the palaeoecological implications of the ETE.

Equipment and Protocol

The National Museum contains a fully equipped osteohistology laboratory with cutting, grinding and polishing machines (Struers Accutom-100; LaboPol 5). Thus, all thin sectioning and analysis of the bone microstructure can be completed in-house. I have 20 years’ experience in osteohistological analysis and the laboratory now has a full-time osteohistology technician (Mrs Sekhomotso Gubuza) who I have personally trained in thin sectioning techniques. Limb bones will be preferentially selected as they provide the most complete information about the life history of an animal. Photographs, casts and gross measurements of the bones will be taken prior to thin sectioning in order to retain a permanent record of the specimens. In most cases, only a small region of the midshaft of each bone is required to obtain a life history record of the individual. Once all information about the bone has been recorded, the portion of bone to be thin sectioned will be embedded, sections cut, stuck to slides and ground using the Struers Accutom-100 following standard practices. Photographs and osteohistology data (e.g. osteocyte lacuna density, vascularity, bone tissue type, growth marks) will be collected using a Nikon Eclipse Ci-Pol polarizing Microscope and various image analysis software (e.g. NIS elements D 4.5, Image J, Bone Profiler for Windows) all of which are available in the department. Once all analysis is complete, the resulting thin sections will be returned to the ESI.

Note: The sections to be taken have been highlighted by red boxes on the bones in the attached images.

Yours faithfully



Dr Jennifer Botha

HOD Karoo Palaeontology