Computed tomography at an African light source: Possibilities for palaeontology

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Abstract. This *Letter of Interest* outlines the research interests in Palaeontology making use of computed tomography (CT) techniques using at an African Synchrotron Light Source. These include the study of incremental lines in fossilized teeth and the Palaeoentomology studies.

1. Introduction

This *Letter of Interest* discusses research directions in the field of Palaeontology making use of computed tomography (CT)beamline at an African Light Source (AfLS). Studies in this field are based on the fossils remains of animals that existed in periods such as the Permian, Triassic and Jurassic eras have been discovered in Africa and around the world. There is also an extensive collection of human ancestral remains from a few million years ago or less that have been found such as *Australopithecus sediba*, Turkana Boy (*Homo ergaster*), Zinjathropus (*Paranthropus boisei)* and *Sahelanthropus tchadensis* which have added to our understanding of the history of life on earth. The discovery of the earliest hominid remains on our continent has led to the designation of Africa as "the cradle of mankind". Computed tomography provides a useful way of studying fossil materials which are rare and sometimes fragile. It allows researchers to observe the internal structures and take measurements that can be used to make useful comparisons and answer questions on subjects such as locomotion and possible diets. There are now many laboratory-based CT scanners available from which resolutions in the micrometre and nanometre ranges can be obtained depending on the size of the specimen. However, laboratory-based scanners have limitations on the X-ray flux and energy which can be generated. This has led to the use of synchrotron facilities to study some of the fossil remains.

2. Palaeontology Research directions

The study of incremental dental development in teeth [1] can be observed using phase contrast imaging which removes the need for destructive methods such as histology. Such studies can be carried out on specimens such as "little foot" [2] which has a well-preserved fossilized skull of an *Australopithecus* ape like hominin. The inner ear of this skull is also well preserved and can be used to study the posture and hearing capabilities. These studies more conveniently carried out at a synchrotron facility with a high flux of x-rays and phase contrast imaging capabilities. An African Light Source will also reduce the security concerns of moving the rare and priceless cultural heritage items across borders and continents.

There is a significant number of fossilized insects mong the over 10 000 fossil specimens curated in at the Evolutionary Studies Institute in South Africa, and also at other museums and academic institutions across the African continent. In some cases, only imprints are found and sometimes they are

preserved in amber. Researchers in Palaeoentomology can benefit from studying the anatomical structures of these specimens which can be used to describe species and phylogenetic analysis using synchrotron CT[3].

References

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