

Proposal to Study Stw 151 and Drimolen Dental Material

Introduction

The aim of this study is to use a combination of traditional and state of the art non-destructive techniques to accurately re-evaluate the dental development and age at death of the Stw 151 juvenile and five individuals from Drimolen. An initial study of the Drimolen hominin teeth was conducted in June of this year along with Jacopo Moggi-Cecchi, Colin Menter, and Charlie Lockwood. The initial results for both *Paranthropus* and early *Homo* dental development were very promising - allowing us to estimate the developmental ages of several of the Drimolen specimens. We request permission to study several more teeth from Drimolen, which will be transported along with Stw 151. The inclusion of Stw 151 from Sterkfontein will allow us to provide a greater context for the dental development of early *Homo* from South Africa. Pending approval from this review committee, we intend to seek a temporary export permit from SAHRA in order to conduct this research.

Research Protocol

1. *Photographic recording of developing teeth and generation of impressions (in Wits)*

A Coopix 4500 digital camera will be employed to capture the developmental stage of each tooth. Following this, dental impressions and peels will be made of each permanent tooth crown with Coltene President soft putty and Struers' Repliset impression materials. Standard protocols of impression generation will be employed to ensure that fragile surfaces are handled carefully and any small remnants of impression materials are removed from the original fossils.

2. *Synchrotron imaging of select developing tooth crowns (in Grenoble, France)*

Approximately 5-6 teeth from Stw 151 will be selected after inspection (from the canines, first, and second molars available) for high resolution synchrotron imaging in Grenoble, France. The following 8 teeth from Drimolen will also be selected: DNH 39, 60a, 60b, 60 (M2), 62, 67, 70, 71 (I1). The teeth will be hand-carried from Wits to Grenoble in late October by Tanya Smith, where they will be deposited in a secure (locked) storage room until scanning. The same secure, carry case (Pelican 1500 hard-shell case) in which the Drimolen teeth were transported safely (and approved by Bernhard Zipfel) will be used for this trip. In collaboration with Paul Tafforeau (Beamline Scientist, European Synchrotron Radiation Facility), the teeth will be micro-CT scanned with 30, 5, and 0.7 micron resolutions employing both absorption and phase-contrast synchrotron imaging techniques over the course of 5 days. This technique is non-destructive and provides results that are far superior to that of laboratory micro-CTs. Copies of the data will be made available to the university upon request.

3. *Expected results*

The combination of developmental information preserved on the surfaces of the teeth and the internal features imaged non-destructively using the synchrotron will permit a

highly precise estimate of the age at death and formation time of the teeth. This will allow some of the estimates used in the Moggi-Cecchi et al. (1998) study to be directly determined and will provide a more accurate account of dental development in this juvenile. The new data on the Drimolen teeth will facilitate important insight into variation in early *Homo* and *Paranthropus* development and life history.

4. *Return of material*

We are fortunate to be able to use “in-house beamtime” which allows for an expedited process of data acquisition. The traditional method of working at the Grenoble synchrotron requires a proposal that is reviewed over the course of several months and it would require work to commence not before mid-2009 (if approved). By taking advantage of available “free shifts” or “down time” during other scheduled experiments during the fall it will be possible to comprehensively image the internal structure and development of the teeth at no cost. Depending on the availability of these free periods, the material will be returned to Wits either by Jacopo Moggi-Cecchi in December or by Paul Tafforeau in February.