

Where do we come from and when? The mystery behind the oldest child

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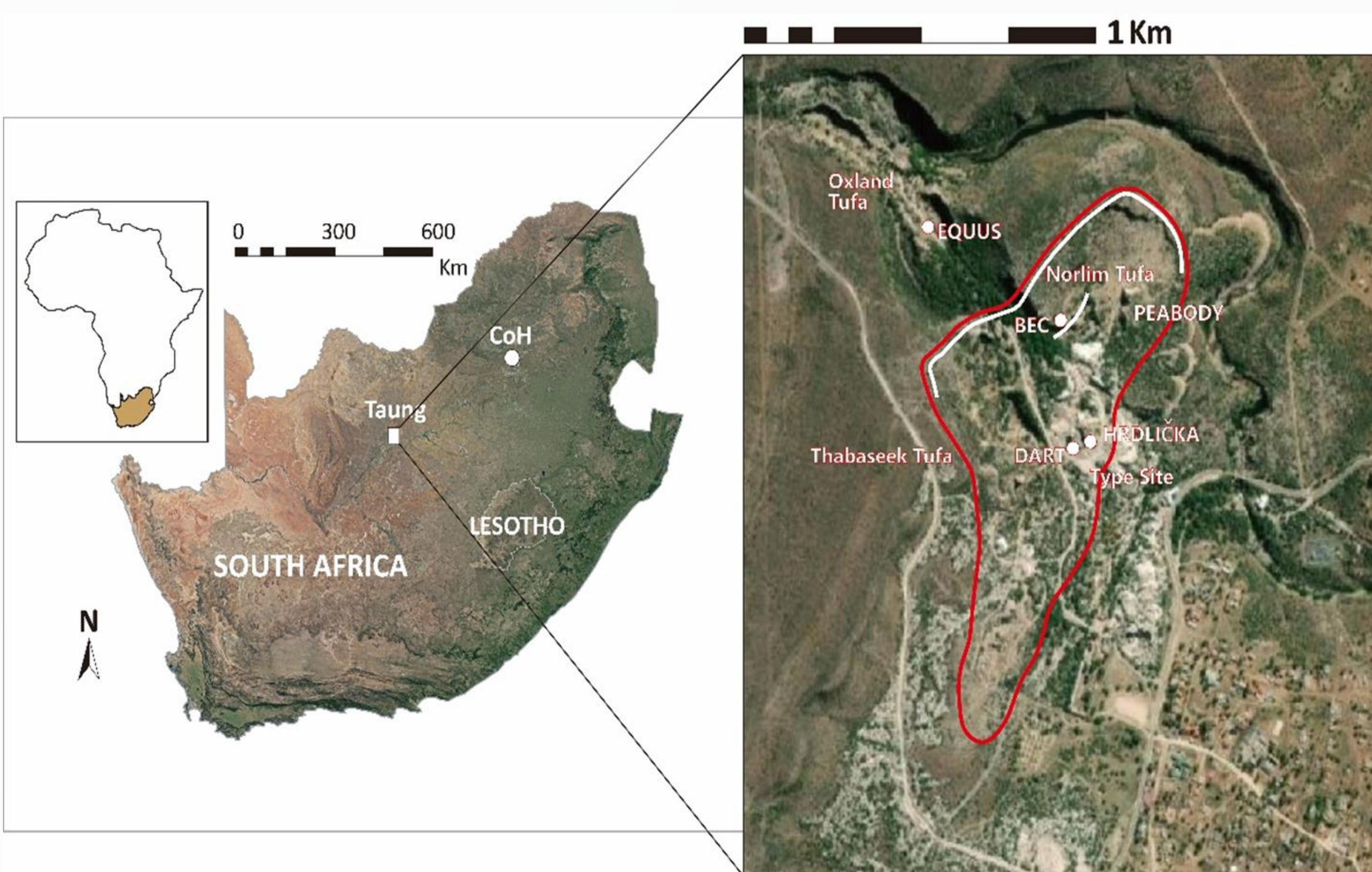
Keywords & Introduction

Taung South African fossils
Tufa Pliocene US-ESR dating Pleistocene
Fossil teeth LA-ICP-MS



This paper presents the analyses of US-ESR dating on enamel fragments from five fossil teeth from the Australopithecus africanus Type Site at the Buxton-Norlim Limeworks, near Taung, South Africa. The teeth were dated using enamel fragments following the US-ESR dating procedure. This is the first attempt to date a late Pliocene to early Pleistocene tufa deposit using ESR. The results provide a weighted mean final age EU estimation of the two teeth from the PCS deposits (contemporary with the Taung skull) of 3.6 Ma to 3.31 Ma. Using the US-ESR model the age could instead be 2.8-2.6 Ma, in keeping with previous biochronological age estimates, and within error of the EU model of one of the teeth, however this was obtained with an extrapolation function. Ultimately, ESR provides ages that are within error of former age estimates, but with some suggestions the fossil could be older than previously suggested.

The location of the site



Materials

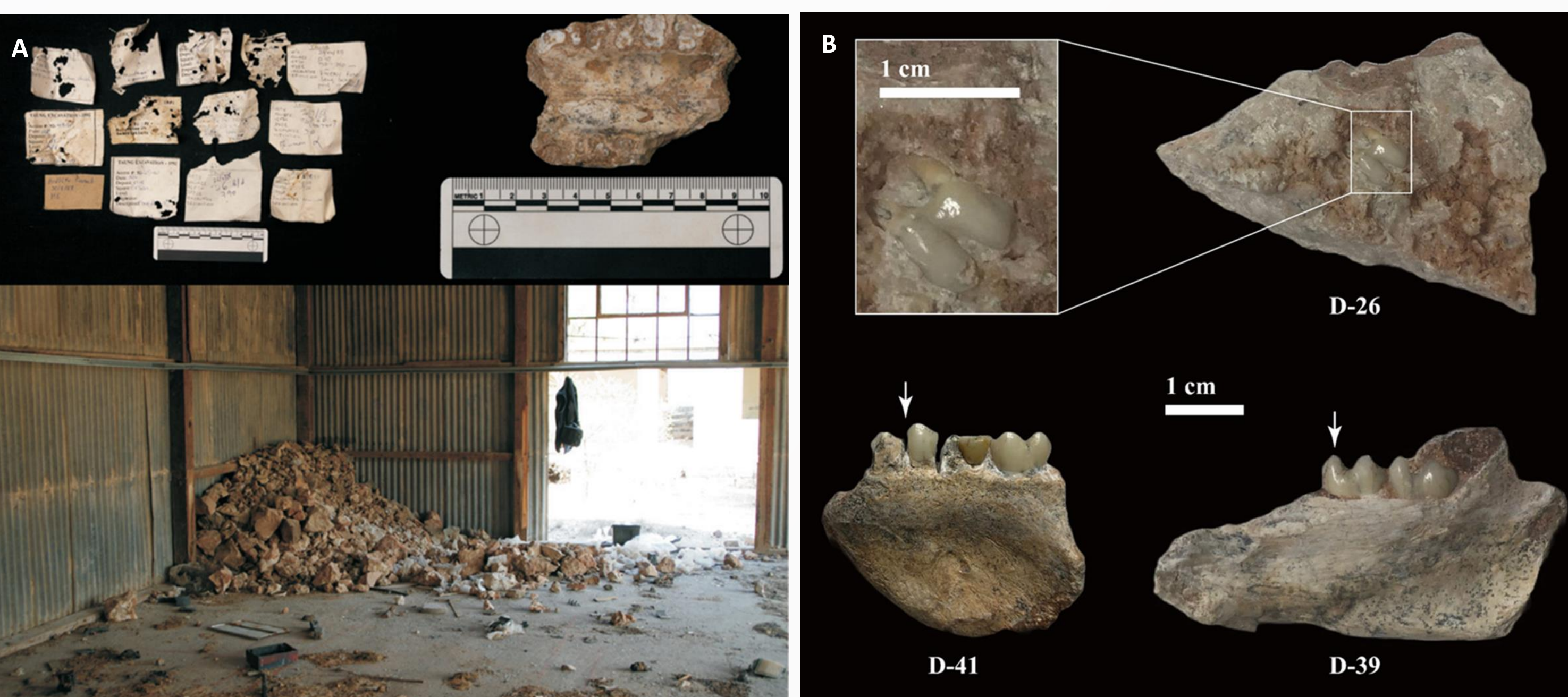


Figure 1. (A) The fossil dump discovered at Taung in 2012 by Kuhn et al. (2016). Some fossil tags recovered from the fossil dump at Taung are hard to identify (B) Photos of the tooth samples recovered from PCS deposit at the Type site. D-26 was recovered in situ, embedded in a breccia at a depth of 780-800 cm. D-41 is an M2 attached to a mandible that was also recovered in situ at a depth of 800 cm. D-39 came from layer D5 at a depth of 740-760 cm. The arrow indicates the location of the dated sample.

Method

Combined US-ESR dating: Direct dating method on fossil teeth & Wide dating range

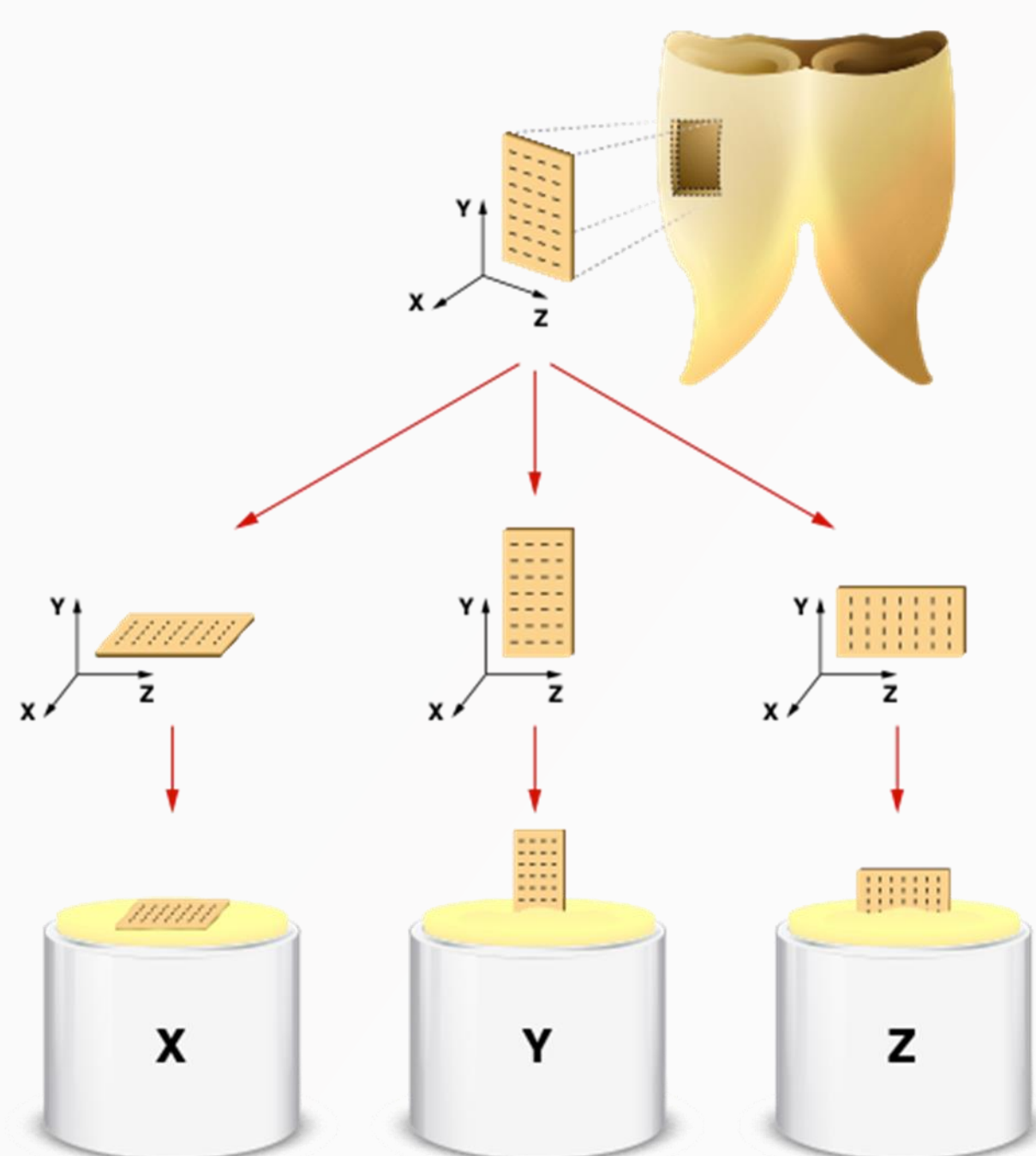


Figure 2. Measuring teeth enamel fragment in three directions in ESR spectrometer

Results

US-ESR modelling using USESR program

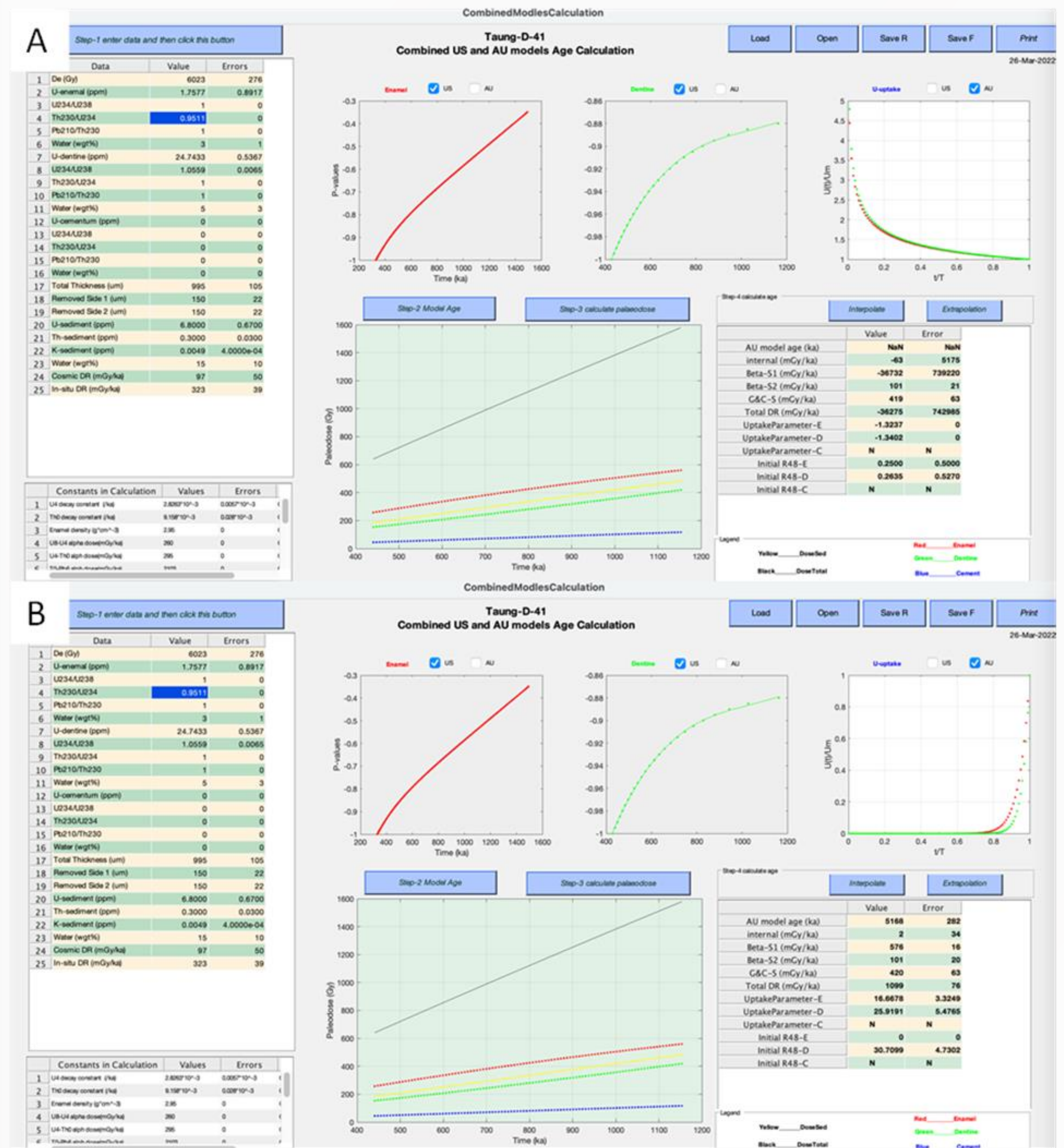


Figure 3. Screenshots of the USESR program for a dated sample from PCS deposit. A) extrapolation function B) interpolation function (Sample ID: D-41).

Palaeomagnetism comparison

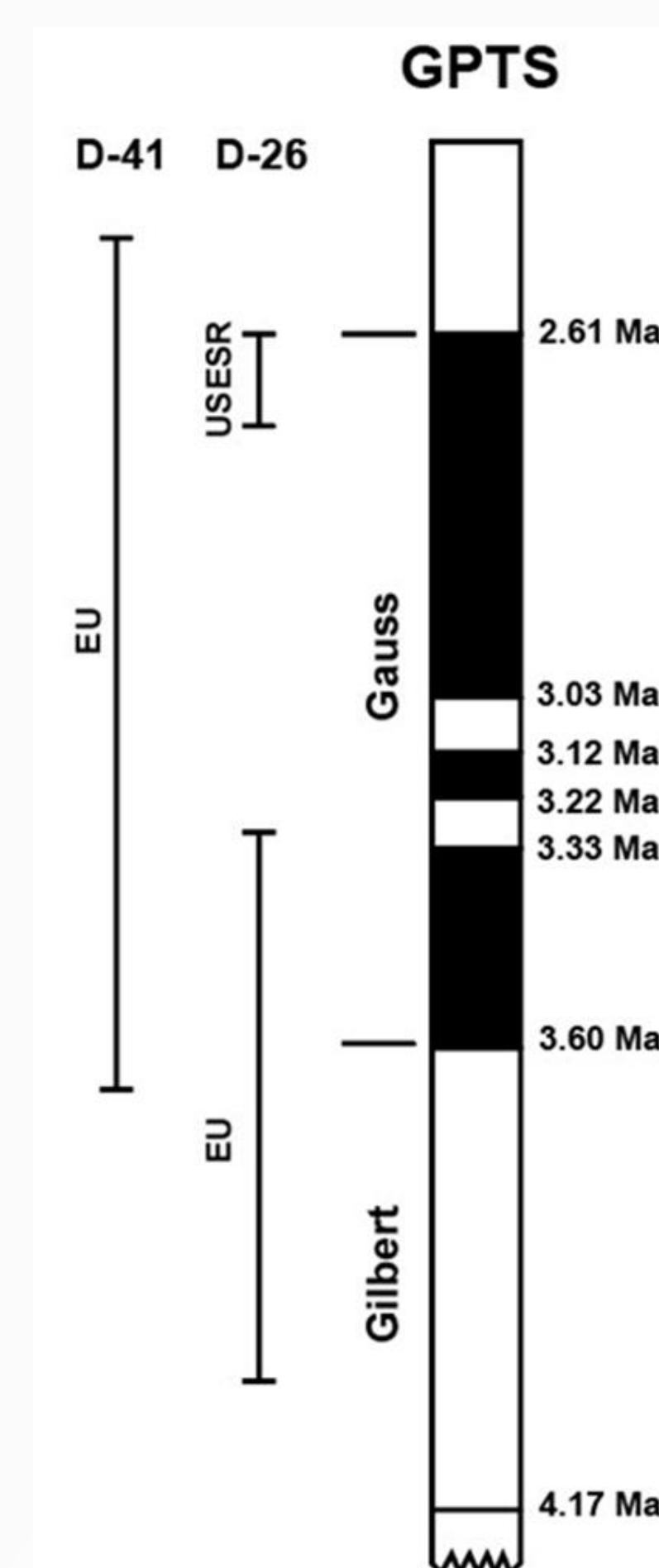


Figure 4 A comparison of ESR ages obtained in this study versus the geomagnetic polarity timescale.

Summary

This research shows the difficulties of dating old sites in South Africa and in particular tufa sequences. The uranium uptake model remains the main challenge for this study. This work potentially pushes the upper limit of the ESR dating to over 3 Ma. However, the samples suffered from significant post depositional events such as diagenetic process, high uranium concentration in the enamel, and uranium leaching is also a concern. Uncertainties also existed in cosmogenic dose rate, external gamma dose rate and water content calculation, and large errors have been applied to these factors for reliable dating results.