Enhancing Historical British Chalk Fish Collections through Nannofossil Biostratigraphy

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1: Introduction

The Natural History Museum, London (NHMUK), houses an important collection of British Chalk fossils from the last 200 years (Figure 1), incorporating specimens from many historical collections such as that of Gideon Mantell (Figure 2). Alas, some historical specimens have limited stratigraphic and/or locality data associated with them, restricting their research value. Fortunately, one of the primary components of the Chalk are coccolithophores, a group of calcareous nannoplankton, which can be used to determine the age of specimens through biostratigraphy owing to their rapid evolution in the Cretaceous. The CFIND Project (Chalk Fish and Invertebrate Nannofossil Dating) has been launched to utilise these nannofossils in the matrix of Chalk fish specimens to improve the precision and accuracy of the stratigraphic ages, and in some instances infer provenance, significantly improving the value of the collections for research.

Figure 1: Inspecting Chalk fish holotypes in the NHMUK collections.

2: Technique

For each specimen, destructive sampling is required to scrape a small (<0.05g) sample of chalk matrix for nannofossil analysis. This is done on the underside of the specimen to result in minimal visible alteration (see Figure 3). A smear slide is created following the technique of Bown & Young (1998), and a cover slip secured using Norland Optical Adhesive. Each slide is analysed for nannofossils and a biozone determined using the UC Nannofossil Biozonation of Burnett (1998). This enabled correlation to chalk macrofossil zones and lithostratigraphy. Two sampling techniques were employed: detailed nannofossil assemblage data (species and their abundance) was logged for holotypes (collected at a rate of 1 – 2 slides per day), while relative abundance data was recorded for other specimens (a rate of 3 – 4 slides per day).

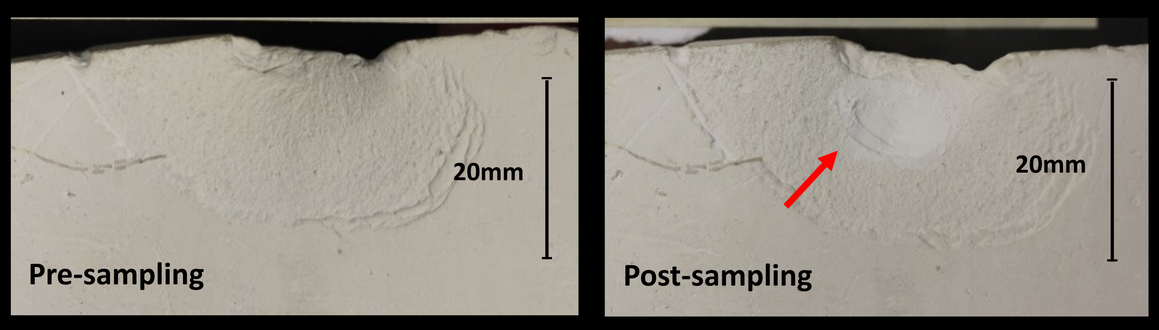

Figure 3: Sampling the matrix for nannofossil analysis (NHMUK PV P 3977).

Figure 2: *Macropoma lewesiensis* (NHMUK PV OR 4219) from the Gideon Mantell Collection sampled as part of the CFIND Project.

3: Outputs

Conducting nannofossil biostratigraphy on the matrix of chalk fish specimens has significantly enhanced the ages and stratigraphic data for most specimens sampled so far (Figure 4). Around 100 NHMUK fossil fish have been sampled to date. Of the holotypes, 98% have been assigned to a single stage, and 90% to a single nannofossil zone/subzone. Using nannofossils is a quick and highly effective method to determine the relative ages of the specimens. The enhanced biostratigraphic ages provides invaluable data for future research into the origins of modern fish groups, evolutionary rates, and past climate change. All specimen records will be regularly updated and available to view on the NHMUK dataportal: https://data.nhm.ac.uk/

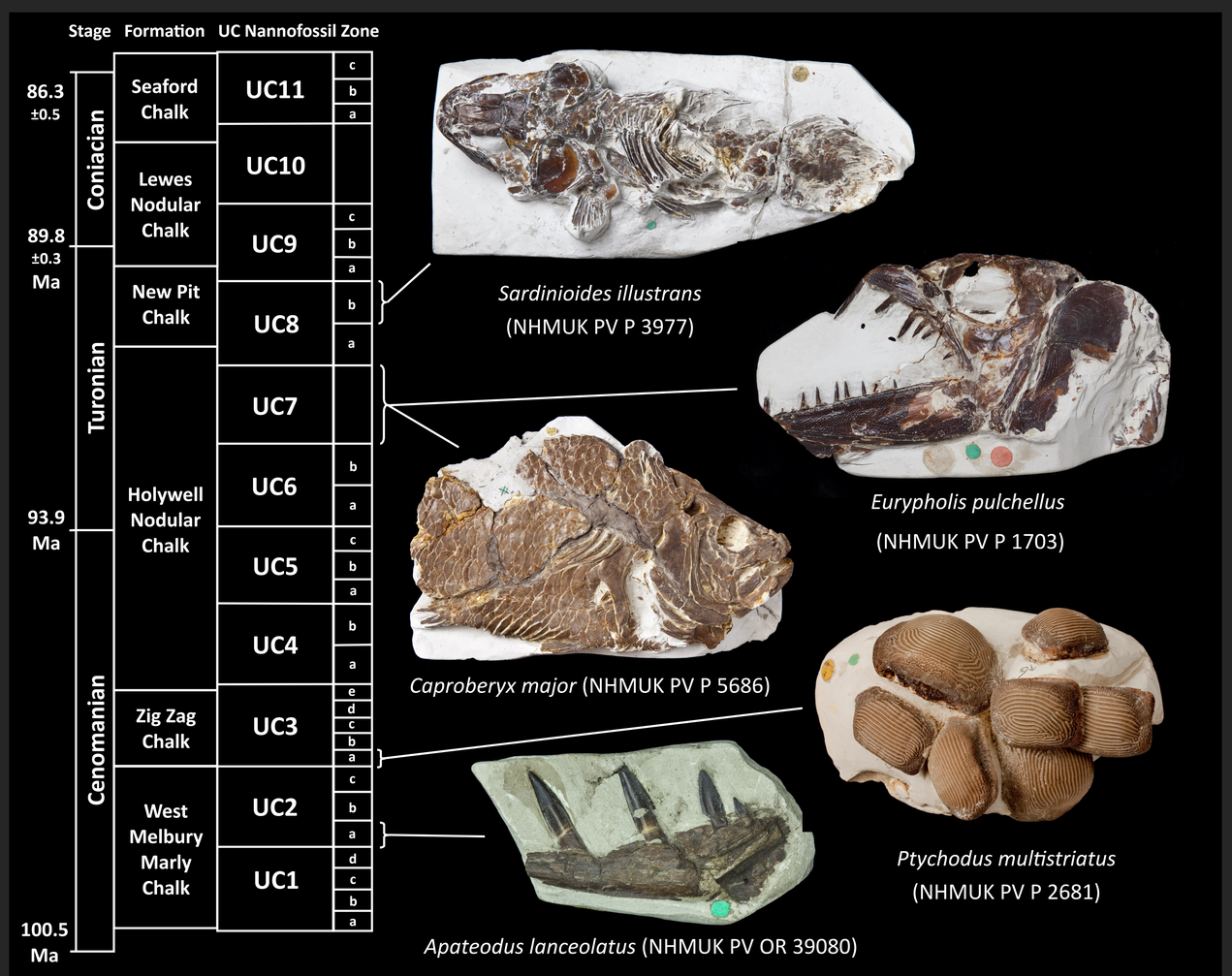

Figure 4: Improved ages of selected fossil fish holotypes from the British Chalk Group following nannofossil biostratigraphy. UC1 to 11 = Upper Cretaceous nannofossil zones of Burnett (1998).

4: Lessons Learned & Future Potential

The benefits of improved stratigraphic data far outweigh the miniscule specimen alteration caused by destructive sampling. Care must be taken to avoid contamination when sampling the specimens. Hardness varies between Chalk formations and locations so both metal and wooden implements are required for sampling. Some specimens have seemingly good historic stratigraphic data, but a small percentage have turned out to be incorrect. When preparing Chalk fossils it is important to keep adequate matrix attached to the specimen. This technique has the potential to significantly enhance most Chalk fossils at the NHMUK and other historical museum collections.

References:

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