Supplementary Information and Methods for:

Two pulses of origination in Pacific pelagic fish following the Cretaceous-Paleogene Mass Extinction

Elizabeth Sibert[1,2,3*], Matt Friedman[4], Pincelli Hull[5], Gene Hunt[6], Richard Norris[3]

[1]Society of Fellows, Harvard University, Cambridge, MA 02138

[2]Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA 02138

[3]Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92037

[4]Museum of Paleontology, University of Michigan, Ann Arbor, MI 48109

[5]Department of Geology and Geophysics, Yale University, New Haven, CT 06511

[6] Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20013

*please address correspondence to esibert@fas.harvard.edu

Earth, Atmospheric, and Planetary Sciences/Evolution

This document includes:

1. Information on DSDP Site 596
2. Ichthyolith Morphological Character Coding System (includes Figure S1)
3. Sampling, Binning, and Reworking (includes Figures S2-3, Tables S1-2)
4. Evolutionary Rates: Capture-Mark-Recapture analyses (includes Figure S4, Table S3)
5. Table S4: morphotype range-chart number key
6. Appendix 1: An image index of all fish tooth morphotypes described in this study

Relevant CSV files and R code are available at http://github.com/esibert/toothmorph

1. DSDP SITE 596

Ichthyoliths were isolated from discrete sediment samples from Deep Sea Drilling Program (DSDP) Site 596. DSDP Site 596 is located in the South Pacific Gyre, at 23°51.20'S, 165°39.27'W, in approximately 5710 meters water depth [1]. DSDP Site 596 is almost completely pure pelagic red clay, and has remained within the South Pacific Gyre for its >85 million year history [2]. A sedimentation history for DSDP Site 596 using a constant cobalt-flux model reveals a relatively low and constant sedimentation rate of approximately 0.2 to 0.27 m/myr throughout the study interval from 73 to 42 Ma. A prominent iridium anomaly at the site at the K/Pg boundary [3], and several biostratigraphic tie points provide additional stratigraphic context [4]. DSDP Site 596 was sampled every 5 cm down-core (~200kyr temporal resolution), from 15 meters below seafloor (mbsf) to 22 mbsf. The 5 to 10-gram samples of red clay were dried to a constant weight in a 50°C oven, disaggregated in de-ionized water, and washed over a 38μm sieve to concentrate and retain the ichthyoliths [5]. The majority of the sediment is red clay, the coarse fraction >38μm is composed nearly exclusively of ichthyoliths, with occasional manganese nodules and other sediment grains. The residues were inspected under a high-power dissection microscope, and a fine paintbrush was used to transfer the ichthyoliths to cardboard microfossil slides for storage and further analysis. Ichthyolith accumulation rate was calculated using the cobalt-accumulation sediment age-depth model by Zhou and Kyte [2].

2. ICHTHYOLITH MORPHOLOGICAL CHARACTER CODING SYSTEM

Defining Tooth Morphological Disparity

Fish teeth have distinct morphological shapes that are likely a combination of taxonomic history and ecological role. While taxonomic identification of Cretaceous and Paleogene fish teeth is not possible at present, a character-based coded system which quantifies morphological traits can be used to quantify the morphological variation in these microfossils and create a non-hierarchical, "taxon-free" morphological classification [6-13]. Here we employ a new ichthyolith morphological coding system that is loosely modeled after the system developed by Doyle, Kennedy, and Riedel (1974).

Our system differs from prior ichthyolith classification schemes in several important ways. First, it differentiates between teeth and denticles: while these ichthyolith subgroups have similar mineral composition, they are produced by different clades of organisms (fish versus elasmobranchs) and have entirely different functional purposes (teeth versus scales), so we consider them completely independently. Second, while prior ichthyolith studies relied on transmitted light microscopy, our system uses reflected light microscopy. This allows for observation of 3D tooth structure, facilitates identification from different angles, reduces the complexity of mounting and analysis of teeth in transmitted-light slides, and leaves the teeth free to be used in future analyses, such as advanced imaging (eg. microCT or Scanning Electron Microscopy) and geochemical analyses. Third, our coding system considers the same set of characters as potential descriptors for all teeth, removing the need for nested, hybrid character states, or complicated nomenclature syntax, as was used in prior ichthyolith morphological coding schemes. Our system retains the flexibility built into prior ichthyolith classification schemes: it is straightforward to include additional characters or character-states to the system as novel tooth morphotypes are found and classified [6, 10]. While our system is still a work in progress, and currently only includes traits for the teeth included in this study (South Pacific Gyre, Cretaceous to Eocene), it represents a considerable step forward in the field of ichthyolith paleontology. Details of the characters, character states, and identified morphotypes are included in Appendix I, and summarized in Figure 1. To facilitate ichthyolith description, ichthyolith assemblages were imaged at high resolution (1µm/pixel), and measured using the Hull Lab Imaging System and *AutoMorph* software at Yale University [14]. Images of individual teeth were then classified within the morphotype description system, described in detail below, and summarized in Figure S1.

We used this system to code each whole or otherwise identifiable tooth from the sample set, from 74 discrete sediment samples, for a total of 1897 identified teeth, ranging in age from 42 to 73 Ma. For this study, we defined any tooth that has a unique set of character-states as a distinct morphotype: 136 unique tooth morphotypes were identified in the set, and given descriptive in-house names to facilitate processing. As this character-coding system is, by definition, non-hierarchical, we felt this "splitting", rather than "clumping" of morphotypes was the most reasonable way to consider tooth types without introducing a potentially false hierarchy into the system.

Description of the Ichthyolith Coding System

We define 23 traits for tooth morphology, within 6 trait groups: general shape/structure, blades (if any), flange (if any), tip shape, base shape, and pulp cavity. While general shape is important for differentiating broad groups of teeth, the majority of variation is within the shape of the pulp cavity, the size and structure of the blades, and composition of the tip, all traits that are distinguishable with reflected light microscopy and high resolution imaging. Using this system, we identified 136 ichthyolith morphotypes in our dataset, where each individual ichthyolith morphotype is defined as a unique combination of character-states within the system. Similar to prior ichthyolith coding schemes, we define a set of characters, each with a series of character-states. While this system is currently designed for handling ichthyoliths from the South Pacific Cretaceous to Eocene, it is straightforward to add novel character states or even whole characters into the analysis. Our ichthyolith coding scheme, with illustrations, follows. Throughout, tooth character-groups are denoted in **bold**, individual characters are denoted as <u>underline</u>, and any specific notes clarifying identification or differentiation of a particular character state are noted in *italics*. Pictoral representations of these traits are shown in Figure S1.

Section 1: General Ichthyolith Classification and identifiers:

Note that while these two traits (A and B) are part of the classification scheme, they are simply quality control and data management flags, and are not used directly in the disparity calculations.

<u>Trait A</u>: Ichthyolith type. *While our system currently only has coded traits for teeth, denticles are present and common in our ichthyolith assemblages, and are quantified here.*

1 = Tooth

2 = Denticle

3 = Other

<u>Trait B</u>: Degree of Fragmentation. *Level of fragmentation determines whether the outline-based morphometrics (length/width/aspect ratio; traits LEN, WID, AR) are included in the*

morphospace analysis, while outline data is not. However, in future studies, tooth outlines may be used, and as such, the teeth are classified to include a differentiation here.

1 = No fragmentation; entire ichthyolith is preserved. *Outline and LEN/WID/AR appropriate for analysis*

2 = Small amounts of fragmentation, whole ichthyolith is identifiable. *LEN/WID/AR appropriate for analysis*

3 = Fragmentation is considerable, but most traits are discernable; ichthyolith is identifiable to morphotype. *Only qualitative descriptors, no measurement data used in final analysis*

4 = Fragmentation is too great to identify morphological characters, but the ichthyolith is identifiable to tooth or denticle

Section 2: Tooth Morphological Characters

Notes: Throughout, the "base" and "bottom" of the tooth refers to the part of the tooth which connects to the jawbone, and the "tip" and "top" refers to the part of the tooth opposite the base, most often a pointed end.

2.1. General ichthyolith shape

<u>Trait C:</u> Overall shape of ichthyolith: *There are many additional potential generic ichthyolith shapes, however none of these were present in this sample set. As such, we include the note that for very different shapes, character-states can be added to this system.*

1 = Cone (tooth starts wide, goes to a small tip, eg. triangular in shape; has round base in cross-section)

2 = Triangle (tooth starts wide, goes to small tip, eg. triangular in shape; has flattened base cross-section)

3 = Asymmetrical triangle with flared base (approximately triangular in shape, has base which flares out from tooth and is not symmetrical)

4 = Flat, cusped

Trait E: Degree of curvature

1 = Straight; Tip centered above base

2 = Small curve: tip does not pass edge of tooth base

3 = Large curve: tip extends past base edge

Trait F: Shape of triangle

1 = Straight (tip centered above base)

2 = Concave edges (tip centered above base)

3 = Convex edges (tip centered above base)

4 = Curved (concavo-convex; tip not centered)

5 = plano-convex (right angle from base to tip, convex hypotenuse; tip not centered)

6 = Right Triangle (right angle from base to tip; hypotenuse straight)

Trait G: Shape of edges

1 = No obvious edge (eg. tooth is cone-shaped [Trait C1])

2 = Defined edge, no extended edge/blade

3 = Has a blade or extended edge

Edge Details: Blades (H1-H5) and Flanges (K1-K2)

Notes: "blades" are defined as edge-details which extend from the side of a tooth, lengthwise, and do not have abrupt beginnings or endings. They can reach the top or bottom of the tooth, but it is not necessary. "Flanges" are edge details which extend from the side of a tooth, and begin at the tip, and which have an abrupt ending partway down the tooth. If the tooth has no blade or no flange, this is encoded with values of 1 in Trait H1 and Trait K1 respectively. All other traits are coded as 0, and not considered in the morphological analysis for those teeth.

Trait H1: Number of blades: *note that the numeric coding does not correspond directly with the absolute number of blades for this trait.*

1 = no blades

2 = both sides have blades (2 blades)

3 = One side has a blade only

Trait H2: Blade symmetry:

0 = no blades

1 = Blades are symmetrical

2 = Blades are asymmetrical (but two are present)

3 = One blade only

Trait H3: Blade width along edge: *while some blades are approximately the same size along the tooth, others flare at the top or bottom.*

0 = no blades

1 = equal sized along length

2 = wider at the top

3 = wider at the bottom

4 = widest in the middle

5 = different each blade; *Note that asymmetrical blades may fall into any H3 character state, as it simply describes the overall shape of the blades.*

<u>Trait H4:</u> Blade size: *describes the relative size of blades present, compared to the tooth proper*

0 = no blades

1 = small blades, both sides (blades combined <1/4 of width of tooth)

2 = large blades, both sides (blades combined > 1/4 of width of tooth)

3 = One small, one large

4 = Concave large, convex/straight small (for non-straight teeth)

5 = convex large, concave/straight small (for non-straight teeth)

<u>Trait H5:</u> Blade length: *note: additional character states are possible for novel tooth morphotypes*

0 = no blades

1 = Blade runs length of tooth, from tip to base

2 = Top 1/3 of tooth only

3 = Top 2/3 of tooth only

4 = Bottom 1/3 of tooth only

5 = bottom 2/3 of tooth only

6 = concave whole length; convex upper part only

7 = large blade runs whole length; small blade runs upper part only

<u>Trait K1:</u> Flange presence/absence

1 = flange absent

2 = flange present

<u>Trait K2:</u> Flange length: *relative to the total tooth size*

0 = no flange

1 = small (<1/4 of tooth length)

2 = medium (1/4-1/2 of tooth length)

3 = long (>1/2 of tooth length)

4 = very long (>80% length)

Trait K3: Flange location:

0 = no flange

1 = concave only

2 = convex or straight side

3 = one side (for an otherwise symmetrical tooth)

Tip (L, M) and base (N1, N2) characters

Trait L: Tip shape

0 = tip not preserved

1 = Pointed tip

2 = smoothed point

3 = rounded

Trait M: Tip material: *note that many actinopterygian teeth have a small layer of acrodin, a modified bone material, as a slight cap on their teeth. Here we assess whether teeth have tips made of different material than the rest of the tooth.*

0 = tip not preserved

1 = same material as rest of tooth

2 = thin layer just over the tip

3 = Whole tip, with flat bottom

4 = Tip and blades

5 = More than tip/blades

Trait N1: Base shape

0 = base not preserved

1 = flat base

2 = concave base *(often has 'base tips', trait N2)*

3 = convex base

4 = asymmetrical base with base tip(s)

5 = flared base *(often correlates with Trait C-3)*

Trait N2: Base tip shape: *if only one tip, assess the single one*

0 = no base preserved

1 = no tips

2 = curved tip(s)

3 = pointed tip(s) (straight)

4 = flat/square tip(s)

5 = asymmetrical tips (two, different)

Pulp cavity size (O-Q) and morphology (R1-R4): *nearly all teeth have some sort of pulp cavity, however some teeth are fully solid and have no obvious pulp cavity. The pulp cavity is often best viewed using transmitted light microscopy, but is visible in high-magnitude reflected light microscopoy as well. As pulp cavity morphology is highly variable, we have defined four characters which, when considered together, describe an overall structure for the pulp cavity.*

While there are some characters that often link together, there are many which can be combined in different permutations to create unique pulp cavity shapes. If there is no pulp cavity, Trait O the only one which counts in the morphospace analysis. The rest are considered a value of 0, which discounts them from the analysis.

Trait O: Is there a pulp cavity?

1 = no pulp cavity present

2 = pulp cavity present

Trait P: Pulp cavity base size: *this is measured relative to the base of the whole tooth*

0 = no pulp cavity

1 = small (<1/3 of base width)

2 = medium (1/3 – 2/3 of base width)

3 = large (>2/3 of base width)

4 = whole base (base of pulp cavity extends to both edges of the tooth)

Trait Q: Pulp cavity length: *measured relative to the whole tooth*

0 = no pulp cavity

1 = short (<1/3 of tooth length)

2 = medium (1/3 – 2/3 of tooth length)

3 = large (>2/3 of tooth length)

4 = full length (pulp cavity stretches to the tip of the tooth)

Trait R1: Pulp cavity approximate shape, in relation to tooth shape: *if tooth is curved, a curved pulp cavity which mirrors the curve of the tooth is considered ‘straight’, etc.*

0 = no pulp cavity

1 = straight

2 = concave (curves in from the tooth edges)

3 = convex (curves out from the tooth edges)

4 = funnel (convex at the bottom, concave at the top)

5 = parallel (pulp cavity edges are parallel to each other, not to the tooth edges)

6 = asymmetrical (pulp cavity combines any two other pulp cavity shape descriptors)

7 = vase-shaped (concave at base, rounded at top)

Trait R2: Pulp cavity center width, in relation to the tooth edges: *here "center" is defined as the middle, length-wise, of the pulp cavity, not the tooth.*

0 = no pulp cavity

1 = small, pulp cavity center width is <1/3 of tooth width

2 = medium, pulp cavity center width is 1/3 to 3/4 of tooth width

3 = large, pulp cavity center width is >3/4 of tooth width

Trait R3: Pulp cavity base shape

0 = no pulp cavity

1 = curve out towards edges of tooth

2 = flat (no change from the rest of the pulp cavity shape)

3 = curve in, away from edges of tooth

Trait R4: Pulp cavity tip shape

0 = no pulp cavity

1 = pointed *goes to obvious angular point*

2 = rounded point *pointed, but no angular tip*

3 = very rounded *nearly semi-circular in many cases*

4 = pinched tip (rounded, wide) *can see area in the tip*

5 = pinched tip (extended, thin) *often appears to be single line at the top*

6 = rounded with tip *similar to state #3, but with an angular tip*

The final traits included in our morphospace analysis are LEN, WID, and AR. These traits are measured as the "length", "width", and "aspect ratio" of the minimum bounding box that surrounds a tooth, when the tooth is placed flat so its widest surface is facing up. These traits are only included in the analysis if the image and tooth are of sufficient quality to obtain appropriate measurements.

Morphotype Designation

Morphotypes were defined as teeth with unique combinations of traits. As our ichthyolith morphological scheme is currently in development, and there is no taxonomic identification for these teeth, we believe that it would be premature to develop and apply a formal naming scheme to the different tooth morphotypes. However, as strings of alpha-numeric codes are cumbersome and do not easily convey information, we have developed a series of working names for the tooth morphotypes identified in this study. These names are a combination of character-trait keywords which capture the essence of the tooth, and facilitated repeated visual identification of morphotypes. We fully expect that these names will change as the morphological scheme continues to expand and develop to include other morphotypes. A morphotype was considered "distinct" when it had a unique set of coded characters, regardless of how large or small the differences were. A key to morphotype names used in the range chart figures (Figure 1, main text, Figure S3 in this supplement) is given in Table S4. Appendix I (at the end of this document) includes pictures of a representative of each tooth morphotype determined in this study. While the assignment of teeth to morphotypes is somewhat subjective, the details included in the coding scheme make it possible to replicate and articulate the characters necessary for a fossil to be grouped with a particular morphotype. For consistency, all of the coding and morphotype designation in this study was done by E. Sibert, however morphotypes were discussed among coauthors. While there is some inter-person variability in the assignment of morphotypes, as there is amongst most taxonomists working to classify organisms, consistent use of the characters and codes allowed for consistent description and tooth morphotype designation.

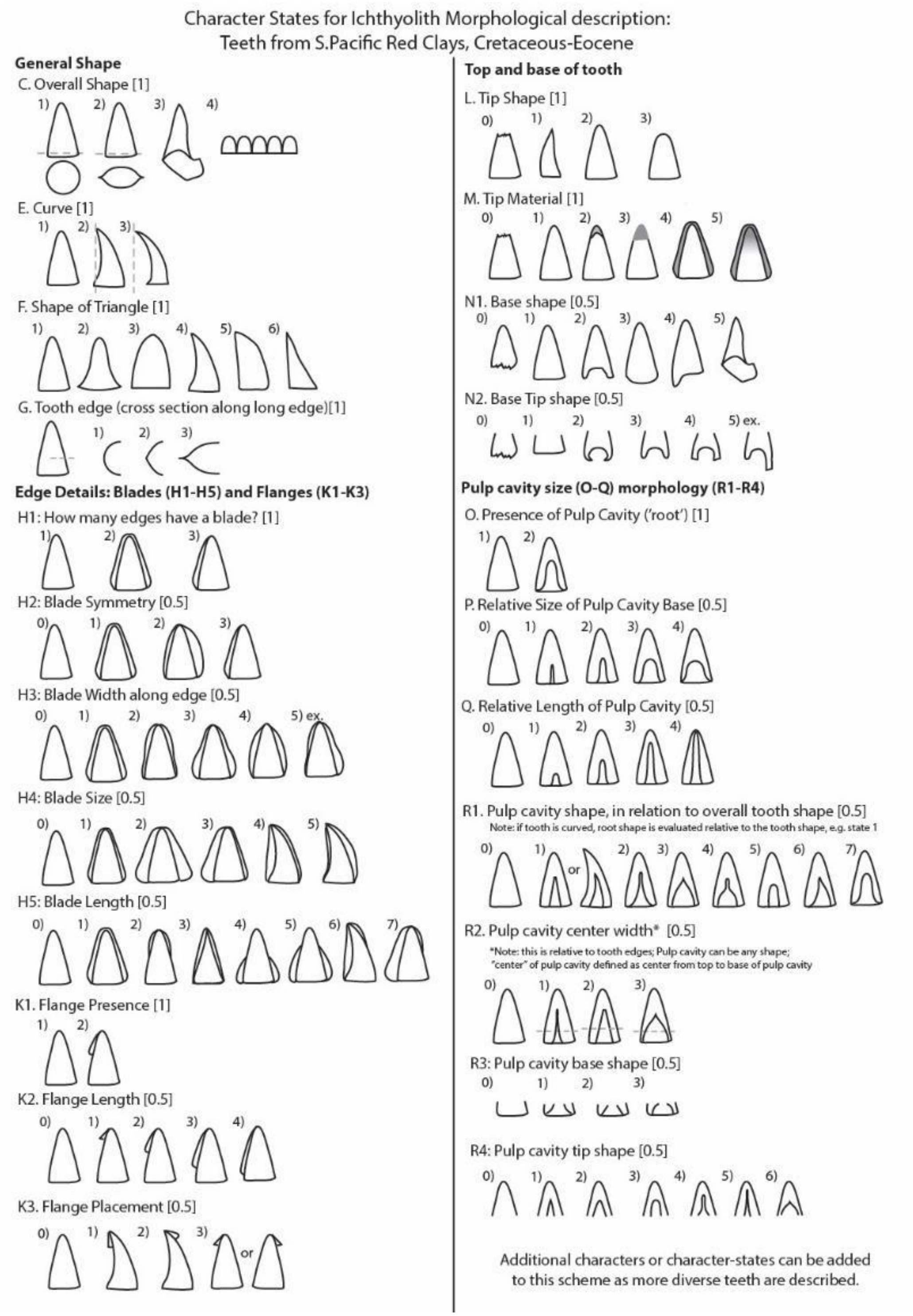


Figure S1. A schematic representation of the different character-states described in our tooth morphology system. We use a generic triangular tooth for simplicity in this figure, however note that because our traits are described relative to overall tooth shape, this schematic can be expanded and applied to a variety of tooth shapes beyond the scope of this study.

Calculating morphological disparity

To assess changes in tooth morphology through time, we evaluated morphological disparity of the tooth morphotypes present in our samples. We calculated distances between tooth types by assigning distances and weights to all characters considered (see Figure S1) and evaluating a weighted distance between each pair of teeth based on the character-states they displayed. Traits within a character were considered to be equally distant unless there was an obvious hierarchy, in which case we created distance matrices for the character states. The characters were weighted either equally, or paired to combine several traits to have the same weight (e.g. the 4 pulp cavity morphology traits were reduced to ½ weight each, so that they did not overpower other characters which were more succinctly described).

Our tooth coding scheme, like many other schemes developed to describe complex biological systems, has several sets of characters which, when not present, may confound disparity analyses – for example, a tooth with no blades (H1) cannot have their blades described (characters H2-H5). These inapplicable characters (H2-H5, K2-K3, R2-R4) are designated in our coding scheme with a value of 0, and where they are not present, this designates the maximum distance (usually 1.0) from teeth with the character present for that particular character in the calculations. These inapplicable characters have no impact on morphotype designations.

For unbroken teeth which had good length, width, and aspect ratio measurements from *AutoMorph*, we combined these discrete character states with the continuous measurements by discretizing the continuous measurements into normalized bins and treating each bin as a discrete state. Distances for all traits available to compare for each pair of teeth were then averaged, to get an average distance value for each pair of teeth. Since the traits are discrete, rather than continuous, the resulting distance matrix was reduced using nonmetric multidimensional scaling (NMDS) to create an ichthyolith morphospace for visualization. We present a 3-dimension NMDS, which has a stress of 0.110, because the visual representation of the teeth did not change considerably by adding more dimensions, and the stress was a reasonable value that was not much improved by adding additional dimensions to the ordination. This was done simply to visualize the major axes of variation. We used NMDS rather than PCA, as it does not use eigenvectors, so that any triangle inequalities caused by missing or inapplicable characters do not have the potential warp the eigenvector space and thus confound the interpretation. All data were analyzed in R using in-house functions and the R package 'vegan' [15]. All data, distance matrices, and code are available at www.github.com/esibert/toothmorph.

3. SAMPLING, BINNING, AND REWORKING

Binning and potential sample bias

Each ichthyolith morphotype has a distinct stratigraphic range within our sample interval, however, not all morphotypes which span the range are present in each sample (Figure 1). The average length of time that a tooth morphotype existed throughout the interval sampled was 12.6 million years (all teeth). If teeth which are likely reworked are excluded, this reduces to 12.0 million years (low levels of reworking, see discussion below) or 11.1 million years (high levels of reworking). As there are a considerable number of morphotypes in our record which extend in range beyond the observed interval (out of 136 described morphotypes, ~24 likely extend deeper in the Cretaceous, ~34 into the Eocene, with at least 5 morphotypes spanning the entire interval), it is likely that this is an underestimate of average morphotype duration. This interval is considerably longer than the estimated species duration for freshwater fish, approximately 3 million years [16], or the duration of marine invertebrate species, which range from 5 to 12 million years [17]. However, it is not surprising that tooth morphotypes, which may represent relatively high level taxonomic groups of fish (e.g. genera or families), or taxonomic-free ecotypes, would have longer persistence through time than is seen in species-level taxonomies. Further, the wide variation in morphotype duration may be due to different morphotypes representing different taxonomic specificity: it is probable that certain families of fish have identical teeth across all individuals, while others have considerable differences within the genera, species, individual, or ontogenetic stage [18].

To address the issue of small sample size, particularly in the Cretaceous and early Paleocene samples, which often had fewer than 20 teeth in a discrete sediment sample, we grouped the samples into ~1 myr time bins, so that each time bin included sufficient teeth for analysis (34-241 teeth per time bin, average = 90.3 teeth). The time bins with the largest numbers of teeth described in this study (sampling intensity) occur after peaks in novel morphotypes suggesting that observed morphotype origination is not simply due to an increase in sampling intensity (Figure S2). It is therefore likely that the peaks in morphotype origination rate reported in this manuscript are underestimates of the true magnitude of origination in fish tooth morphology.

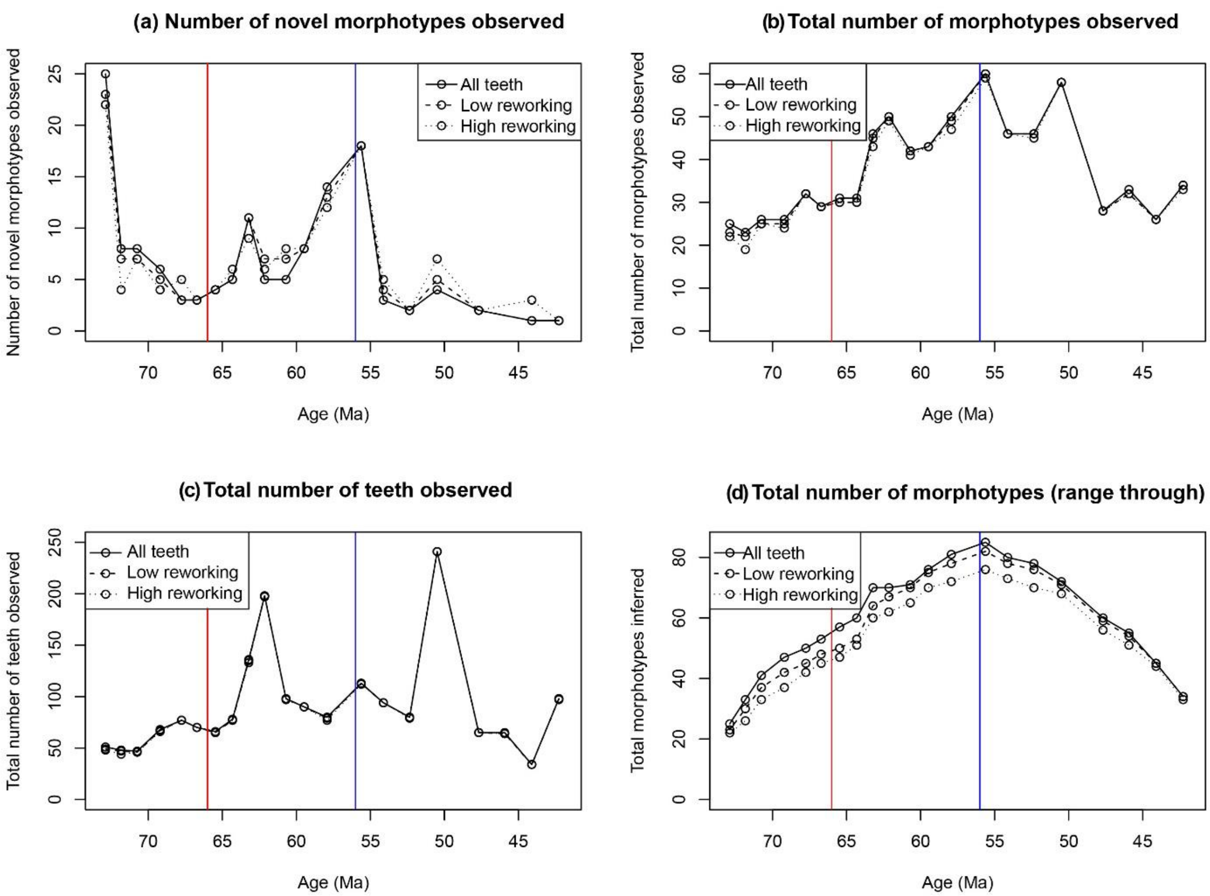


Figure S2: Plots comparing sampling intensity to morphotype observation. Plots showing the absolute abundance of a) novel morphotypes observed in each sample; b) number of total morphotypes observed in each sample; c) the total number of teeth counted in each sample; and d) the total number of morphotypes inferred for each sample counting range-through taxa not present in the sample. Note that the peaks in tooth observed fall after the peaks in novel morphotypes. Red line is the K/Pg mass extinction; Blue line is the Paleocene/Eocene boundary.

Reworking

In some cases, a single occurrence of a tooth morphotype was found well outside its more common stratigraphic range, suggesting that there was some amount of reworking or bioturbation within the sediment core. To assess the impact of reworked teeth artificially extending the range of any given morphotype, we selectively removed individual occurrences of particular teeth from the analysis following a specific set of rules, described in full below, to generate three datasets: (1) original, with no teeth removed, (2) low reworking, and (3), high reworking. Using our conservative set of rules ("low reworking"), we removed 9 occurrences (0.5% of total teeth described, Table S1) from the analysis due to suspected reworking (1887 teeth total, ranging from 34-241 teeth per time bin, average = 89.9). Following a more liberal set of rules ("high reworking"), we removed an additional 14 occurrences (1% of total teeth described, Table S2) from the analysis (1873 total teeth, 34-241 teeth per time bin, average = 89.2). We conducted all successive analyses on all three of these datasets, and note that while the high reworking dataset consistently yields slightly higher estimates for speciation and extinction rates, as it has the shortest ranges, overall, the patterns reported here are robust regardless of dataset analyzed, suggesting that the effect of reworking on the overall tooth record is minimal. When only one dataset is represented in the figures, we use the "low reworking" dataset throughout the main text. A comparison of the range charts for all three datasets is shown in Figure S3.

Rules used for removing potentially reworked teeth from analysis.

A. Low reworking

Remove a data point if:

1. Suspected reworking of previously abundant taxa that has likely gone extinct: if abundance decreases from >3 per time bin to 1 per time bin and lasts <1 million years across a known geologic boundary (either the K/Pg or the P/E)
2. Suspected reworking: if there is an interval of >5 myr between a singleton occurrence of a morphotype, before or after an interval where the morphotype is not rare (eg. present in at least 2 time bins in a row)
3. Suspected reworking: if there is an interval of >8 myr, only single occurrence, assume reworking of the morphotype away from most common time intervals which it is present (not necessary to be present in two consecutive time bins, as in rule 2)

Table S1: Teeth removed from analysis under the low reworking dataset rules (10 total)

Tooth Morphotype Name	Tooth Object ID	Action	Rule
Straight, half−length flange	P136.084.1.obj00024 P137.085.1.obj00022	remove upper 2 samples	1
Clear, convex tooth, dome root, small blades	P127.075.1.obj00076	remove upper 1 sample	1
Clear, full straight root	P175.123.1.obj00031	remove lower 1 sample	2/3
Clear, flared blades, 3/4 root	P173.121.1.obj00002	remove lower 1 sample	2/3
Acrodin Tip, 1/2 length funnel root	P169.117.1.obj00011	remove lower 1 sample	3
Acrodin Tip, 1/2 length convex root	P163.111.1.obj00004	remove lower 1 sample	2/3
Acrodin Tip, no obvious root	P158.106.1.obj00012	remove lower 1 sample	2/3
cone short dome root	P065.013.1.obj00019	remove upper 1 sample	2
Clear, 3/4 Dome root	P109.057.1.obj00033	remove lower 1 sample	2

B. High reworking

Remove teeth from the dataset if they meet the criteria for low reworking cuts OR any of the following:

4. If common during range (>2 per time bin, no long intervals), singleton present >3 myr before common range (mixed down)

5. If common during range (>2 per time bin, no long intervals), any individuals >5 myr above common range (mixed up)
6. If the morphotype is rare (eg. present as a singleton occurrence throughout range, with intervals of non-presence <5myr), any gaps >12 million years, remove singleton at end of gap.

Table S2: Teeth removed from analysis under the high reworking dataset rules (14 total)

Tooth Morphotype Name	Tooth Object ID	Action	Rule
Clear, pointed tip, 1/2 dome root	P175.123.1.obj00008	remove lower 1 sample	4
Clear, flared blades, 3/4 root	P116.064.1.obj00037; P124.072.1.obj00090	remove next lowest 2	4
Cloudy, extended triangle	P168.116.1.obj00022	remove lower 1 sample	4
Cloudy, Triangle, full root	P085.033.1.obj00031; P098.046.1.obj00102	remove upper 2 samples	5
Clear, flared blades (small), cocnave root***	P168.116.1.obj00019	remove 1 lower sample	6
Clear, Flat, Curved, 3/4 dome root	P170.118.1.obj00006	remove 1 lower sample	6
Acrodin Tip, 1/2 length straight root	P156.104.1.obj00012	remove 1 lower sample	4
Bladed cone (acrodin tip)**	P129.077.1.obj00023	remove lower 1 sample	6
Acrodin Tip, 3/4 length convex root	P131.079.1.obj00076	remove 1 lower sample	4
Bladed cone	P105.053.1.obj00019	Remove 1 lower sample	6
Clear, Flat, thin root	P053.001.1.obj00070	remove 1 upper sample	5
Curved, large concave root	P105.053.1.obj00057	remove 1 lower sample	6

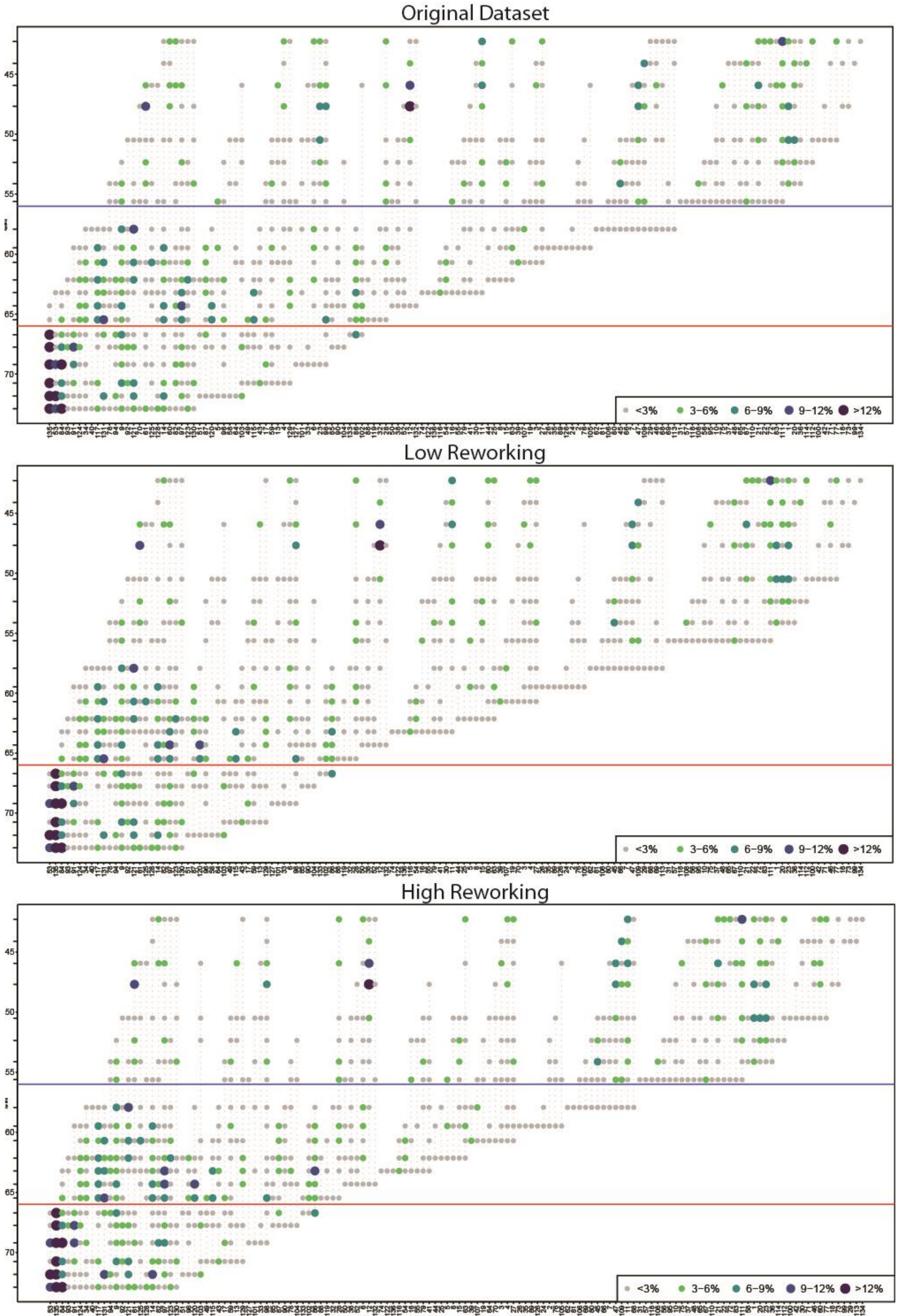

Original Dataset
45
50
55
60
65
70
<3%
3–6%
6–9%
9–12%
>12%
Low Reworking
45
50
55
60
65
70
<3%
3–6%
6–9%
9–12%
>12%
High Reworking
45
50
55
60
65
70
<3%
3–6%
6–9%
9–12%
>12%

Figure S3: Stratigraphic range charts of all ichthyolith morphotypes for each of the three levels of reworking considered. Size and color of dot is the absolute number of each morphotype observed in a time bin, from small and gray representing a single occurrence, to large and purple representing up to 18 teeth of a particular morphotype). Red horizontal line is the K/Pg extinction; Blue line is the Paleocene-Eocene boundary. The x-axis morphotype, ordered by first occurrence then last occurrence age. Note that the abundance values reported in the figure are absolute abundance, not relative abundance, so the absolute number of ichthyoliths in a time bin can vary considerably – the time bins with the most teeth (62.1 and 50.5 Ma) contain nearly 2x the number of teeth for each other time bin considered.

4. EVOLUTIONARY RATES: CAPTURE-MARK-RECAPTURE ANALYSIS

To assess the turnover of tooth morphotypes, we estimated origination and extinction rates. While we recognize that these fish teeth are not identifiable as individual taxa, and indeed, likely represent a combination of ecological groups, taxonomic clades, and ontogenetic stages. However their distinct stratigraphic ranges can be used for crude biostratigraphy [7, 12, 19], suggesting that they represent a clade undergoing evolutionary change through time. Therefore our calculations cannot be compared in absolute terms to taxonomic-unit based evolutionary rates (e.g. genus-specific origination rates). However, as these teeth do represent lineages or ecotypes which originate and go extinct, these rate estimations can highlight times of significant change in open ocean fishes and their roles in the open ocean ecosystem. Our approach is similar to other 'taxon-free' morphological approaches that have been used to describe evolution in many now-extinct groups, including trilobites and blastoids [20]. Here we use two different metrics to calculate per-capita origination and extinction rates for fish tooth morphotypes: Boundary Crossers (BC) [21] and maximum likelihood-based capture-mark-recapture (CMR) [22, 23].

CMR models use a time-series-based set of presence/absence observations for individuals in a population and a maximum-likelihood approach to estimate detection probability (p) and probability of survival (φ) of individuals in a population from one observation point in a time series to the next. In macroevolutionary terms, this means that one can estimate the probability that one individual (or morphotype, in the case of our data) present in time bin (t), has survived to the next time bin (t+1). The compliment of this is the probability that this individual (morphotype) has gone extinct, yielding an estimation of extinction probability. Run in reverse, this can be used to estimate "recruitment", or the probability that an individual that was present in time point (t) was not around in the prior time point (t-1) – in macroevolutionary terms, this provides an estimate of origination [23]. For our analyses, we used the Pradel-recruitment model in MARK, a parameterization of Pradel's 1996 model [24] suitable for use with fossil datasets, which provide estimates of recruitment (f), in addition to the survival and detection probability parameters. These CMR models best fit the assumptions of the fossil record, and incorporate incomplete sampling into the estimates [22]. The estimated parameters can be transformed to extinction rate (1-survival) and origination rate (recruitment). Models were fit allowing for the parameters to vary within each time bin, to be fixed over the whole interval, or to vary with sampling intensity, which was higher in the Cretaceous and Paleocene than in the Eocene, to make up for the lower abundances of teeth in individual samples in the Cretaceous and Paleocene. As the time bins were not evenly spaced (though we aimed for approximately 1 myr resolution), we incorporated these unequal time bins into the design matrices of the CMR models, such that the probabilities estimated for each time interval were normalized to "probability per 1 million years". The models were evaluated using AICc, and the figures are made with a weighted average of each model parameter, using the AICc weight (function model.average() in the RMark package [25]) – however, it is worthwhile noting that the two best-fit models are nearly identical in their parameter estimation, and this model-averaging had no significant impact on the outcome (Table S3).

Model	# of Parameters	AICc	Δ AICc from best fit model	weight	Deviance
φ(~1)p(~1)f(~time)	22	2697.77	0.00	0.63	1354.32
φ (~1)p(~sample)f(~time)	23	2699.18	1.41	0.31	1353.60
φ (~time)p(~1)f(~time)	41	2703.29	5.52	0.04	1318.48
φ (~time)p(~sample)f(~time)	42	2705.21	7.44	0.02	1318.17
φ (~time)p(~time)f(~time)	61	2710.58	12.82	1.04E-03	1279.87
φ (~time)p(~1)f(~1)	22	2725.78	28.01	5.23E-07	1382.33
φ (~time)p(~sample)f(~1)	23	2727.89	30.12	1.82E-07	1382.32
φ (~time)p(~time)f(~1)	42	2730.94	33.17	3.96E-08	1343.90
φ (~1)p(~time)f(~time)	42	2740.83	43.06	2.82E-10	1353.79
φ (~1)p(~1)f(~1)	3	2745.29	47.53	3.02E-11	1441.16
φ (~1)p(~sample)f(~1)	4	2747.06	49.30	1.25E-11	1440.91
φ (~1)p(~time)f(~1)	23	2785.90	88.14	0.00E+00	1440.33

Table S3: model variations and output summary from MARK analysis for Pradel-Recruitment analysis on the "low reworking reworking" dataset. (~1) corresponds to "hold parameter value constant through time". (~time) corresponds to allowing a different parameter value for each time interval. (~sample) allowed the parameter to differ between the Cretaceous/Paleocene, and Eocene, where different sampling intensities were used. Weighted averages were calculated for each parameter. Note that p(~sample) and p(~1) carried 94% of the weight, and the probability of detection (p) values were very similar for p(~sample) [0.58 pre-Eocene and 0.56 Eocene] and p(~1) [0.57 throughout the interval]. Other model-estimated parameters for every model considered here are available in the MARK output files included with the extended code and data package.

CMR has a distinct advantage over other traditional rate metrics: it inherently assumes that the observed first and last occurrences of a taxon may not be the precise origination or extinction dates. The likelihood model that is fit assumes that the observation of an individual is a function of the probability that the individual was alive (survival) and the probability that it was detected (p). Thus, the parameters estimated by CMR include detection probability for all observed stratigraphic ranges, negating the need for additional confidence interval calculations (e.g. Marshall [26]), and allowing for the inclusion of single occurrences in the dataset. In contrast, we discarded the oldest 2 origination rate estimates and the youngest 2 extinction rate estimates within the time-series because they algebraically yield highly inflated estimates, effectively edge effects [21], and all morphotypes which occurred only once were not considered in the BC calculations. The CMR analysis was carried out using the MARK software [27, 28] through the RMark package [25]. All evolutionary rate calculations were carried out in R [29].

It is unlikely that sampling biases are driving the evolutionary rate signals, as BC and CMR yield similar patterns in evolutionary rate estimates, despite being significantly different in their approach: BC calculates origination and extinction for each interval independently and is unable to estimate confidence intervals, while CMR assumes a null model of constant origination and extinction rates throughout all intervals, and uses Akaike Information Criterion (AIC) to evaluate time-variant models, penalizing for higher numbers of parameters, and estimating confidence intervals for each parameter estimated. Further, where the BC method is designed to minimize the impact of incomplete sampling, CMR explicitly accounts for error due to sampling biases. The broad congruence between these two incredibly different methodological approaches provides evidence that our results are likely real, and not just due to random sampling errors. The absolute value of origination and extinction rate differs somewhat between CMR and BC. During certain intervals, CMR yields values for origination approximately twice the BC estimates. The BC method ignores single occurrences of taxa, and as such may underestimate the true extinction and origination rates for our dataset, as there are considerable morphotypes which occur only once, particularly during the early Paleocene (Figure 1), when abundance is low but novelty is high. Further, the three datasets with varying levels of reworking yield strikingly similar patterns using both BC and CMR, suggesting that reworking of teeth through bioturbation is not a significant factor in the estimates of tooth morphotype origination and extinction rates in our dataset.

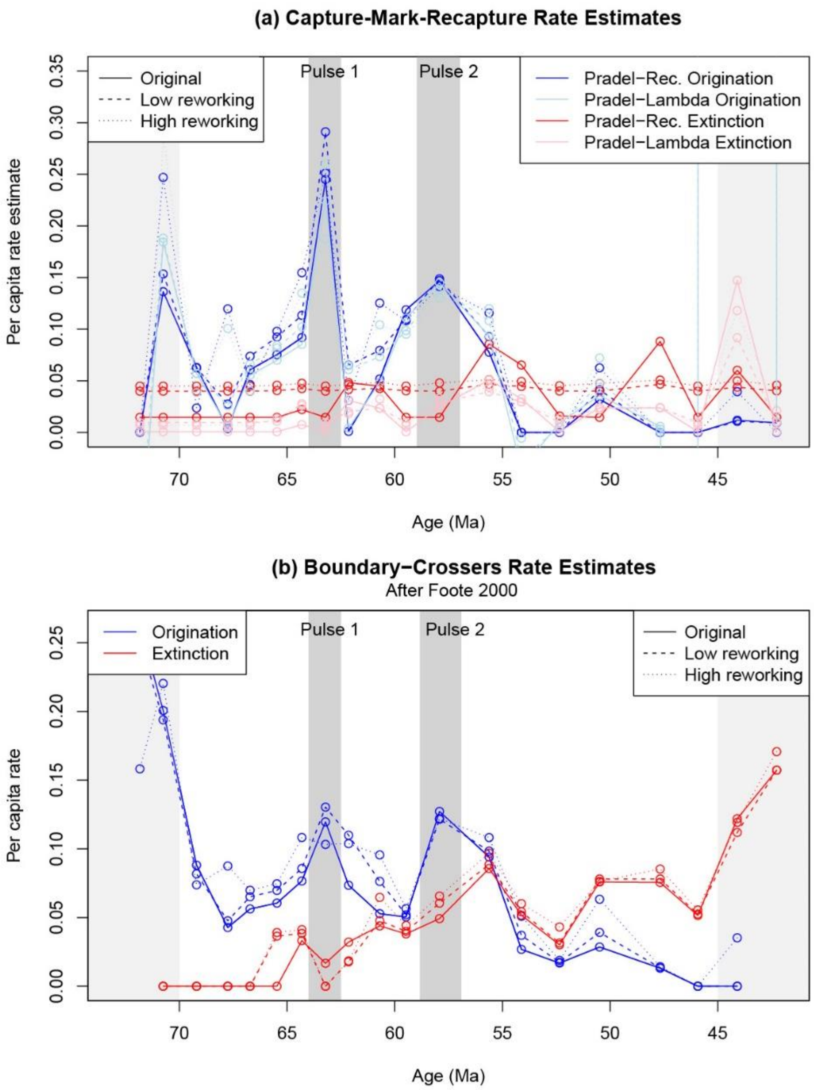


Figure S4. Origination and extinction rate estimates using (a) the Pradel-Recruitment and Pradel-Lambda formulations of the Pradel capture-mark-recapture models in MARK [24, 27] (top) and comparing to the Boundary Crosser calculations (bottom; Foote 2000). Dark gray shaded regions represent the two non-zero pulses of origination observed. Light-gray shaded areas represent regions of possible edge effects in our sampling. Red is extinction, while blue is origination. The different shades represent different configurations of the CMR models, while the different line dashes represent the three levels of reworking assumed in the data.

While our results are robust to variations in tooth morphotype designations. While we erred on the side of caution and were morphological "splitters" throughout this process, some tooth types are invariably much more similar than others, which could have an impact on the outcome of the study. To test whether our split morphotypes were biasing our results, we used k-means cluster analysis (a non-hierarchical clustering method) to group the 136 morphotypes into half that number (68 morphotypes), allowing the most similar morphotypes to be grouped into a single category. We then repeated the CMR on the revised morphotype capture histories. Overall, the results were nearly identical to the original dataset analyses (Figure S5), with the two pulses occurring at the same time intervals. The main difference is that the extinction estimate decreased from ~4% to ~2.9%, which is to be expected when there are fewer morphotypes which persist longer and are more commonly found throughout their ranges. Further, the error bars on the origination estimations on this clumped morphotype analysis were slightly smaller than the original analyses. This suggests that our conclusions are robust to morphotype similarity metrics, and that, if anything, we erred on the side of "splitting" too much, though this did not have a significant impact on our conclusions, and if anything, our conclusions are more conservative than they would have been with less distinct morphotypes.

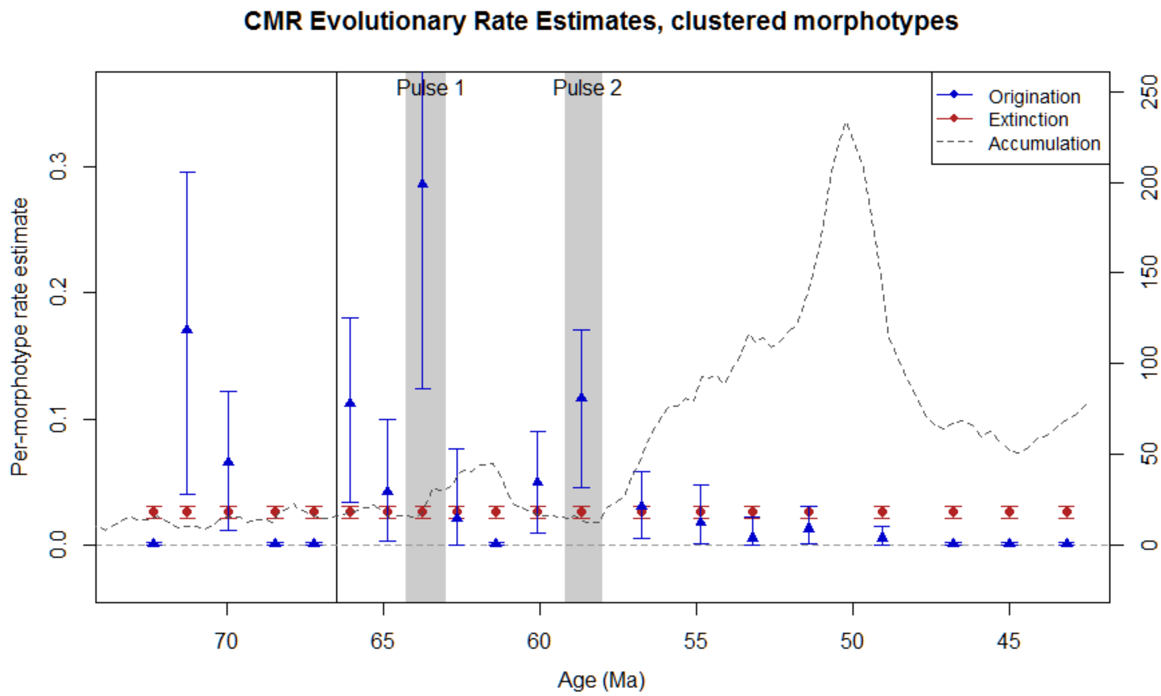


Figure S5. Capture-Mark-Recapture evolutionary rate analyses using revised capture-histories of 68 clustered morphotype groups. Note that this is highly similar to the results generated by the full 136-morphotype dataset considered in our manuscript, and suggests that our results are generally robust to morphotype “splitting”.

Table S4. An alphabetical list of tooth morphotype names used in this study, and the corresponding axis labels used on the range chart figures (Figure 1 of the main text and Figure S3).

Range Chart ID	Morphotype Name
1	Acrodin Tip, 1/2 length Concave Root
2	Acrodin Tip, 1/2 length Concave root, flared blades
3	Acrodin Tip, 1/2 length Concave Root, no tips
4	Acrodin Tip, 1/2 length convex root
5	Acrodin Tip, 1/2 length funnel root
6	Acrodin Tip, 1/2 length straight root
7	Acrodin Tip, 1/2 length straight root, flare blades
8	Acrodin Tip, 1/4 length concave root
9	Acrodin Tip, 1/4 length dome root
10	Acrodin Tip, 3/4 length concave root
11	Acrodin Tip, 3/4 length convex root
12	Acrodin Tip, 3/4 length straight root
13	Acrodin Tip, Cone-like, Big blades
14	Acrodin Tip, Cone, small dome root
15	Acrodin Tip, convex tooth, straight 1/2 root
16	Acrodin Tip, convex tooth, straight 3/4 root
17	Acrodin Tip, Convex, Curved
18	Acrodin Tip, Curve, 1/2 concave root
19	Acrodin Tip, curve, full root
20	Acrodin Tip, Dome Root
21	Acrodin Tip, extended long root
22	Acrodin Tip, Flared Blades
23	Acrodin Tip, no obvious root
24	Acrodin Tip, pointy convex, 1/2 root
25	Acrodin Tip, right, convex
26	Acrodin Tip, small blades
27	Acrodin Tip, Thick Blades, Big root
28	Acrodin Tip, Thick Blades, Small root
29	Bladed cone
30	Bladed cone (acrodin tip)
31	Bladed cone (acrodin tip), curved
32	Bladed cone single blade
33	Bladed cone small root acrodin tip
34	Bladed cone straight no flare
35	Bladed cone, curved
36	Blades on top
37	Blades on top (cone)
38	Clear, 1/2 convex root
39	Clear, 1/2 dome root
40	Clear, 1/2 straight dome root
41	Clear, 1/2 straight root
42	Clear, 1/3 dome root

43	Clear, 1/4 straight root
44	Clear, 1/4 straight root, convex tooth
45	Clear, 3/4 concave root
46	Clear, 3/4 Dome root
47	Clear, 3/4 straight root
48	Clear, 3/4 thin root
49	Clear, concave tooth, 1/4 root
50	Clear, concave tooth, full root
51	Clear, convex tooth, 1/4 dome root
52	Clear, convex tooth, dome root
53	Clear, convex tooth, dome root, small blades
54	Clear, curved, 1/2 root
55	Clear, curved, concave root
56	Clear, curved, full root
57	Clear, flange, straight
58	Clear, flared blades (small), cocnave root
59	Clear, flared blades, 1/2 root
60	Clear, flared blades, 3/4 root
61	Clear, flared blades, concave root
62	Clear, Flat, Curved, 1/2 concave root
63	Clear, Flat, Curved, 3/4 concave root
64	Clear, Flat, Curved, 3/4 dome root
65	Clear, Flat, curved, extended root
66	Clear, flat, curved, full root
67	Clear, flat, small root
68	Clear, flat, straight, tall
69	Clear, Flat, thin root
70	Clear, full straight root
71	Clear, Funnel root
72	Clear, large root
73	Clear, long flange
74	Clear, long flange pointed tip
75	Clear, long S-shape root
76	Clear, long straight root
77	Clear, Long, skinny root
78	Clear, pointed tip, 1/2 dome root
79	Clear, right, concave extended root
80	Clear, right, concave root, flange
81	Clear, right, concave root, small flange
82	Clear, thick, concave
83	Clear, vase-root
84	Cloudy, 1/2 root, flare blades
85	Cloudy, convex, flared bottom
86	Cloudy, curve bladed
87	Cloudy, extended triangle
88	Cloudy, flare blades
89	Cloudy, hooked

90	Cloudy, right convex
91	Cloudy, small thin root
92	Cloudy, Triangle, 3/4 root
93	Cloudy, Triangle, 3/4 root thin blades
94	Cloudy, Triangle, dome root
95	Cloudy, Triangle, extended root
96	Cloudy, Triangle, full root
97	Cone Elongated (no acrodin tip)
98	Cone Elongated (with acrodin tip)
99	Cone long thin root
100	Cone long thin root (acrodin tip)
101	Cone pointed tip
102	cone short dome root
103	Cone small curved
104	Cone small curved acrodin tip
105	Cone triangle root acrodin tip
106	Curved (minor), large concave root
107	Curved triangle dome root
108	Curved, Flange (fat)
109	Curved, Flange (large)
110	Curved, Flange (large) small root
111	Curved, Flange (small)
112	Curved, flat, 1/2-3/4 root, convex sides
113	Curved, large concave root
114	Curved, large concave root, asym bottom
115	Flared base, big curve
116	Flared base, cloudy bladed
117	Flared base, cusps
118	Flared base, flange
119	Flared base, short cloudy cone
120	Flared base, straight bladed cone
121	Flared blades, dome root
122	Hooked, flat head
123	Large long cone
124	Large long curved bladed cone
125	Large long curved cone
126	Large long straight bladed cone
127	Mostly Blade
128	Pointy, Flare bottom, curve
129	Pointy, flare bottom, tall
130	Pointy, flare bottom, wide
131	Pointy, flare, convex
132	Right Triangle, flat
133	Right Triangle, one blade
134	Short triange flared blades
135	Straight, half-length flange
136	Straight, many cusps

REFERENCES

1. Menard H.W., Natland J.H., Jordan T.H., Orcutt J.A., Adair R.G., Burnett M.S., Kim I.I., Lerner-Lam A., Mills W., Prevot R., et al. 1987 Site 596; hydraulic piston coring in an area of low surface productivity in the Southwest Pacific. *Initial Reports of the Deep Sea Drilling Project* **91**, 245-267. (doi:http://dx.doi.org/10.2973/dsdp.proc.91.103.1987).
2. Zhou L., Kyte F.T. 1992 Sedimentation history of the South Pacific pelagic clay province over the last 85 million years inferred from the geochemistry of Deep Sea Drilling Project Hole 596. *Paleoceanography* **7**(4), 441-465.
3. Zhou L., Kyte F.T., Bohor B.F. 1991 Cretaceous/Tertiary boundary of DSDP Site 596, South Pacific. *Geology* **19**(7), 694-697. (doi:10.1130/0091-7613(1991)019<0694:ctbods>2.3.co;2).
4. Winfrey E.C., Doyle P.S. 1984 Preliminary ichthyolith biostratigraphy, Southwest Pacific, DSDP sites 595 and 596. In *Eos, Transactions, American Geophysical Union* (p. 949. Washington, American Geophysical Union.
5. Sibert E.C., Cramer K.L., Hastings P.A., Norris R.D. 2017 Methods for isolation and quantification of microfossil fish teeth and elasmobranch dermal denticles (ichthyoliths) from marine sediments. *Palaeontologia Electronica* **20**(1), 1-14.
6. Doyle P., Kennedy G.G., Riedel W.R. 1974 Stratigraphy. *Initial Reports of the Deep Sea Drilling Project* **26, Durban, South Africa to Fremantle, Australia; Sept.-Oct. 1972**, 825-905. (doi:10.2973/dsdp.proc.26.135.1974).
7. Doyle P.S., Riedel W.R. 1979 *Ichthyoliths: present status of taxonomy and stratigraphy of microscopic fish skeletal debris*. La Jolla, CA, Scripps Institution of Oceanography, University of California, San Diego.
8. Doyle P.S., Riedel W.R. 1985 *Cenozoic and Late Cretaceous ichthyoliths*. Cambridge, United Kingdom (GBR), Cambridge Univ. Press, Cambridge.
9. Tway L.E. 1977 Pennsylvanian ichthyoliths from the Shawnee Group of eastern Kansas [Master's]. Norman, University of Oklahoma.
10. Tway L.E. 1979 A coded system for utilizing ichthyoliths of any age. *Micropaleontology* **25**(2), 151-159.
11. Tway L.E., Riedel W.R. 1991 Prototype expert system to assist in ichthyolith identifications. In *J Vertebr Paleontol* (eds. Emry R.J., Sues H.-D.), pp. 58-59. Norman, University of Oklahoma.
12. Johns M.J., Barnes C.R., Narayan Y.R. 2006 Cenozoic ichthyolith biostratigraphy; Tofino Basin, British Columbia. *Canadian Journal of Earth Sciences/ Revue Canadienne des Sciences de la Terre* **43**(2), 177-204. (doi:10.1139/e05-102).
13. Riedel W.R. 1978 Systems of morphologic descriptors in paleontology. *Journal of Paleontology* **52**(1), 1-7.
14. Hsiang A.Y., Nelson K., Elder L.E., Sibert E.C., Kahanamoku S.S., Burke J.E., Kelly A., Liu Y., Hull P.M. 2017 AutoMorph: Accelerating morphometrics with automated 2D and 3D image processing and shape extraction. *Methods Ecol Evol*, n/a-n/a. (doi:10.1111/2041-210X.12915).
15. Oksanen J., Blanchet F.G., Friendly M., Kindt R., Legendre P., McGlinn D., Minchin P.R., O'Hara R.B., Simpson G.L., Solymos P., et al. 2017 vegan: Community Ecology Package. R package version 2.4-4. (

16. McKinney M.L. 1997 Extinction Vulnerability and Selectivity: Combining Ecological and Paleontological Views. *Annu Rev Ecol Syst* **28**, 495-516.
17. Raup D.M. 1981 Extintion: bad genes or bad luck? *Acta geológica hispánica* **16**(1), 25-33.
18. Streelman J., Webb J., Albertson R., Kocher T. 2003 The cusp of evolution and development: a model of cichlid tooth shape diversity. *Evol Dev* **5**(6), 600-608.
19. Edgerton C.C., Doyle P.S., Riedel W.R. 1977 Ichthyolith age determinations of otherwise unfossiliferous Deep Sea Drilling Project cores. *Micropaleontology* **23**(2), 194-205.
20. Foote M. 1993 Discordance and concordance between morphological and taxonomic diversity. *Paleobiology* **19**(02), 185-204.
21. Foote M. 2000 Origination and extinction components of taxonomic diversity: general problems. *Paleobiology* **26**(sp4), 74-102.
22. Liow L.H., Nichols J.D. 2010 Estimating rates and probabilities of origination and extinctionusing taxonomic occurrence data: capture-mark-recapture (CMR) approaches. *Alroy and Hunt*, 81-94.
23. Nichols J.D., Pollock K.H. 1983 Estimating taxonomic diversity, extinction rates, and speciation rates from fossil data using capture-recapture models. *Paleobiology* **9**(2), 150-163.
24. Pradel R. 1996 Utilization of capture-mark-recapture for the study of recruitment and population growth rate. *Biometrics*, 703-709.
25. Laake J.L. 2013 *RMark: an R interface for analysis of capture-recapture data with MARK*, US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center.
26. Marshall C.R. 1997 Confidence intervals on stratigraphic ranges with nonrandom distributions of fossil horizons. *Paleobiology*, 165-173.
27. White G.C., Burnham K.P. 1999 Program MARK: survival estimation from populations of marked animals. *Bird study* **46**(S1), S120-S139.
28. Cooch E., White G. 2006 Program MARK: a gentle introduction. *Available in pdf format for free download at http://wwwphidotorg/software/mark/docs/book*.
29. R Core Team. 2017 R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; . (

Appendix 1. An image index of all fish tooth morphotypes described in this study.

Acrodin Tip, 1/2 length
Concave Root

100 microns
25 microns
Object #00001 of 00157 (489 x 605 pixels at slide position 06.47% x 78.92%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, ½ length
concave root, flared blades

100 microns
25 microns
Object #00025 of 00214 (323 x 458 pixels at slide position 14.00% x 64.92%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-033-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:46:18
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P085-033-3H-2W-45-48cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, 1/2 length
Concave Root, no tips

100 microns
25 microns
Object #00004 of 00072 (326 x 440 pixels at slide position 08.71% x 74.99%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-007-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 19:01:17
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-P059-007-3H-1W-50-53cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, 1/2 length
convex root

100 microns
25 microns
Object #00060 of 00157 (364 x 469 pixels at slide position 42.11% x 74.06%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, ½ length
funnel root

100 microns
25 microns
Object #00035 of 00253 (195 x 367 pixels at slide position 24.06% x 51.53%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-046-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, ½ length
straight root, flare blades

100 microns
25 microns
Object #00080 of 00353 (321 x 606 pixels at slide position 30.07% x 70.48%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-10 at 07:15:25
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P078-026-3H-2W-10-13cm-g106_Hwell_N1of4_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, 1/2 length
straight root

100 microns
25 microns
Object #00065 of 00157 (386 x 591 pixels at slide position 44.35% x 87.12%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, ¼ concave
root

100 microns
25 microns
Object #00333 of 00353 (337 x 353 pixels at slide position 86.56% x 63.74%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-10 at 07:15:25
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P078-026-3H-2W-10-13cm-g106_Hwell_N1of4_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, ¼ dome root

100 microns
25 microns
Object #00184 of 00214 (269 x 239 pixels at slide position 68.60% x 74.55%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-033-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, ¾ length
concave root

100 microns
25 microns
Object #00047 of 00102 (242 x 406 pixels at slide position 42.35% x 75.40%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-019-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:20:35
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P071-019-3H-1W-110-113cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, 3/4 length
convex root

100 microns
25 microns
Object #00016 of 00157 (493 x 721 pixels at slide position 17.43% x 72.93%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

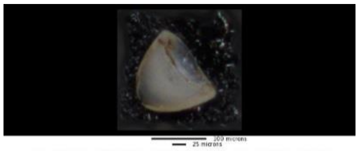
Acrodin Tip, 3/4 length straight root

Object #00043 of 00157 (528 x 752 pixels at slide position 34.01% x 79.03%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, cone-like, big blades

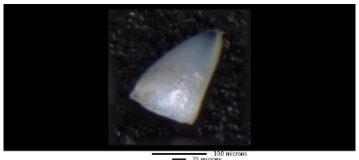
Object #00054 of 00114 (326 x 241 pixels at slide position 46.39% x 72.15%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-013-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, Cone, small dome root



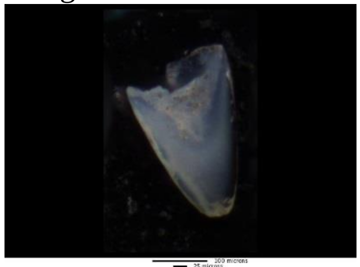
Object #00139 of 00157 (225 x 218 pixels at slide position 75.65% x 73.18%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, convex, curved



Object #00416 of 00431 (258 x 246 pixels at slide position 79.69% x 35.26%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-040-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, convex tooth, straight ½ root



Object #00348 of 00353 (279 x 440 pixels at slide position 93.67% x 56.51%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, convex tooth, straight ¾ root

Object #00016 of 00214 (504 x 437 pixels at slide position 09.31% x 59.30%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-033-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, Curve, 1/2 concave root

Object #00011 of 00072 (736 x 1315 pixels at slide position 18.83% x 42.94%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-007-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, curve full root

Object #00107 of 00214 (323 x 1193 pixels at slide position 43.00% x 37.34%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-033-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, Dome Root

Object #00049 of 00157 (458 x 850 pixels at slide position 37.01% x 77.87%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Acrodin Tip, extended long root

100 microns
25 microns
Object #00023 of 00157 (326 x 613 pixels at slide position 22.73% x 74.54%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, Flared Blades

100 microns
25 microns
Object #00136 of 00157 (262 x 412 pixels at slide position 74.16% x 67.75%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, no obvious root

100 microns
25 microns
Object #00087 of 00157 (673 x 438 pixels at slide position 53.61% x 71.35%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, pointy convex, ½ root

100 microns
25 microns
Object #00017 of 00047 (267 x 410 pixels at slide position 40.89% x 81.69%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-063-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-07-10 at 11:02:59
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-P115-063-3H-2W-50-53cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, right convex

100 microns
25 microns
Object #00083 of 00163 (203 x 447 pixels at slide position 43.29% x 57.90%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-074-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-07-10 at 10:57:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P126-074-3H-3W-110-113cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin tip, small blades

100 microns
25 microns
Object #00004 of 00035 (273 x 392 pixels at slide position 11.72% x 47.12%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-059-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 21:44:50
Threshold of 0.18 and size filter of 125 - 3000 microns
Directory: DSDP-596-P111-059-3H-3W-30-33cm-g106_Hwell_N1of1_Mcompound_Oflat_I1_TzEDF-0_X5

Acrodin Tip, Thick Blades, Big root

100 microns
25 microns
Object #00119 of 00157 (672 x 617 pixels at slide position 66.76% x 84.50%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Acrodin Tip, Thick Blades, Small root

100 microns
25 microns
Object #00125 of 00157 (241 x 295 pixels at slide position 70.88% x 71.14%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Bladed cone

100 microns
25 microns
Object #00011 of 00157 (326 x 424 pixels at slide position 15.16% x 77.90%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Bladed cone (Acrodin tip)

100 microns
25 microns
Object #00060 of 00072 (349 x 612 pixels at slide position 62.55% x 82.11%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-007-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 19:01:17
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-P059-007-3H-1W-50-53cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

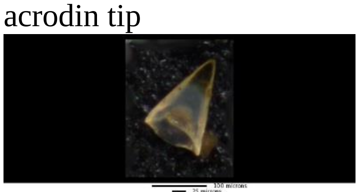
Bladed cone (Acrodin tip) curved

100 microns
25 microns
Object #00055 of 00253 (578 x 1019 pixels at slide position 28.46% x 30.00%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-046-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 17:30:30
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P098-046-3H-2W-110-113cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

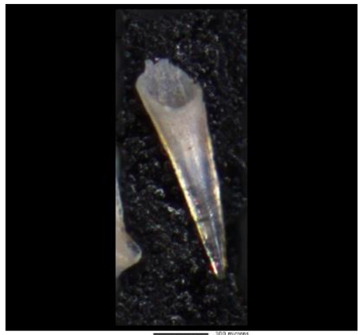
Bladed cone, curved

Bladed cone, single blade

Bladed cone small root acrodin tip



Bladed cone, straight, no flare



Blades on top

Blades on top (cone)

Clear, ½ convex root

Clear, ½ dome root

Clear, ½ straight dome root

Clear, ½ straight root

Clear, 1/3 dome root

Clear, ¼ straight root

100 microns
25 microns
Object #00085 of 00119 (223 x 514 pixels at slide position 48.30% x 50.54%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-077-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-17 at 12:47:46
Threshold of 0.18 and size filter of 125 - 3000 microns
Directory: DSDP-596-P129-077-3H-3W-125-128cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, ¼ straight root, convex tooth

100 microns
25 microns
Object #00065 of 00129 (444 x 595 pixels at slide position 45.44% x 62.15%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-070-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-16 at 13:30:21
Threshold of 0.18 and size filter of 125 - 2000 microns
Directory: DSDP-596-P122-070-3H-3W-85-88cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, ¾ concave root

100 microns
25 microns
Object #00037 of 00190 (343 x 634 pixels at slide position 24.80% x 43.80%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 00:23:08
Threshold of 0.14 and size filter of 125 - 2000 microns
Directory: DSDP-596-P078-026-3H-2W-10-13cm-g106_Hwell_N4of4_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, ¾ dome-root

100 microns
25 microns
Object #00062 of 00157 (433 x 680 pixels at slide position 42.41% x 79.37%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, ¾ straight root

100 microns
25 microns
Object #00001 of 00114 (399 x 1053 pixels at slide position 04.51% x 59.02%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-013-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:04:15
Threshold of 0.16 and size filter of 125 - 3000 microns
Directory: DSDP-596-F065-013-3H-1W-80-83cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, ¾ thin root

100 microns
25 microns
Object #00067 of 00072 (266 x 683 pixels at slide position 76.44% x 78.01%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-007-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 19:01:17
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-P059-007-3H-3W-50-53cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, concave tooth, ¼ root

100 microns
25 microns
Object #00006 of 00071 (638 x 339 pixels at slide position 10.74% x 79.78%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-089-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-20 at 09:18:02
Threshold of 0.14 and size filter of 100 - 1500 microns
Directory: DSDP-596-F141-089-3H-4W-40-43cm-g106_Hwell_N1of1_Mcompound_Oflat_I1_TzEDF-0_X5

Clear, concave tooth, full root

Clear, convex tooth, dome root

Object #00078 of 00102 (405 x 610 pixels at slide position 62.59% x 77.12%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-019-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:20:35
Threshold of 0.14 and size filter of 125 - 3000 microns

Clear, convex tooth, dome root, small blades

Object #00003 of 00028 (762 x 984 pixels at slide position 15.25% x 47.34%)
1.00 microns per pixel | Age and Source: Cretaceous from DSDP-596-103-Cretaceous
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Clear, convex tooth, ¼ dome root

Object #00006 of 00054 (413 x 470 pixels at slide position 16.40% x 73.07%)
1.00 microns per pixel | Age and Source: Cretaceous from DSDP-596-116-Cretaceous
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-20 at 11:26:30
Threshold of 0.14 and size filter of 125 - 2500 microns

Clear, curved, concave root

Object #00057 of 00214 (629 x 456 pixels at slide position 26.51% x 62.57%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-033-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:46:18
Threshold of 0.14 and size filter of 125 - 3000 microns

Clear, curved, full root

Object #00188 of 00214 (330 x 623 pixels at slide position 69.55% x 54.86%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-033-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:46:18
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P085-033-3H-2W-45-48cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, curved 1/2 root

Object #00095 of 00096 (416 x 729 pixels at slide position 70.97% x 40.95%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-076-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

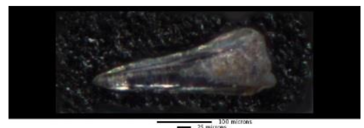
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-16 at 14:51:37
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-P128-076-3H-3W-120-123cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, flange, straight

Object #00004 of 00253 (371 x 890 pixels at slide position 12.97% x 42.20%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-046-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 17:10:30
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P098-046-3H-2W-110-113cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, flared blades, 1/2 root



Object #00163 of 00353 (468 x 185 pixels at slide position 48.38% x 69.65%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-10 at 07:15:25
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P078-026-3H-2W-10-13cm-g106_Hwell_N1of4_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, flared blades, 3/4 root

Object #00068 of 00157 (253 x 465 pixels at slide position 46.14% x 74.80%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, flared blades
concave root

100 microns
25 microns

Object #00042 of 00114 (258 x 645 pixels at slide position 38.13% x 61.93%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-013-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:04:15
Threshold of 0.16 and size filter of 125 - 3000 microns
Directory: DSDP-596-P065-013-3H-3W-80-83cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, flared blade (small),
concave root

100 microns
25 microns

Object #00138 of 00353 (433 x 664 pixels at slide position 43.44% x 75.53%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-10 at 07:15:25
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P078-026-3H-2W-10-13cm-g106_Hwell_N1of4_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, Flat, Curved, 3/4
concave root (or ½ root)

100 microns
25 microns

Object #00137 of 00157 (535 x 1053 pixels at slide position 74.11% x 46.91%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, Flat, Curved, ¾
dome root

100 microns
25 microns

Object #00134 of 00190 (251 x 501 pixels at slide position 67.10% x 39.45%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 00:23:08
Threshold of 0.14 and size filter of 125 - 2000 microns
Directory: DSDP-596-P078-026-3H-2W-10-13cm-g106_Hwell_N4of4_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, flat curved full root

100 microns
25 microns

Object #00090 of 00190 (417 x 1161 pixels at slide position 47.60% x 15.29%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 00:23:08
Threshold of 0.14 and size filter of 125 - 2000 microns
Directory: DSDP-596-P078-026-3H-2W-10-13cm-g106_Hwell_N4of4_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, Flat, Curved,
extended root

100 microns
25 microns

Object #00061 of 00072 (322 x 805 pixels at slide position 66.55% x 81.47%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-007-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 18:01:17
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-P059-007-3H-1W-50-53cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, flat, small root

Clear, flat, straight, tall

Clear, Flat, Thin root
should be “cloudy”

Clear, full straight root

Clear, funnel root

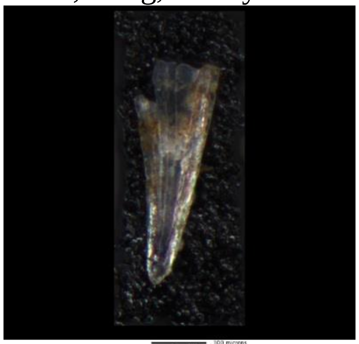
Clear, large root

Clear, long flange

Clear, long flange, pointed tip

Clear, long S-shape root

Clear, Long, skinny root



200 microns
25 microns

Object #00105 of 00157 (237 x 585 pixels at slide position 62.00% x 88.21%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, long straight root

100 microns
25 microns

Object #00033 of 00353 (220 x 468 pixels at slide position 17.86% x 68.52%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-10 at 07:15:25
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F078-026-3H-2W-10-13cm-g106_Hwell_N1of4_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, pointed tip, ½ dome root

100 microns
25 microns

Object #00093 of 00431 (608 x 755 pixels at slide position 25.35% x 59.67%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-040-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 08:57:20
Threshold of 0.13 and size filter of 100 - 3000 microns
Directory: DSDP-596-F082-040-3H-2W-80-83cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, right, concave extended root

200 microns
25 microns

Object #00135 of 00190 (417 x 1126 pixels at slide position 67.70% x 46.49%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 00:23:03
Threshold of 0.14 and size filter of 125 - 2000 microns
Directory: DSDP-596-F076-026-3H-2W-10-13cm-g106_Hwell_N4of4_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, right, concave root, flange

100 microns
25 microns

Object #00128 of 00214 (414 x 528 pixels at slide position 49.61% x 69.39%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-033-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:46:18
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P085-033-3H-2W-45-48cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, right, concave root, small flange

100 microns
25 microns

Object #00055 of 00063 (442 x 715 pixels at slide position 74.77% x 49.65%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-053-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 19:44:48
Threshold of 0.16 and size filter of 125 - 3000 microns
Directory: DSDP-596-F105-053-3H-2W-145-147cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, thick, concave

100 microns
25 microns

Object #00109 of 00157 (251 x 423 pixels at slide position 62.77% x 79.69%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Clear, vase-root

100 microns
25 microns

Object #00010 of 00157 (279 x 554 pixels at slide position 14.43% x 72.66%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Cloudy, ½ root flare blades

100 microns
25 microns

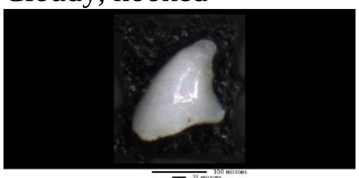
Object #00037 of 00050 (328 x 336 pixels at slide position 63.07% x 71.84%)
1.00 microns per pixel | Age and Source: Cretaceous from DSDP-596-094-Cretaceous
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-26 at 07:13:38
Threshold of 0.16 and size filter of 125 - 2500 microns
Directory: DSDP-596-P146-094-3H-4W-70-73cm-g106_Hwell_N1of1_Mcompound_Oflat_I1_TzEDF-0_X5

Cloudy, convex, flare bottom

Object #00097 of 00112 (531 x 470 pixels at slide position 58.67% x 62.20%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-072-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Cloudy, hooked



Object #00038 of 00049 (238 x 270 pixels at slide position 53.44% x 65.60%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-061-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Cloudy, right convex

Object #00015 of 00119 (806 x 1687 pixels at slide position 15.34% x 23.05%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-077-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Cloudy curve bladed

Cloudy extended triangle

Object #00004 of 00119 (413 x 820 pixels at slide position 03.69% x 55.16%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-077-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Cloudy flare blades

Object #00010 of 00071 (636 x 697 pixels at slide position 13.66% x 58.33%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-089-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Cloudy, small thin root

Object #00007 of 00050 (216 x 553 pixels at slide position 22.71% x 73.52%)
1.00 microns per pixel | Age and Source: Cretaceous from DSDP-596-094-Cretaceous
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Cloudy triangle ¾ root

Object #00018 of 00353 (300 x 367 pixels at slide position 11.78% x 64.16%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Cloudy triangle, ¾ root thin blades

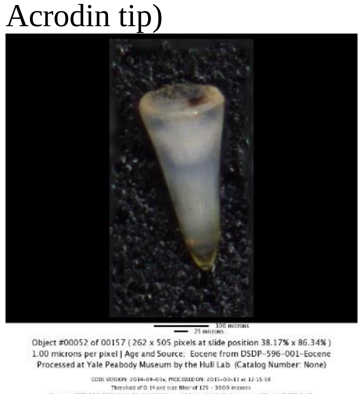
Object #00114 of 00119 (550 x 911 pixels at slide position 69.72% x 47.61%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-077-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

Cloudy triangle, dome root

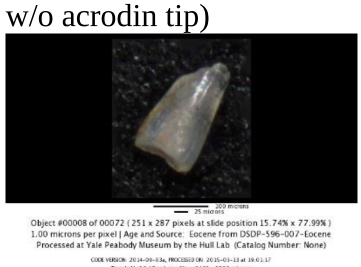
Cloudy triangle extended root

Cloudy triangle full root

Cone elongated (w/ or w/o Acrodin tip)



Cone long thin root (w/ or w/o acrodin tip)



Cone pointed tip

Cone small curved

Cone small curved acrodin tip

Cone Triangle root acrodin tip

Curved flange (fat)

100 microns
25 microns

Object #00096 of 0043 | (874 x 1760 pixels at slide position 25.72% x 26.13%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-040-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-06 at 10:57:20
Threshold of 0.12 and size filter of 125 - 3000 microns
Directory: [illegible]

Curved Flange (large)

100 microns
25 microns

Object #00020 of 00072 (351 x 1200 pixels at slide position 32.01% x 47.20%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-007-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 19:01:17
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-F059-007-3H-1W-50-53cm-g106_Hwell_N1of1_Ncompount_Oflat_I1_TzEDF-0_X5

Curved Flange (large)
small root

100 microns
25 microns

Object #00025 of 00072 (228 x 813 pixels at slide position 37.42% x 72.08%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-007-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 19:01:17
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-P059-007-3H-1W-50-53cm-g106_Hwell_N1of1_Ncompount_Oflat_I1_TzEDF-0_X5

Curved, Flange (small)

100 microns
25 microns

Object #00106 of 00157 (455 x 1492 pixels at slide position 62.09% x 41.79%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Ncompount_Oflat_I1_TzEDF-0_X5

Curved, flat, 1/2-3/4 root,
convex sides

100 microns
25 microns

Object #00046 of 00157 (609 x 874 pixels at slide position 34.95% x 70.73%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Ncompount_Oflat_I1_TzEDF-0_X5

Curved, large concave root

100 microns
25 microns

Object #00032 of 00157 (259 x 682 pixels at slide position 29.00% x 79.55%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Ncompount_Oflat_I1_TzEDF-0_X5

Curved, large concave
root, asym bottom

100 microns
25 microns

Object #00015 of 00072 (424 x 669 pixels at slide position 25.64% x 70.03%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-007-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 19:01:17
Threshold of 0.17 and size filter of 125 - 3000 microns
Directory: DSDP-596-P059-007-3H-1W-50-53cm-g106_Hwell_N1of1_Ncompount_Oflat_I1_TzEDF-0_X5

Curved (minor), large concave root

100 microns
25 microns
Object #00014 of 00253 (326 x 722 pixels at slide position 16.42% x 54.78%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-046-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 17:10:30
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P098-046-3H-2W-110-113cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Curved triangle, dome root

100 microns
25 microns
Object #00038 of 00253 (354 x 641 pixels at slide position 24.88% x 71.37%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-046-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 17:10:30
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P098-046-3H-2W-110-113cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Flared base, big curve

100 microns
25 microns
Object #00077 of 00119 (543 x 720 pixels at slide position 44.37% x 21.46%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-077-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-17 at 12:47:46
Threshold of 0.18 and size filter of 125 - 3000 microns
Directory: DSDP-596-P129-077-3H-3W-125-128cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Flared base, flange

100 microns
25 microns
Object #00106 of 00253 (545 x 1446 pixels at slide position 38.45% x 39.03%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-046-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 17:10:30
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-P098-046-3H-2W-110-113cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Flared base, cusps

100 microns
25 microns
Object #00021 of 00052 (710 x 699 pixels at slide position 26.48% x 32.69%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-060-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 21:46:28
Threshold of 0.18 and size filter of 125 - 3000 microns
Directory: DSDP-596-P112-060-3H-3W-35-38cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Flared base, cloudy bladed

Flared base, short cloudy cone

100 microns
25 microns
Object #00030 of 00067 (417 x 440 pixels at slide position 43.07% x 50.23%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-066-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-16 at 12:33:43
Threshold of 0.18 and size filter of 125 - 3000 microns
Directory: DSDP-596-P118-066-3H-3W-65-68cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Flared base, straight bladed cone

Flared blades, dome root

100 microns
25 microns

Object #00103 of 00353 (472 x 1022 pixels at slide position 36.18% x 56.84%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-026-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-10 at 07:15:25
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F078-026-3H-2W-10-13cm-g106_Hwell_N1of4_Mcompount_Oflat_I1_TzEDF-0_X5

Hooked, flat head

100 microns
25 microns

Object #00022 of 00106 (452 x 1007 pixels at slide position 24.50% x 56.66%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-075-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-07-10 at 10:51:14
Threshold of 0.18 and size filter of 125 - 3000 microns
Directory: DSDP-596-F127-075-3H-3W-115-118cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Large, Long cone

100 microns
25 microns

Object #00144 of 00157 (315 x 1130 pixels at slide position 79.21% x 45.97%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 - 3000 microns
Directory: DSDP-596-F053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Large, long, curved bladed cone

Large, long, straight

bladed cone

100 microns
25 microns

Object #00001 of 00052 (262 x 953 pixels at slide position 12.99% x 68.11%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-058-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 21:07:44
Threshold of 0.16 and size filter of 125 - 2000 microns
Directory: DSDP-596-F110-058-3H-3W-25-28cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Large, long curved cone

100 microns
25 microns

Object #00009 of 00114 (391 x 1770 pixels at slide position 14.62% x 38.31%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-013-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)

CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:04:15
Threshold of 0.16 and size filter of 125 - 3000 microns
Directory: DSDP-596-F065-013-3H-1W-80-83cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Mostly Blade

100 microns
25 microns
Object #00047 of 00253 (197 x 844 pixels at slide position 27.31% x 41.63%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-046-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-15 at 17:10:30
Threshold of 0.14 and size filter of 125 – 3000 microns
Directory: DSDP-596-P098-046-3H-2W-110-113cm-g106_Hwell_N1of2_Mcompount_Oflat_I1_TzEDF-0_X5

Pointy, flare bottom, “Tall” (can also be “wide” or “curved”)

100 microns
25 microns
Object #00135 of 00157 (780 x 911 pixels at slide position 72.68% x 54.15%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 – 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

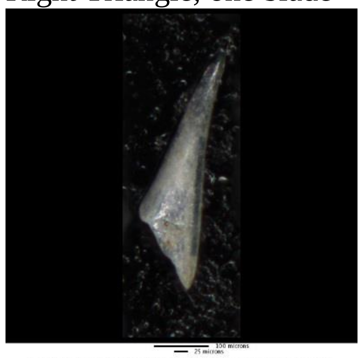
Pointy flare, convex

100 microns
25 microns
Object #00051 of 00119 (393 x 652 pixels at slide position 35.13% x 60.75%)
1.00 microns per pixel | Age and Source: Paleocene from DSDP-596-077-Paleocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-17 at 12:47:46
Threshold of 0.18 and size filter of 125 – 3000 microns
Directory: DSDP-596-P129-077-3H-3W-125-128cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Right Triangle, flat

100 microns
25 microns
Object #00133 of 00157 (249 x 435 pixels at slide position 72.62% x 76.28%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 – 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Right Triangle, one blade



100 microns
25 microns
Object #00005 of 00035 (214 x 589 pixels at slide position 12.75% x 65.09%)
1.00 microns per pixel | Age and Source: Cretaceous from DSDP-596-092-Cretaceous
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-26 at 07:04:38
Threshold of 0.20 and size filter of 125 – 2500 microns
Directory: DSDP-596-P144-092-3H-4W-60-63cm-g106_Hwell_N1of1_Mcompound_Oflat_I1_TzEDF-0_X5

Short triangle flared blades

100 microns
25 microns
Object #00152 of 00157 (241 x 318 pixels at slide position 88.18% x 68.27%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-001-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-13 at 12:15:58
Threshold of 0.14 and size filter of 125 – 3000 microns
Directory: DSDP-596-P053-001-3H-1W-20-23cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5

Straight, half-length flange

100 microns
25 microns
Object #00010 of 00050 (588 x 1239 pixels at slide position 33.13% x 70.72%)
1.00 microns per pixel | Age and Source: Cretaceous from DSDP-596-094-Cretaceous
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-03-26 at 07:13:38
Threshold of 0.16 and size filter of 125 – 2500 microns
Directory: DSDP-596-P146-094-3H-4W-70-73cm-g106_Hwell_N1of1_Mcompound_Oflat_I1_TzEDF-0_X5

Straight many cusps

100 microns
25 microns
Object #00008 of 00114 (468 x 596 pixels at slide position 13.55% x 58.17%)
1.00 microns per pixel | Age and Source: Eocene from DSDP-596-013-Eocene
Processed at Yale Peabody Museum by the Hull Lab (Catalog Number: None)
CODE VERSION: 2014-09-03a, PROCESSED ON: 2015-04-08 at 07:04:15
Threshold of 0.16 and size filter of 125 – 3000 microns
Directory: DSDP-596-P065-013-3H-1W-80-83cm-g106_Hwell_N1of1_Mcompount_Oflat_I1_TzEDF-0_X5