

DataREADME.Rmd

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18 December, 2018

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General notes about the data and analyses

We are restricting this analysis to the Early Eocene Climate Optimum (52-50 Ma at its peak) and including an 8-million year window around this, from ~60-42 Ma. There is ichthyolith data prior to 60 Ma, however there is considerable evolutionary variability in the earliest Paleocene in fish following the K /Pg. We are jumping into the record *after* the first wave of radiation is complete.

The data discussed here are ichthyolith abundance and size from DSDP Site 596 in the South Pacific Ocean, and oxygen isotopes from both Zachos 2008 and Cramer 2009.

DSDP_596_Fish_Accumulation.csv

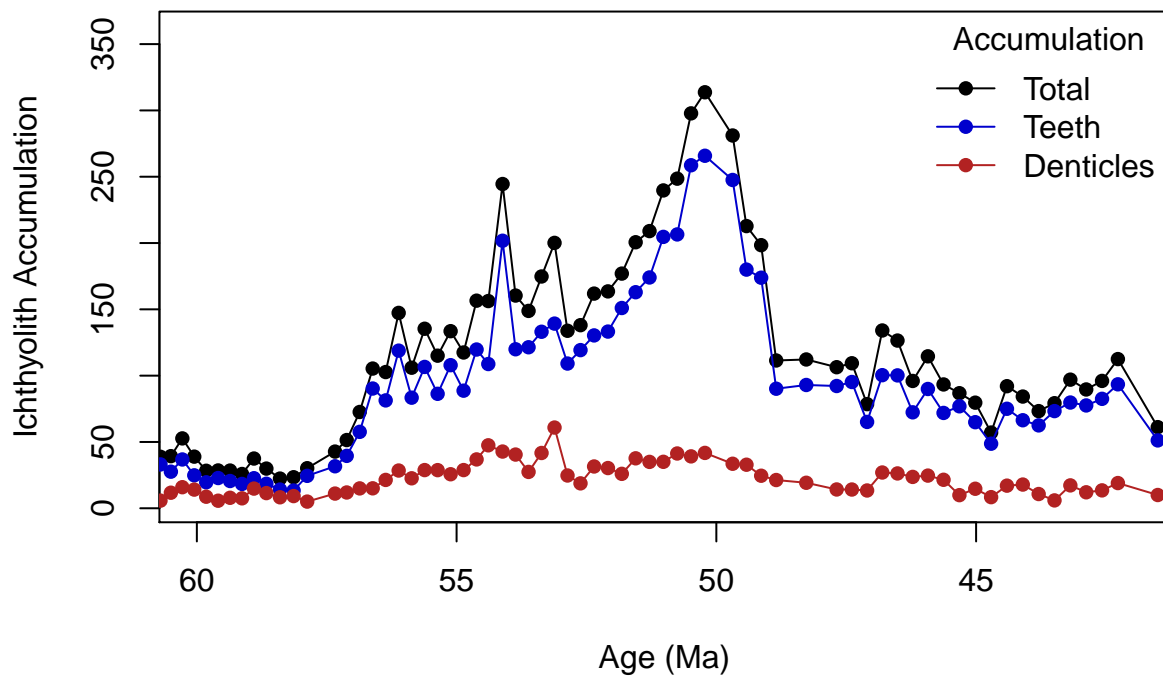
This CSV file contains age and ichthyolith accumulation rate from the South Pacific Ocean, Deep Sea Drilling Project (DSDP) Site 596. These data have been corrected for changes in sedimentation rate as well as shifts in sediment density, and include ichthyoliths >106 μm from 0-85 million years ago (Ma).

There are five columns in this dataset:

1. 'siteID' - the internal ID that identifies each sample to its precise age
2. 'age' - the age, in millions of years before present, for each data point
3. 'ich_accum' - tooth+denticle (total) accumulation rate (ich/cm²/myr) at each data point
4. 'fish_accum' - tooth accumulation rate (tooth/cm²/myr) at each data point
5. 'dent_accum' - denticle accumulation rate (dent/cm²/myr) at each data point

Their age is scaled such that the Cretaceous/Paleogene Boundary occurs at 66.04 Ma, in correspondance with GTS 2012 (Gradstein et al 2012).

Eocene DSDP 596 Ichthyolith Accumulation



596_size_structure.csv

This contains all imageJ measurements on all particles (teeth, denticles, etc) from DSDP Site 596 samples #1-132. (ignores samples with a prefix of “L”, which are included in the DSDP_596_Fish_Accumulation.csv dataset)

There are 25 columns in this spreadsheet, a standard set of imageJ measurements. The ones in ***bold** (1, 3, 5, 18) are the most relevant measurements for this study. All measurements are in mm except for the mean/min/max (columns 6-8), which are in grayscale color space. See <https://imagej.nih.gov/ij/docs/guide/146-30.html> for more information

1. ***SiteID** - this corresponds to the sample that the object is from. SiteID matches to age, and the look-up columns for this can be found in the DSDP_596_Fish_Accumulation.csv file - column 1 is the SiteID, and column 2 is age.
2. PhotoID - Some sites had more than one slide worth of teeth, so there were multiple photos for the same site. For our purposes this can be ignored, but it is useful for matching specific values to specific teeth.
3. ***Dent1_Ich2** - this column identifies whether the particle measured was a:
 - 1) denticle
 - 2) tooth
 - 3) other non-ichthyolith particle and is useful as a way to sort out only the teeth from the dataset
4. Particle_ID - this column identifies which particle within the image was measured. ImageJ keeps this information in its annotations. Each particle has a unique identification number, and the combination of SiteID (col 1), PhotoID (col 2) and Particle_ID (col 4) are unique to each tooth.
5. ***Area** - this column is the total area for each particle. Note that for this dataset, all particles with an area of $<0.018 \text{ mm}^2$ should be removed from the analysis. This needs to happen in post-processing.
6. Mean - mean grayscale value of the object
7. Min - minimum grayscale value of the object
8. Max - maximum grayscale value of the object
9. Perim. - length of the outside boundary of the object
10. BX - upper left x-coordinate of the minimum bounding rectangle containing the object (not rotated with respect to the image)
11. BY - upper left y-coordinate of the minimum bounding rectangle containing the object (not rotated with respect to the image)
12. Width - width of the minimum bounding rectangle containing the object (not rotated with respect to the image)
13. Height - height of the minimum bounding rectangle containing the object (not rotated with respect to the image)
14. Major - length of major axis of best-fit ellipse to the object
15. Minor - length of minor axis of best-fit ellipse to the object
16. Angle - angle between the primary axis and a line parallel to the X-axis of the image
17. Circ. - circularity is a measurement of how circular the object is, with 1.0 being a perfect circle, and tending towards 0.0 as more elongated. $4\pi * area / perimeter^2$
18. ***Ferret** - the longest distance between any two points along the selection boundary, also known as maximum caliper
19. FeretX - starting x-coordinate of the Feret diameter
20. FeretY - starting y-coordinate of the Feret diameter
21. FeretAngle - angle (0-180) of the Feret diameter [I assume from horizontal, but they don't specify]
22. MinFerret - minimum caliper
23. AR - aspect ratio of the particle's fit ellipse: $\frac{[major.axis]}{[minor.axis]}$
24. Round - Roundness or 'inverse of aspect ratio': $4 * area / (\pi * major.axis^2)$
25. Solidity - a measurement of how “solid” the object is based on a convex hull of the area: $area / convex.area$