



TimeScale Creator

www.tscreeator.org

Reference time scales, visualization and chart system *Tour, Datapack Examples and Introduction to making datapacks*

“*TimeScale Creator*” is a time-scale database with visualization software-package in JAVA (which should work on most platforms; see FAQs for solving problems). This version is the current phase of our dream of a general portal to Earth history, plus user-generated charts. Most of the datasets are oriented toward geologic history, but we include a demo datapack with some aspects of human civilization.

This *Tour and Sample Exercises* is oriented toward a general audience.

What it does:

- (1) **Screen display** of user-selected time-span and selected columns of geologic time scale information (stages, paleontology, magnetics, sea-level, chemistry, impacts, other planets, etc.). You, the user, can change the vertical-scale, column widths, fonts, colors, titles, ordering, range chart options and many other features. Mouse-activated pop-ups provide additional information on columns and events.
- (2) **Save** the final graphic as a SVG (scalable vector graphics) or PDF file for direct import into Adobe Illustrator or other common drafting software. You can also save your “settings” to recreate the charts on-screen.
- (3) **Upload additional datapacks** of regional geology and transects, high-resolution isotopes, ancient cultural episodes, etc.; plus create and upload your own datasets. The **Pro** version, after uploading such datapacks, allows you to save the associated graphic files and to re-save merged datasets. See “*About Pro*” on the website for details, plus additional datapacks.

Internal Database (approximately 25,000 event-ages in this version):

There are over 300 stratigraphic columns grouped into categories, mainly spanning the past 550 million years (the era with animal fossils) of Earth’s history. All events are calibrated to ["The Geologic Time Scale 2012"](#) by F.M. Gradstein, J.G. Ogg, M.D. Schmitz and G.M. Ogg (Elsevier, 2012). You can download a full listing of columns, plus the main references, from the website.

THIS INTRODUCTORY TUTORIAL:

This suite has 4 parts:

- (1) How to use TSCreator and hands-on tour of some of its features (ca. 30 minutes)
- (2) Examples of datapacks with additional features (evolution, map-interfaces, etc.) (ca. 30 minutes)
- (3) How to make your own datapacks (fossils with images; rock-column) (ca. 1 hour for all 3)
- (4) Using the on-line chart-delivery versions (TSC-Lite; TSC-chart-server) (ca. 15 minutes)

Part 1 – Using the main TSCreator

How to use it: *(a simple step-by-step tutorial; see the extensive Manual.pdf for more features)*

First, if you haven't already downloaded the program, go to <https://engineering.purdue.edu/Stratigraphy/tscreator/index/index.php> (which mirrors to a server at Purdue University's College of Engineering) and install either the .exe (for Windows) or the .jar (JAVA for most platforms). If you have a problem with the program under Windows or Mac, then you may need to update or install its JAVA – see link on the download page of the website. **You need Java 8 to run TSCreator 7.1**

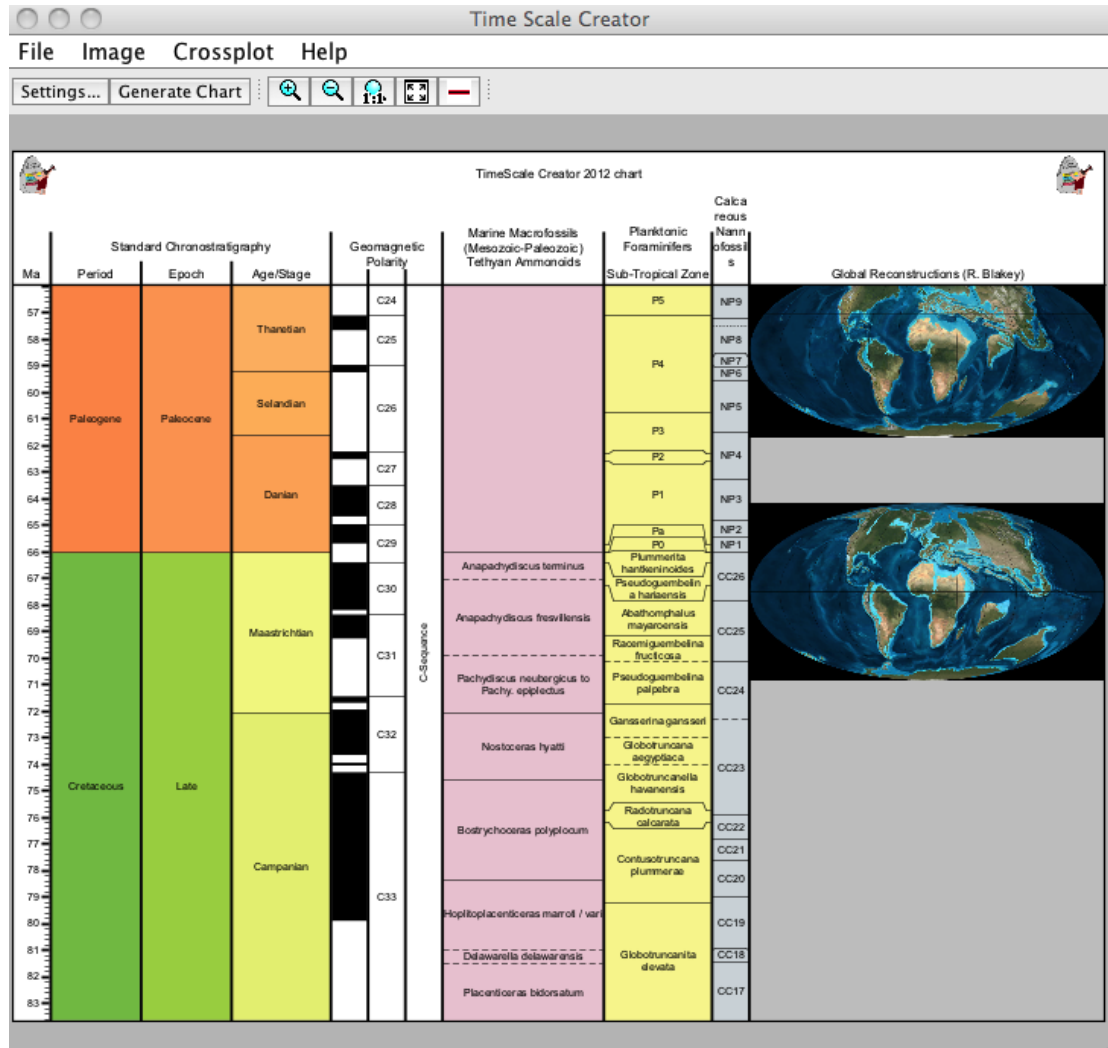
Tour #1 -- Default settings

- (1) **Begin** the program by double-clicking on the ***TS-Creator.jar*** or ***TS-Creator.exe*** icon.
- (2) **An opening screen window** with our data-providers appears, and the internal database is automatically loaded (~60,000 data lines of event-ages and curves). Stretch this window to fill your particular screen size, because this will determine the “fit to window” size of the output graphic display.

[NOTE: The default screen display is independent of the actual diagram, but you can rescale the image to actual size. The saved SVG graphics will be scaled according to the scales set by you, and will not be the sizing that you initially see on the screen.] Advanced users can go under the File-menu to append external databases or replace the default suite. We will give examples under the Part 2 (using “datapacks”) below.]

- (3) Click “**Generate**”. A message about “**Rendering**” should be displayed. The default run takes about 10 seconds. The image is a part of the Neogene (ca. 2 to 15 myr ago) with the initial default set of zonations – international divisions of geologic time, magnetic polarity chrons, major planktonic foraminifer and calcareous nannofossil zones and global reconstructions. This is just a sampling of the array of biologic, geochemical, sea-level, magnetic and other information that has been cross-calibrated by a generation of earth scientists. In the supporting databases (a separate array, with output that is mirrored in this software), the age of all these events are computed according to their observed or statistical occurrence relative to each other, to astronomical-climate cycles and to radiometric-age control. If one calibration is changed, or an age is updated, then all events that depend upon that calibration will also automatically adjust; therefore, new charts can be quickly produced. It is not real-time, yet – the relational databases do not directly feed into values within the visualization system – but this will come in the near future.
- (4) **Age-control:** Click the “**Settings**” button. This opens a new window. There are 4 tabs. Begin with “**Choose Time Interval**”. For your first adventure, set the “**Top of Interval**” as “**Thanetian**” stage (55.96 Ma at top), and the “**Base of Interval**” as “**Campanian**” stage (83.64 Ma at base). *[Notice that you can also designate the Top/Bottom of the interval in millions of years.]*

- (5) Click “**Generate**”. The image now includes ammonites zones of Tethyan Realm. For each time-interval within the Phanerozoic, the default-on sets generally include the primary biological reference scales.



Tour #2 -- User-selected stratigraphic columns and other options

Now, suppose we wish to plot planktonic foraminifer datums and named global sequences through the late Campanian through mid-Paleogene (75 Ma to 60 Ma).

- First, click the **Choose Columns** tab of the **Settings** window. The available stratigraphic columns are indicated. For now, we will turn OFF the Ammonite columns.
Open Marine Macrofossils (Mesozoic-Paleozoic). Then **open Ammonoids**.
The blue-box for *Tethyan Ammonoids* is checked “on” – Click this highlighted box to **OFF**.
- Close** the directory of *Marine Macrofossils (Mesozoic-Paleozoic)*; and **Open Standard Chronostratigraphy** (top of directory listing).
Click the box **ON** next to the *GSSPs* to activate that column. This will display which stages have international-ratified basal definitions or Global Stratotype Section and Points (“GSSP”). Close the directory.

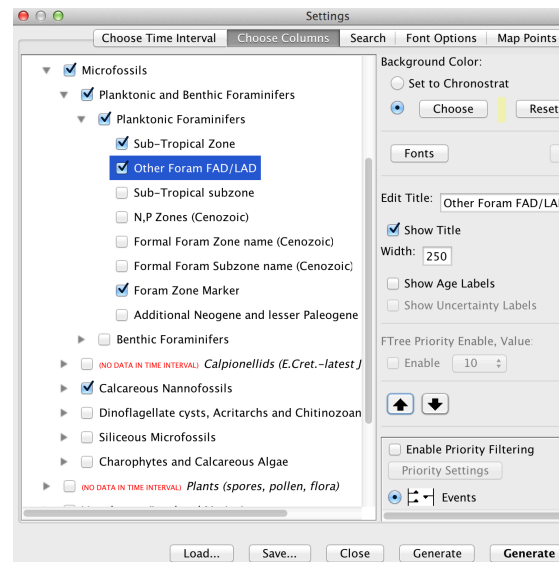
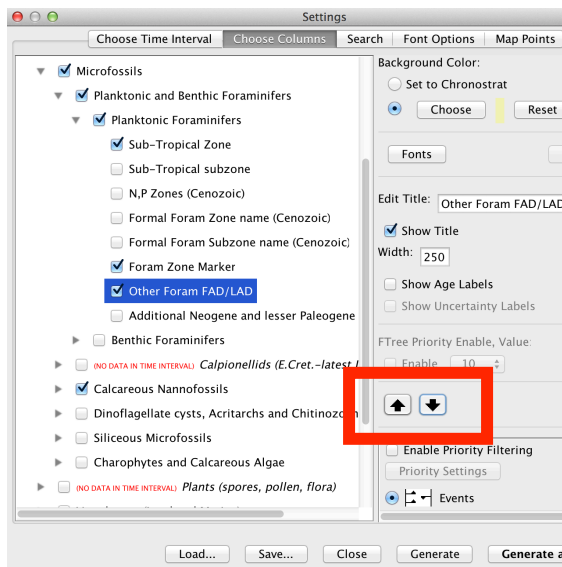
(3) Next, **open** the directory *Microfossils*, then the sub-directory *Planktonic and Benthic Foraminifers*, then sub-sub-directory *Planktonic Foraminifers*. Highlight the name *Planktonic Foraminifers*, and notice that the main selected sources of data appear in the lower-right box.

Click the boxes **ON** next to *Foram Zone Marker* and *Other Foram FAD/LAD*. Notice on our screen display that the column for *Sub-Tropical Zone* was too narrow to adequately display the full zone genera-species names.

Highlight the name *Sub-Tropical Zone* – a set of options appears on the right panel. In the middle is “Width”, which has a default of **120**. Change this to **150**, followed by a Return to activate that choice.

Notice that you can also change the title of the column (*by typing in that window*), font sizes, direction of labels, move the column relative to adjacent ones, change background color, show age-labels, and other options. We will explore these later.

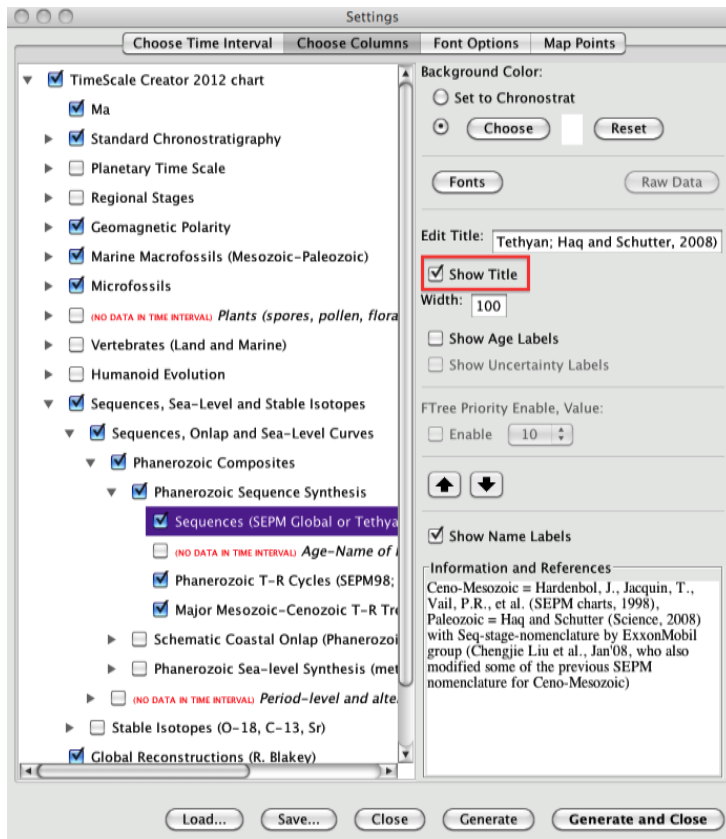
Let’s say you want the *Other Foram FAD/LAD* column next to the *Sub-Tropical Zone* column: Highlight *Other Foram FAD/LAD* and then move it upward with the arrows. You can move all the sub-directories up or down inside their directories.



(4) Similarly, turn **ON** *Sequences (SEPM Global or Tethyan; Haq and Schutter 2008)*, which are the major sea-level changes. This column is located in the
Sequences, Sea-Level and Stable Isotopes directory
Sequences, Onlap and Sea-level Curves sub-directory
Phanerozoic Composites sub-subdirectory
Phanerozoic Sequence Synthesis
Sequences (SEPM Global or Tethyan; Haq and Schutter 2008)

To avoid excessive column labels when we are displaying only a single column within a larger suite the “Show Title” box (middle of the right-hand menu of options) is unchecked in the upper 3 directories.

Highlight *Phanerozoic Sequence Synthesis* and see that the “Show Title” box is selected.



- (5) Now, we want to select the time interval and enlarge the vertical scale.
 Click the “**Choose Time Interval**” tab at TOP of Menu window. Click **ON** the *Millions of Years* option for the Top of Interval, and enter **60**.
 Then, click **ON** the *Millions of Years* option for the Base of Interval, and enter **75**.
 Set the underlying vertical scale to be **2** cm per 1 myr on printed page (rather than the default of 1 cm per myr).
- (6) Click **Generate**. Depending on your screen size, it will be possible to read the names of the different planktonic foraminifer species that appear or become extinct through this time interval.

-
- Foram Zone Marker**
- Globanomalina pseudomenardii*
- Igorina albeari*
- Morozovella angulata*, *Igorina pusilla*
- Praemurica uncinata*

Tour #3 – Pop-ups, Internet access, and selected display options

(1) **Hot-Mouse**

Now, return to the “**Choose Time Interval**” menu under **Settings**. At the bottom, click **ON** the **Add MouseOver info**. This will activate pop-up windows of additional information.

(2) Click the **Choose Columns** tab, and open the sub-directory with the *Sequences (SEPM Global or Tethyan)*.

Sequences, Sea-Level and Stable Isotopes directory

Sequences, Onlap and Sea-level Curves sub-directory

Phanerozoic Composites sub-subdirectory

Phanerozoic Sequence Synthesis

Sequences (SEPM Global or Tethyan; Haq and Schutter 2008)

Highlight the name “*Sequences (SEPM ...)*” to bring up options on the Right panel.

Click **ON** “**Show Age Labels**” (just below the *Width* box). **Generate**.

(3) Notice that all Sequence boundaries now have tiny age-labels next to the displayed names. One can display such ages for any selected zone or datum columns.

Move your Mouse-pointer over Sequence boundary “Ma5”. As you put the Mouse-pointer over the name “Ma5”, notice a red rectangle. Click directly on the text “Ma5”, and a window will appear with information on the calibration of this sequence boundary.

Now, move the Mouse-pointer over the column title “*Sequences (SEPM Global or Tethyan)*”, and a new pop-up window appears with the source of information. This “MouseOver” option is currently installed for all Column headers (either major or minor), Sequence boundaries, and most of the Planktonic Foraminifer and Calcareous Nannofossil zones and datums. Eventually, we will try to provide such background information and hot-links for the other thousands of items.

(4) **Internet links** – Move your Mouse-pointer over the title “**Standard Chronostratigraphy**”. A red rectangle appears. Click on the title, and another window will appear that says:

“[International Commission on Stratigraphy [ICS](#). Click [Geol. TimeScale Foundation GSSP](#) for boundary (GSSP) definitions, status and nomenclature.]”

Click on the active-phrase “**Geol. TimeScale Foundation GSSP**”. Your default browser will be activated and an Internet site will be opened that has tables of the definitions of all international divisions of the geologic time scale (middle of the orange-background top menu).

Now, back to the **TimeScale Creator** display -- click on the GSSP arrow next to the base of the Maastrichtian Stage. Another window will open, which says “[The base of the Maastrichtian Stage [click **GSSP** for graphics] is defined ...]”. When you click on that **GSSP**, then an Internet site will open with a description and links to location map and outcrop graphics. You can click on the thumbnail (upper-right) to see a summary graphic of that GSSP.

(5) **Saving Display Parameters** -- If you create a screen display that you like, then under *Settings*, there are bottom-buttons that enable you to **SAVE ...** a "*Settings file*" that contains most of the necessary instructions for your current TimeScale Creator chart, or to **LOAD ...** an earlier one to re-generate that same graphic for an audience or for additional revisions. If you are working on a major diagram, then we suggest using this feature to periodically save intermediate graphics, just in case the operating system has problems.

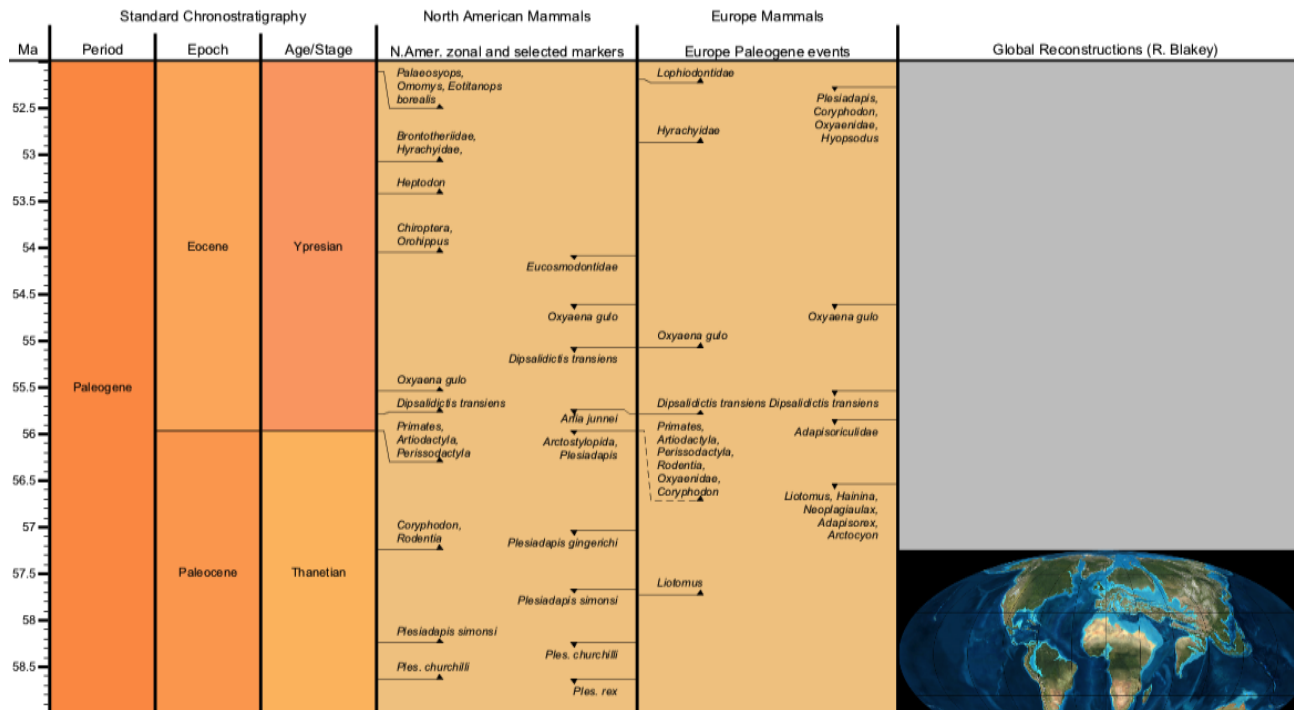
Exercise – Global Warming

Under FILE (top-left of menu bar); click “Replace Data with Default Datapack”. This will clear all your settings.

Set up a diagram with the following: **Age** (use manual entry, and be sure to click that option) = (52 Ma top) to (59 base); **vertical scale** = 3; **Geomagnetic Polarity** – turn OFF; **Microfossils** – turn OFF.

Under “*Vertebrates (Land and Marine)*”, turn ON ***Mammals***, then **open** the appropriate subdirectories to turn ON ***N.Amer. zonal and selected markers*** (only, turn off the other sub-columns), **and**, under Europe, turn on ONLY the ***Europe Paleogene events***; and turn **OFF** all other Mammal columns.

Generate.



- (2) Under both North America and Europe Mammals, you will see that the first appearance of **Primates** (early apes) occurred near the base of the Eocene epoch.

Earlier in North America (57.2 Ma), you see that **Coryphodon** (browsers that looked like a hippopotamus) and **Rodentia** (the family of mice and rabbits) appeared; but in the Europe column, these did not appear until the same time as Primates.

Look closely at the reconstruction. The only way for animals to walk between North America and Europe was via land bridges from Asia to each continent in the latitudes of the Arctic-circle. Hippopotamus-like animals could not survive such Arctic temperatures IF it was a world like today. Plus, there is the appearance of Primates -- Primates in the Paleocene-Eocene, like their relatives today, are tropical creatures. These Primates could not thrive in North America and Europe if the climate was like today (*until their human descendents arrived with warm clothing*).

Let us investigate this question: ***What enabled these appearances of American-mammals (Coryphodon, Rodentia) within Europe at the beginning of the Eocene, and the ability of Primates to thrive on both continents?***

- (3) Let's look at climate indicators. First, to save space, turn OFF **Global reconstructions**, but remember what that diagram told us.

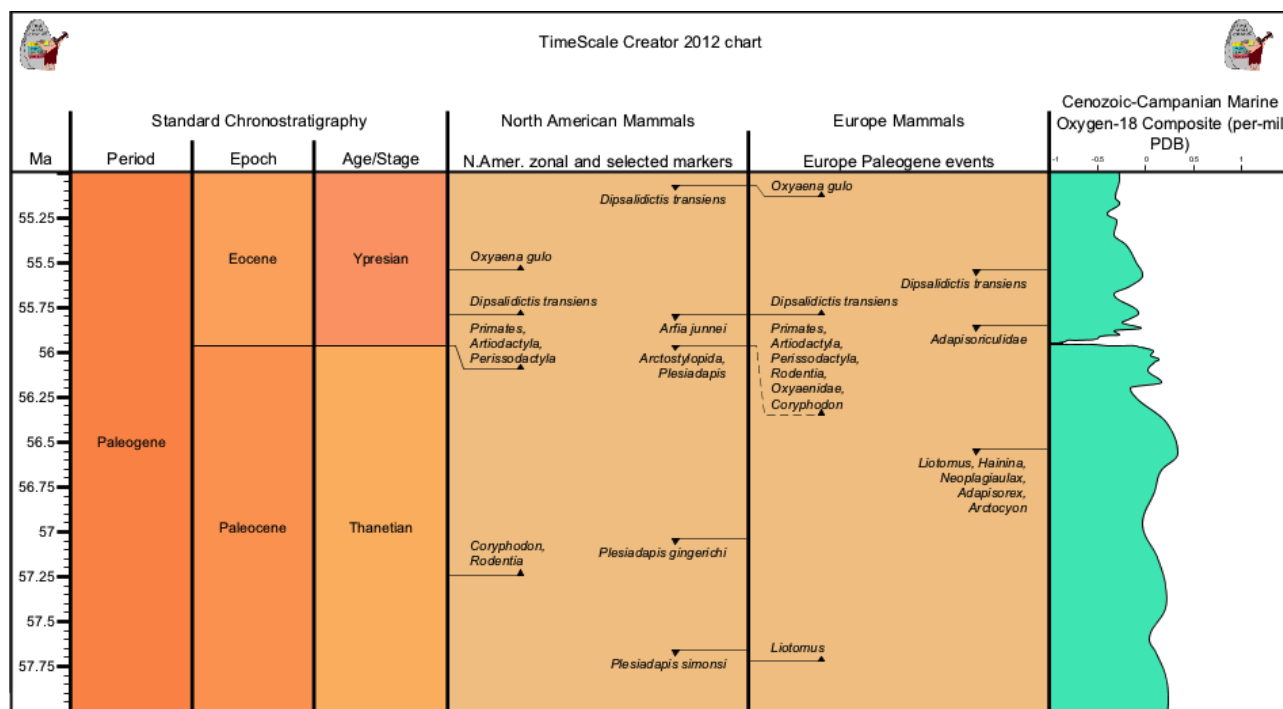
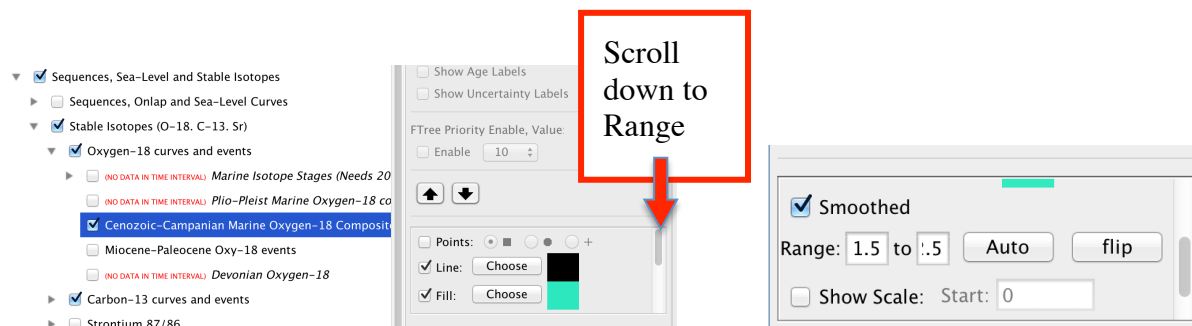
Make the Time Settings to be **55 to 58 Ma**; and Vertical Scale as **5**.

Under **Sequences ...**, turn OFF **Sequences, Onlap and Sea-level Curves**, turn **ON Stable Isotopes**, open this sub-directory and **Oxygen-18 curves and events**, and be sure that the **Cenozoic-Campanian Marine Oxygen-18 Composite** column is ON.

Highlight the name **Cenozoic Campanian Marine Oxygen-18 Composite** to bring up the menu of display options.

Scroll down and Change the **Range** (currently -1.5 to 2.5) to be (-1.0 to 1.5); and click **Show Scale** (and make Step as 0.5). To enlarge the scale, click the **FONT button**, and change the 6 to an **8**.

Generate.



Oxygen-18 is a monitor of deep-sea temperatures, and helps indicate the temperatures in high-latitudes where these deep waters form. In an Antarctic-ice-cap-free world (which was the Eocene situation), an Oxy-18 value of “0” corresponds to a temperature of about 10°C, and a value of “1” is about 6°C.

To help you see these temperature trends more clearly we will underlay the Oxy-18 plot with a gradient background.

Go back to **Settings** and **Highlight** the name *Cenozoic Campanian Marine Oxygen-18 Composite* again. Now turn off the **Fill** button in the menu and scroll down to select **BgrndGrad** (Background Gradient) and choose a color for the left side (warmer side) of the plot. Then do the same for the right side (colder side).

▼ ☒ Sequences, Sea-Level and Stable Isotopes

▶ ☐ Sequences, Onlap and Sea-Level Curves

▼ ☒ Stable Isotopes (O-18, C-13, Sr)

▼ ☒ Oxygen-18 curves and events

☐ (NO DATA IN TIME INTERVAL) Plio-Pleist Marine Oxygen-18 cor.

☒ Cenozoic-Campanian Marine Oxygen-18 Composite

▶ ☐ (NO DATA IN TIME INTERVAL) Marine Isotope Stages (Needs 20 i

☐ Miocene-Paleocene Oxy-18 events

▶ ☒ (NO DATA IN TIME INTERVAL) Paleozoic-Mesozoic Oxygen-18 a

▶ ☒ (NO DATA IN TIME INTERVAL) Ordov-Silur-Devon and Triassic c

☒ (NO DATA IN TIME INTERVAL) Cryogenian-Ediacaran Glaciations

☒ (NO DATA IN TIME INTERVAL) Precambrian Oxygen & Banded Iro

▶ ☐ Carbon-13 curves and events

Row Shift:

☒ Smoothed

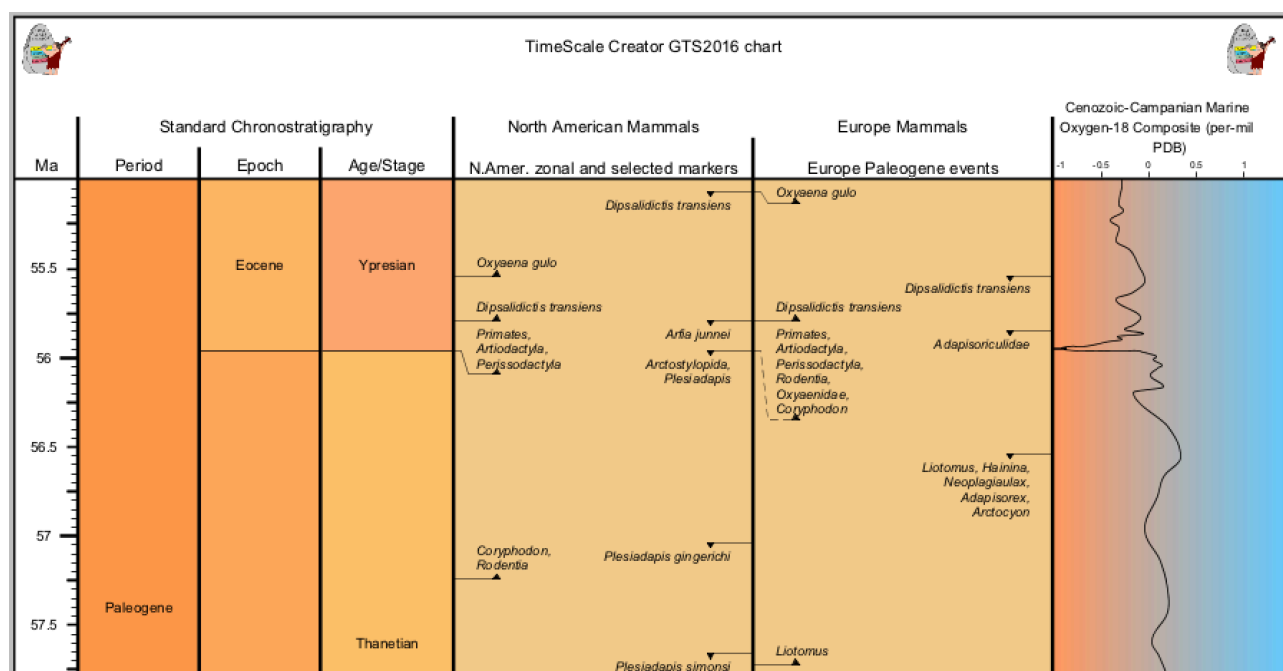
☒ BgrndGrad:

☐ CurveGrad:

Information and References

Derived from Cramer (2009) -- See Saltzman and Thomas (GTS2012 Carbon-isotope chapter); but only every 10th item from 9-point averaging of Benthic foraminifer compilation (29000 data points in original) is shown here; NOTE: Cramer had two sets -- original and "adjusted" (which removed many of the original)

Hit **generate** and you should get the following chart:



(4) This is interesting. Think about the plot, and answer the following:

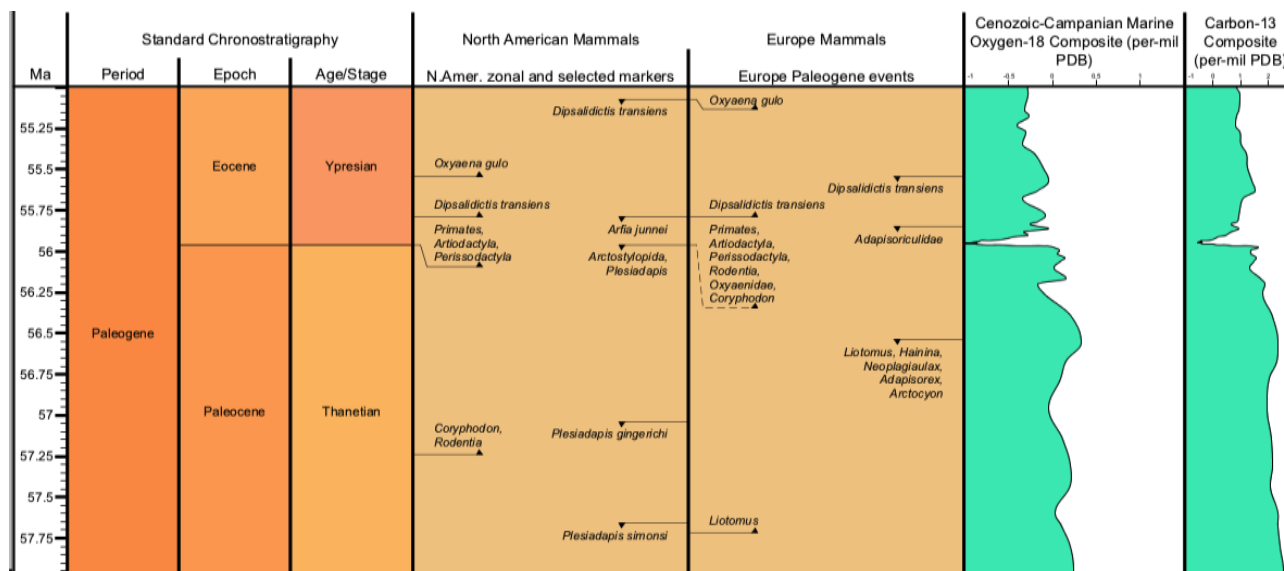
- *What was the general temperature trend of deep-waters from 58 million-years-ago until the base of the Eocene?*
- *What happened to bottom-water temperature at the time that Primates appeared in North America and Europe?*
- *What does this imply about the changing climate at that time?*

(5) Now, what may have caused this?

Under **Sequences** ..., then under **Stable Isotopes** --> **Carbon-13 curves and events**, turn **ON** the **Cenozoic-Mesozoic Marine Carbon-13 Composite**.

As we did with Oxygen, highlight the name *Cenozoic Marine Carbon-13 Composite* to bring up the menu of display options. Change the Range to be (-1 to 3); Show Scale (and make Step as 1). Turn OFF *Carbon-13 and Anoxic Events*.

Generate.



(6) Carbon-13 of organic matter is Negative, because life prefers to use Carbon-12. This is also true for coal and oil, which are derived from organic matter. Therefore, if the global-ocean becomes more “negative”, then it means that the organic carbon is being recycled back into the Earth system (especially the atmosphere) or that another source (volcanic eruption gases and/or methane) is pumping new “light” carbon into the atmosphere/ocean. A negative shift in the Carbon-13 value by 1 is nearly equivalent to doubling the Earth’s carbon-dioxide through release of stored organic-carbon.

- *Therefore, when you look at both the carbon and oxygen, what might have happened at the base of Eocene?*
- *What were the implications for mammals on the continents of North America and Europe? Think about those “normally cold” high-latitude land bridges.*
- *This event marked the emergence of modern mammals. Given that coincidence, then what might happen with future global warming?*

(7) **Possible contributing cause.**

The bottom directory in *Choose Columns* menu is *Impacts, Volcanism, Tectonics*. Turn it ON; then open it to turn **OFF** *Impacts* and **ON** *Large Igneous Provinces*.

Under the *Choose Time Interval* menu, turn **ON** *Add MouseOver info (popups)*.

Generate

This episode is known as the “**Thermal Maximum**” of the past 70 million years. The reasons for the ultra-high greenhouse and carbon-release are still debated, it appears that a phase of the massive volcanic event “North Atlantic Volcanic Province” that began at the Iceland volcanic center and released carbon-dioxide was one of the initial triggers. As the ocean began to warm, the warmer deep waters may have de-stabilized methane hydrates (which have *very negative* carbon-13 values) in the sediments, and the potent methane greenhouse gas accelerated the warming feedback. This is explored if you click the pop-up, then its link to “LIP of the Month 08aug” at Largeigneousprovinces.org.

Tour #4 – Obtaining ages of events and using SEARCH

There are three ways in TSCreator to obtain the numerical age of events, zones or other items. For this exercise, we will use the Tethyan calcareous nannofossil, *Tribrachiatulus orthostylus*, which has a short range in the Ypresian stage of early Eocene. Our question is what is the age of its first-appearance datum (FAD) and last-appearance datum (LAD).

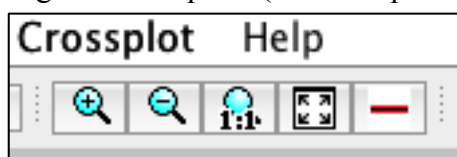
(1) Using horizontal guide line

Reset the TSCreator display using “**Replace Data with Default Datapack**” under the File menu (under left button on uppermost menu bar). Select a time interval that is only **Ypresian** (base to top) with a vertical scale of 3. Use “**Add MouseOver**” option.

Turn on the **Tethyan Nanno Zone Marker** column (under Microfossils). Generate.

The LAD of *Tribrachiatulus orthostylus* is the defining event for the NP12/NP13 zonal boundary, and its FAD occurs in the upper part of NP10.

Turn on the RED guide line option (icon at top of display):

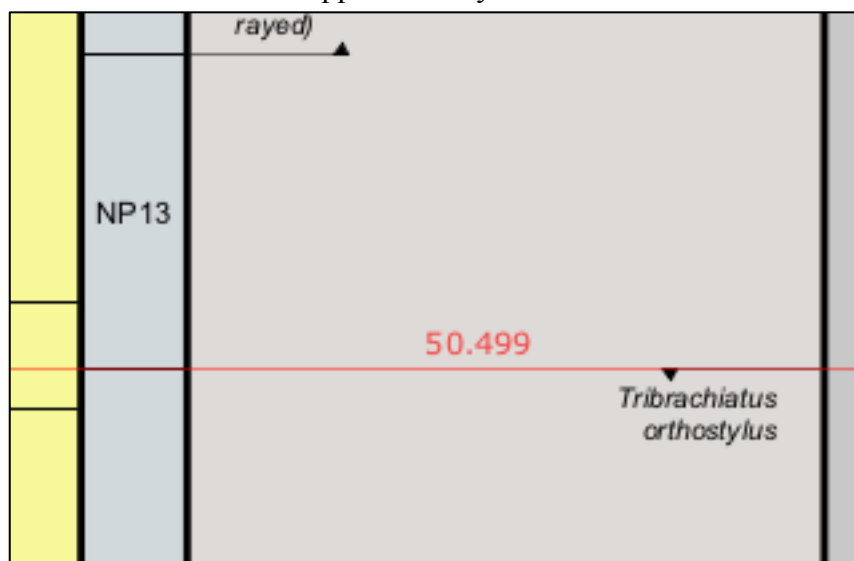


This activates the guide line, until the red-icon is again clicked off.

Position the line over the LAD. The age of the line position is displayed in Red-font to 3-decimals; but the ability to move this line is constrained by the pixels of your screen display.

NOTE: A single-click when the red-line is activated will LOCK that line, until clicked again. This is useful when having zoomed into a large diagram and you wish to see what other events are coeval – lock the red-line and move the diagram sideways with the scroll bars.

We see that the LAD is approximately 50.50 Ma:



Do the same for the FAD of *Tribrachiatulus orthostylus*. It is about 54.4 Ma.

You can click on the taxa name to get a popup explaining some of the published calibration logic. At the bottom of each popup is a hot-link to Nannotax (Univ. London) that provides details and images for the selected fossil.

(2) Using “show ages” display

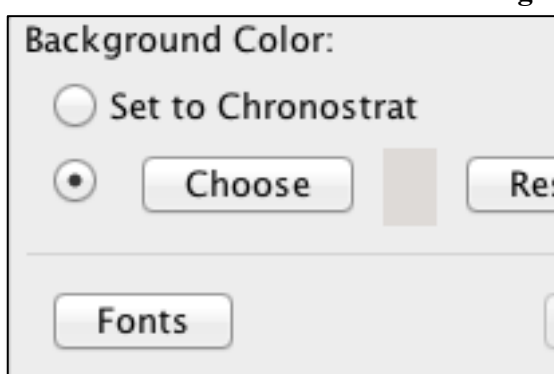
Turn off the red-line option.

You already did this “show ages” briefly for Sequences, but we now wish to apply it to our particular fossil.

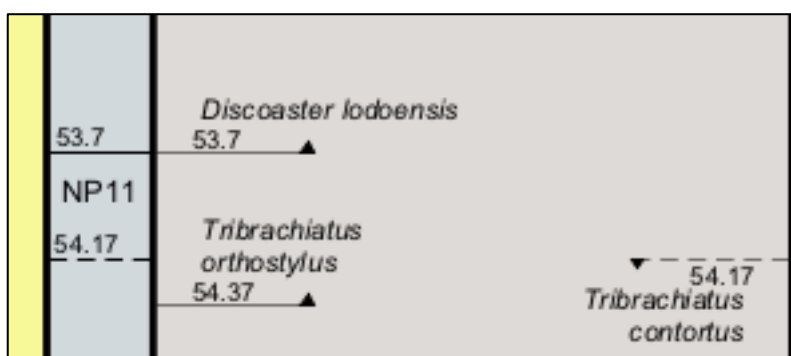
In the settings menu, highlight the *Tethyan Nanno Zone Marker* column. In the column-option menu to the right, click ON “Show Age Labels”. Do the same for the *NN,NP,CC,NJT,NT Zone* column. Generate.

The display now has small numerical ages attached to each nannofossil FAD/LAD and your NP zones.

The default font is small to avoid clutter, but let’s now make these numerical ages larger. Back to the Settings, and highlight the *Tethyan Nanno Zone Marker* column again. Click the “Fonts” button that is below the **Background Color** at top of right menu:



Activate the “Age Label:” option set which currently has Arial 6 as the font. Increase this to Arial 10. Do the same for the NP column. Generate, and the numerical age labels are now easier to read:



The ages in this option are displayed as 2-decimals. You also have options to make these in a different color.

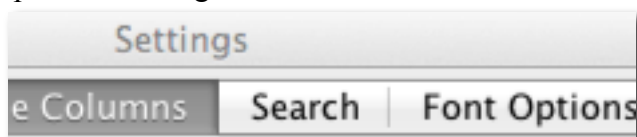
So, from this method, what are the FAD/LAD ages for *Tribrachiatum orthostylus*?

NOTE: You can also use the “Font Options” at the top of Settings menu to set a default for the Age Labels of all columns at once, however if you’ve set these for an individual column (as we just did) then your column-setting overrides the general default.

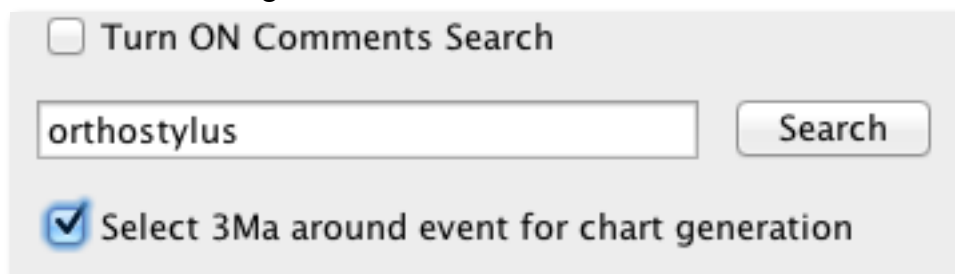
NOW, do a Reset using “**Replace Data with Default Datapack**” followed by Generate to make the default chart. We’ll now look at a very elegant method.

(3) Using SEARCH (TSCreator Pro version only)

At the top of the Settings menu is a Search button:



Open Search, and we'll input the last name of our nannofossil, plus turn **ON** the "Select 3Ma around event for chart generation":



Tap "Search" button, and you receive (1) full name of the taxa and type of column in which it is found (e.g., *Tribrachiatus orthostylus* was found only in an Event column in our case), (2) The partial name of that column (e.g., Tethyan Nanno Zone markers – but only the first part is shown), (3) the numerical Age, (4) the type of event (LAD/FAD, etc.), and the option to see the popup for this item.

This immediately gives us our desired age information without needing to find the items in the chart.

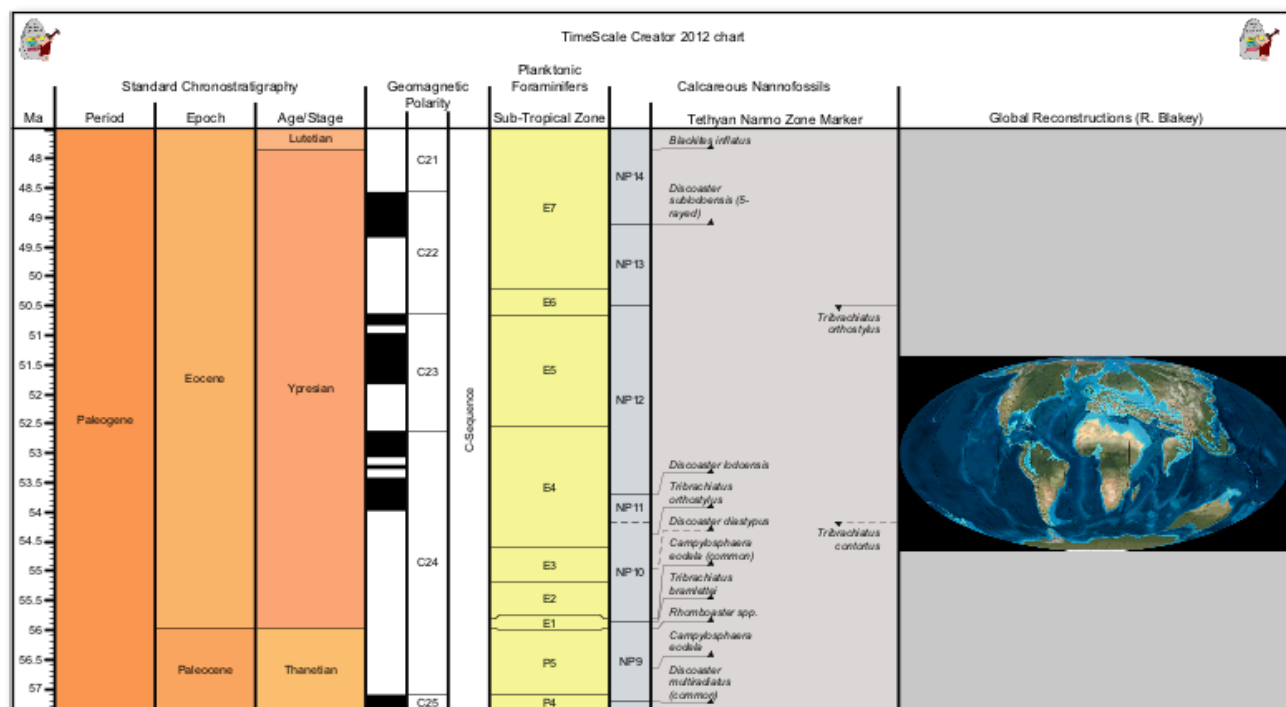
However, we can also generate a custom chart that shows these "in context" with 3 myr added to the top/bottom limits.

Click **ON** "Add to Chart" for the LAD and the FAD of our fossil:

| Tribrachiatus orthostylus – Event | | | | |
|-------------------------------------|----------------------|-------|-----------|---------------------------------|
| Add To Chart | ColumnPath | Age | Qualifier | More Info. |
| <input checked="" type="checkbox"/> | Tethyan Nanno Zon... | 50.5 | LAD | Additional Info |
| <input checked="" type="checkbox"/> | Tethyan Nanno Zon... | 54.37 | FAD | Additional Info |

Click Generate, and voila!

The Search has automatically turned on the Tethyan Nanno Zone Marker column, set the age span as 3 myr above the LAD of *Tribrachiatus orthostylus* to 3 myr below its FAD and made the scale as 2 cm/myr.



Other Search options

You can use “*” as wild characters to search for all names of events, zones, etc. that have that partial string.

Prof. Dr. Hans **Gocht** at University of Tübingen was an expert on dinocysts, and some were named after him. Input “**Gocht***” (with asterix at end) into the Search. Hit Search.

In this case, the search returns species (e.g., *Wetzeliiella gochtii*) and genera (e.g., *Gochteodinia*) in different columns. Use the scroll-bar on the right to see the other entries.

Let’s see what one of these look like.

At the top, for *Wetzeliiella gochtii*, click the “Additional Info” button.

Additional Info

Additional Info

Additional Info

Additional Info

Comments – *Wetzeliiella gochtii*

Priority(10=Highest) = 10; Comments: [For details click [Wetzeliiella gochtii](#)]. CALIBRATION = Base of N22 on GTS04 diagram. Pre-2012 TSC version of GTS04 = 1/8th up in Chron C12r (or Base of Nanno Zone NP22)

This returns “Priority” (an option in datapacks for avoiding cluttered displays, which will be explained briefly in the presentation; and the default is “10”), and the Comments associated with this fossil and its calibration. Click the [Wetzeliiella gochtii](#) hot-link, and **Dinoflag** will open in a browser to provide a drawn image of this dinocyst:

