TimeScale Creator Manual
Section 2

Hands-on Exercises for TSCreator and how to make Datapacks

www.timescalecreator.org

This Manual is divided into 5 sections, each section is independent of the others and can be used on its own.

Section 1: Reference of TSCreator Features and Datapack Formats
Section 2: Hands-on Exercises for using TSCreator and how to make datapacks
Section 3: TSC Makers: Online tools to create lithology, transect and curve datapacks.
Section 4: Crossplot, convert outcrop or well datapacks from meters or feet to age datapacks in Ma or Ka.
Section 5: Online TSCreator display systems. Not yet fully functional.

Important websites for TimeScale Creator

TSCreator main website   https://timescalecreator.org

Datapack Makers (Transect, Lithology, Curve Maker)

https://timescalecreator.org/tscmaker/

TSC Lite

https://timescalecreator.org/tsclite/index/index.php

Online TimeScale Creator (testing site):

http://show.timescalecreator.com:3000/

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https://timescalecreator.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, evolutionary trees, 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 50,000 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 "A Concise Geologic Time Scale 2016" by J.G. Ogg, G.M. Ogg and F.M. Gradstein (Elsevier, 2016). 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. 1 hour)
(2) Examples of datapacks with additional features (evolution, map-interfaces, etc.) (ca. 1 hour)
(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) (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 *http://timescalecreator.org* 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 JAVA – see link on the download page of the website. You need Java 8 to run TSCreator 7.3

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 (or 5 tabs in the Pro version). 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 (84.19 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.
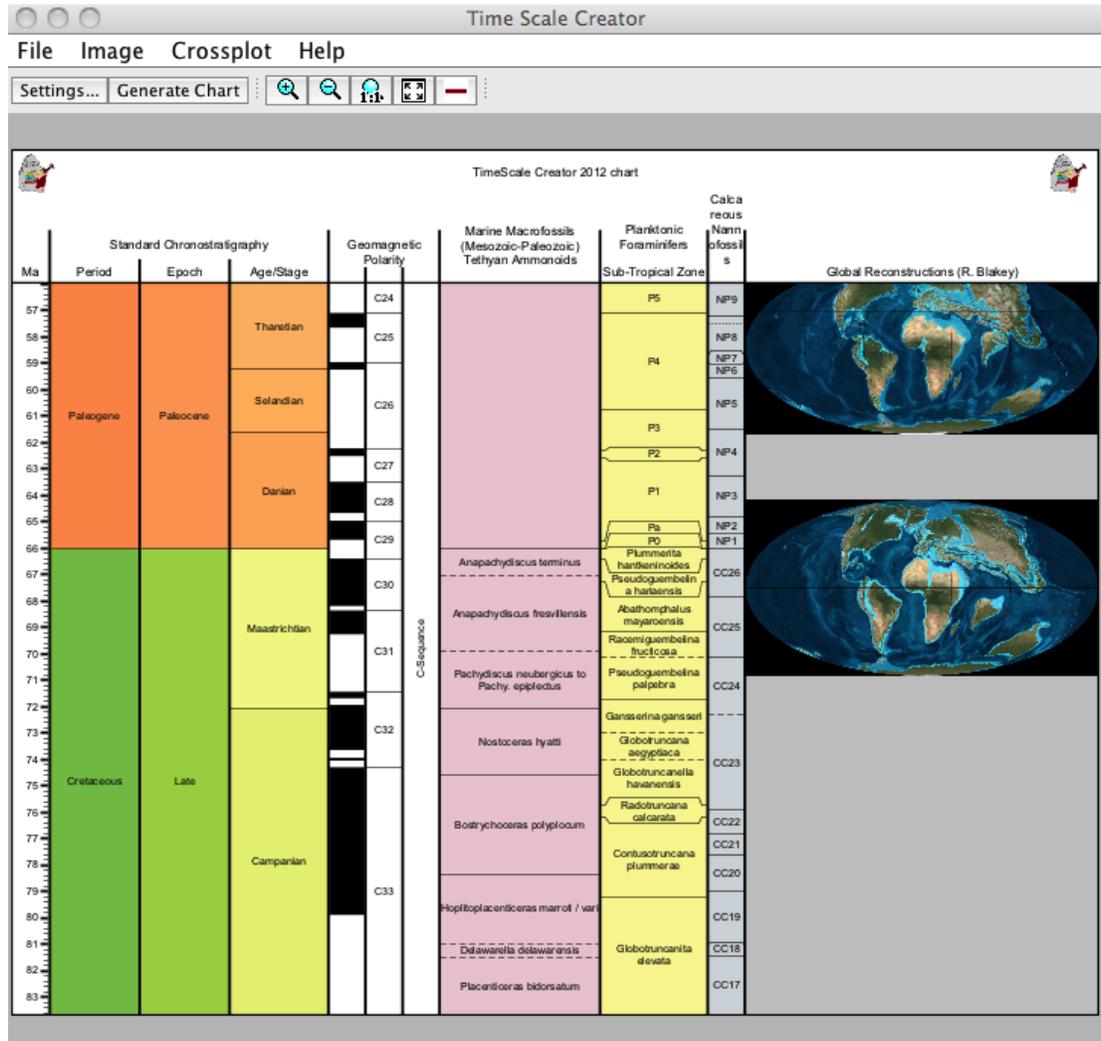
Tour #2 -- User-selected stratigraphic columns and other options

Now, suppose we wish to plot planktonic foraminifer datums and named global sequences through the late Campanian through mid-Paleogene[choose 75 Ma (Base) to 60 Ma (Top) for the time interval].

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(1) 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**.

(2) **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.
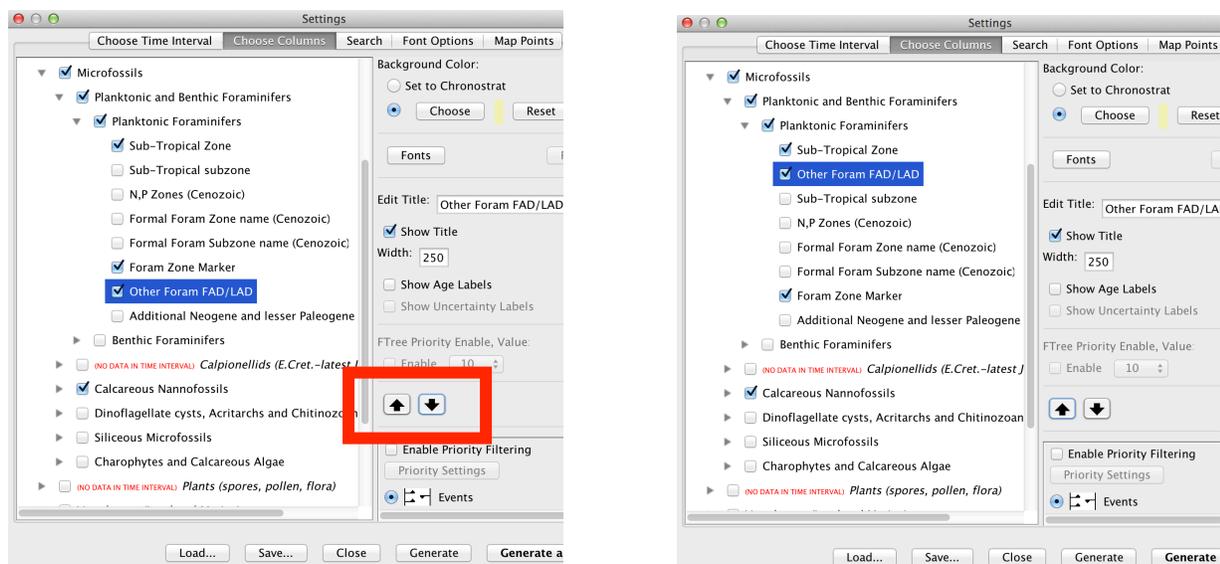
(4) Similarly, turn **ON** *Sequences (Global or Tethyan)*, which are the major sea-level changes. This column is located in the

Sequences, Sea-Level and Stable Isotopes directory
  Sequences, Onlap and Sea-level Curves sub-directory
    Phanerozoic Composites sub-subdirectory
      Phanerozoic Sequence Synthesis
        Sequences (Global or Tethyan)

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.
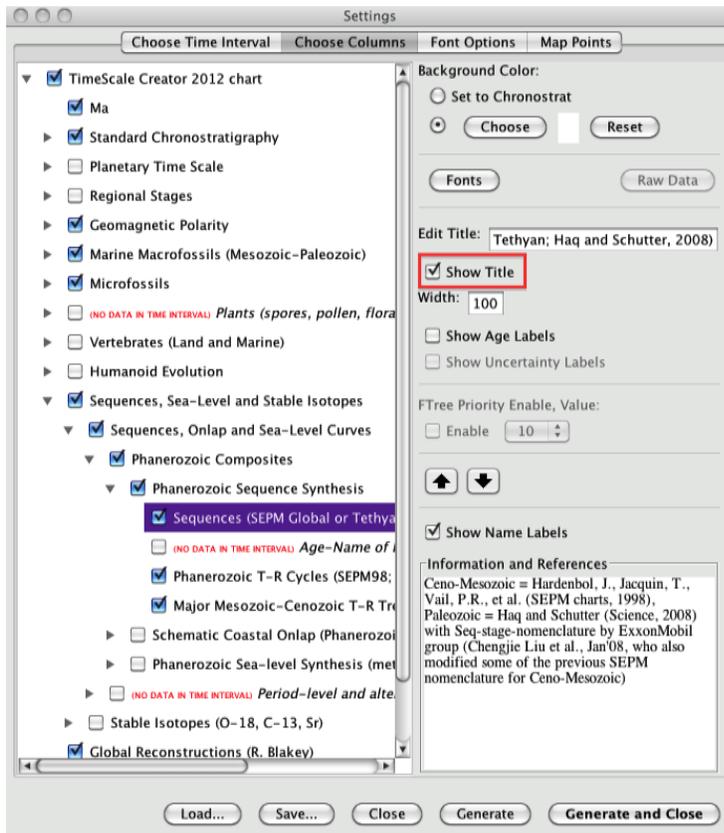
(5) Now, we want to select the time interval and enlarge the vertical scale.
   Click the "***Choose Time Interval***" tab at TOP of Menu window. Click **ON** the *Millions of Years* option for the Top of Interval, and enter **60**.
   Then, click ON the *Millions of Years* option for the Base of Interval, 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.
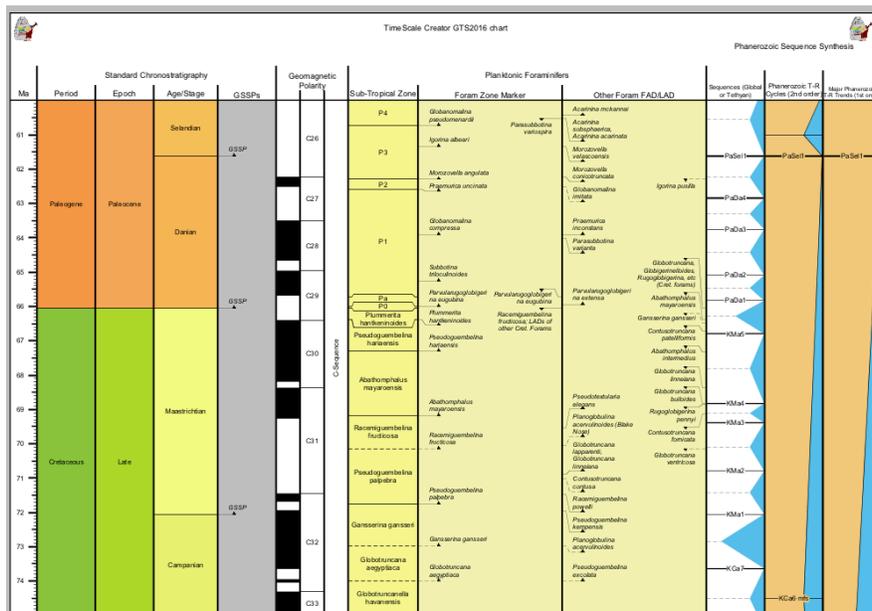
(7) To see this information easier, you can either use the Magnifying or Reducing icons on the upper menu, or use a bit of magic – While continuously pressing down the CONTROL key on the keyboard, hold down the left-button on the Mouse (on Mac; on some Window's versions, it is the right-button) and sweep over the region that you wish to display on the screen. You can use the side-bars on the display to pan over the magnified image. To return to the full display, either use the Reducing or 1:1 icon or fill-screen (right-icon of the box with arrows) as needed.

Zoom Buttons:
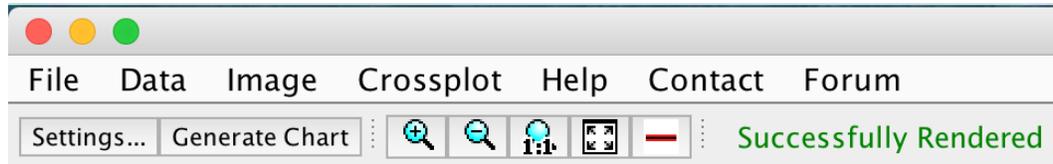
Example of an enlarged Area:
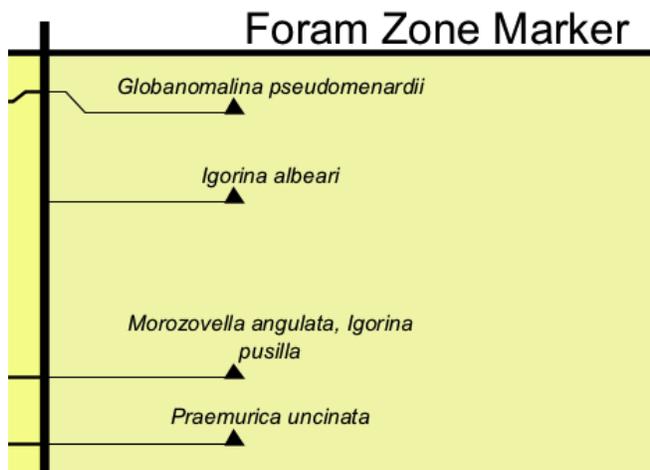
If you changed some settings after zooming in to a specific part of the chart, "generate chart" will automatically bring you back to that magnified spot. This is especially useful when having zoomed-in on an evolutionary branch, then clicking a branch on/off.

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

(1) **Hot-Mouse**
    Now, return to the "***Choose Time Interval***" menu under ***Settings***. In the lower part, 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 (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 (Global or Tethyan)

    Highlight the name "*Sequences (Global…)*" 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 "KMa5". As you put the Mouse-pointer
    over the name "KMa5", notice a red rectangle. Click directly on the text "KMa5", and a
    window will appear with information on the calibration of this sequence boundary.
    Now, move the Mouse-pointer over the column title "*Sequences (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.
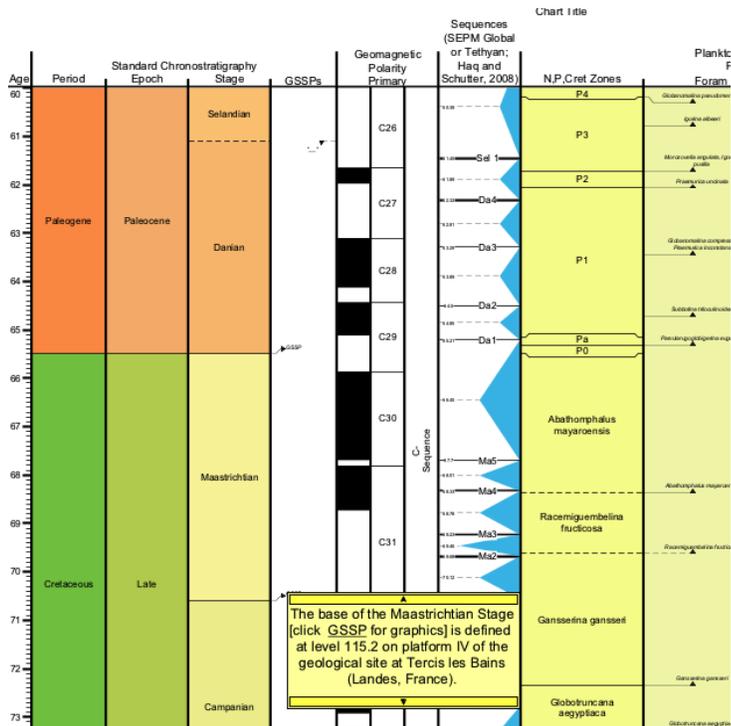
We will see even more of how this system acts as a gateway to other data stored around the world in
Part 2 of our suite of tours.

(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.

Details on the many other capabilities and display options are illustrated under "Features" in
the Help menu (main window).

Exercise – Global Warming

(1) **Resetting display; then focus on Paleocene/Eocene boundary interval**
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.

Ma	Period	Epoch	Age/Stage	N.Amer. zonal and selected markers	Europe Paleogene events	Global Reconstructions (R. Blakey)

Standard Chronostratigraphy / North American Mammals / Europe Mammals
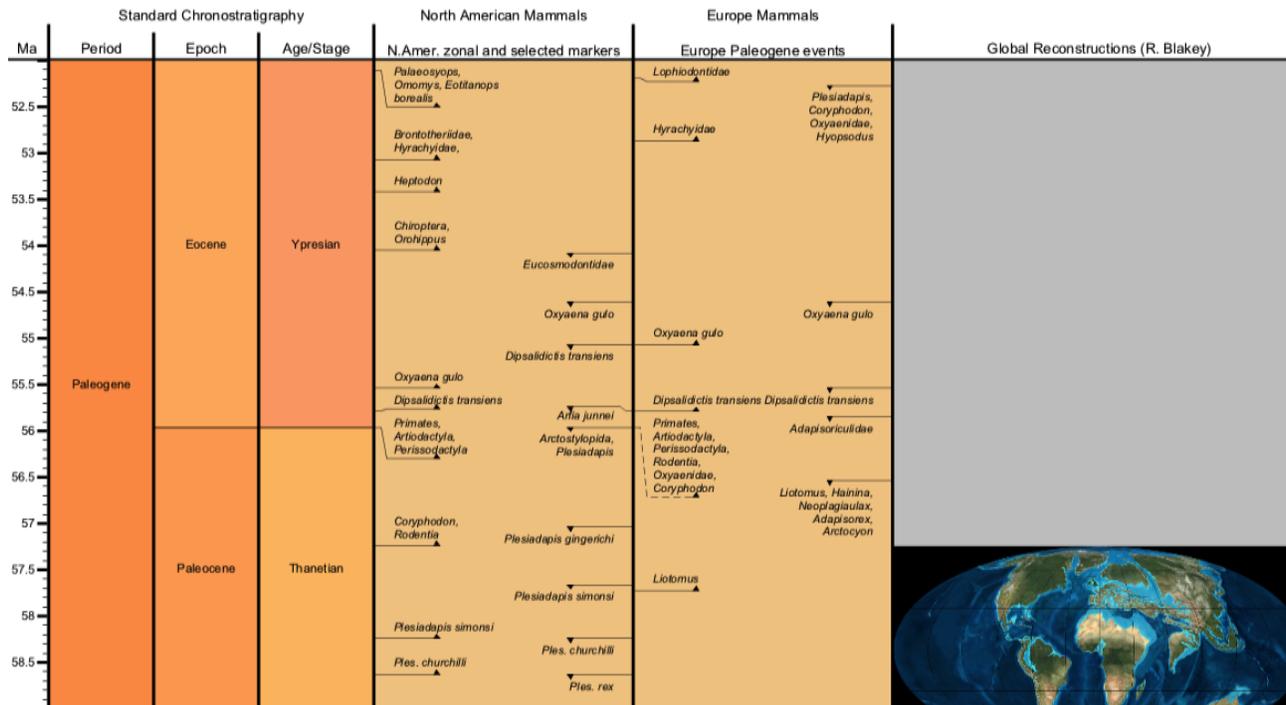
(2) Under both North America and Europe Mammals, you will see that the first appearance of
Primates (early apes) occurred near the base of the Eocene epoch.
Earlier in North America (57.2 Ma), you see that ***Coryphodon*** (browsers that looked like a
hippopotamus) and **Rodentia** (the family of mice and squirrels) appeared; <u>but</u> 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 <u>*Cenozoic Campanian Marine Oxygen-18 Composite*</u> 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 "Point Column Scale Label" from **6** to an **8**.
Generate.
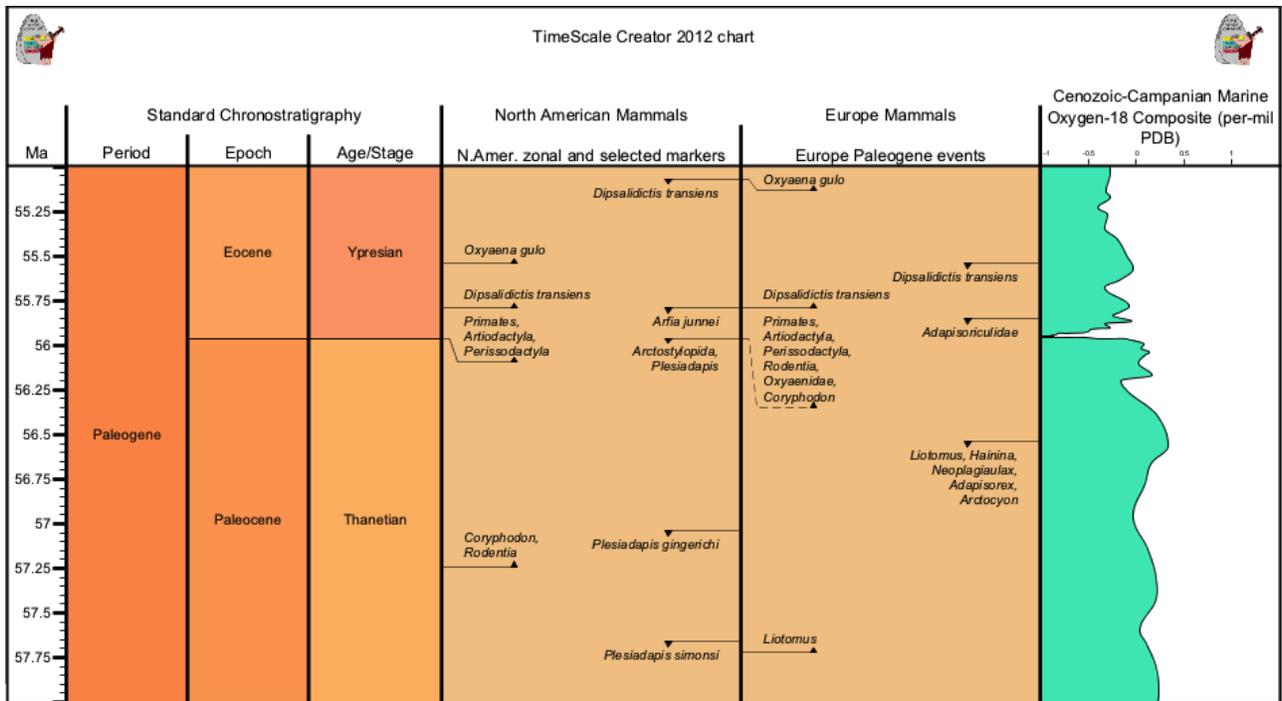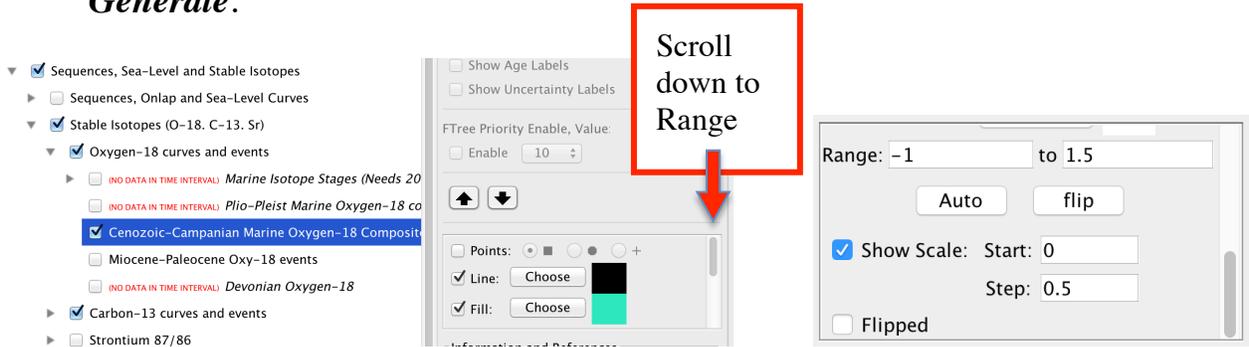
Oxygen-18 is a monitor of deep-sea temperatures, and helps indicate the temperatures in high-latitudes where these deep waters form. In an Antarctic-ice-cap-free world (which was the Eocene situation), an Oxy-18 value of "**0**" corresponds to a temperature of about 10°C, and a value of "**1**" is about 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).

Hit **generate** and you should get the following chart:
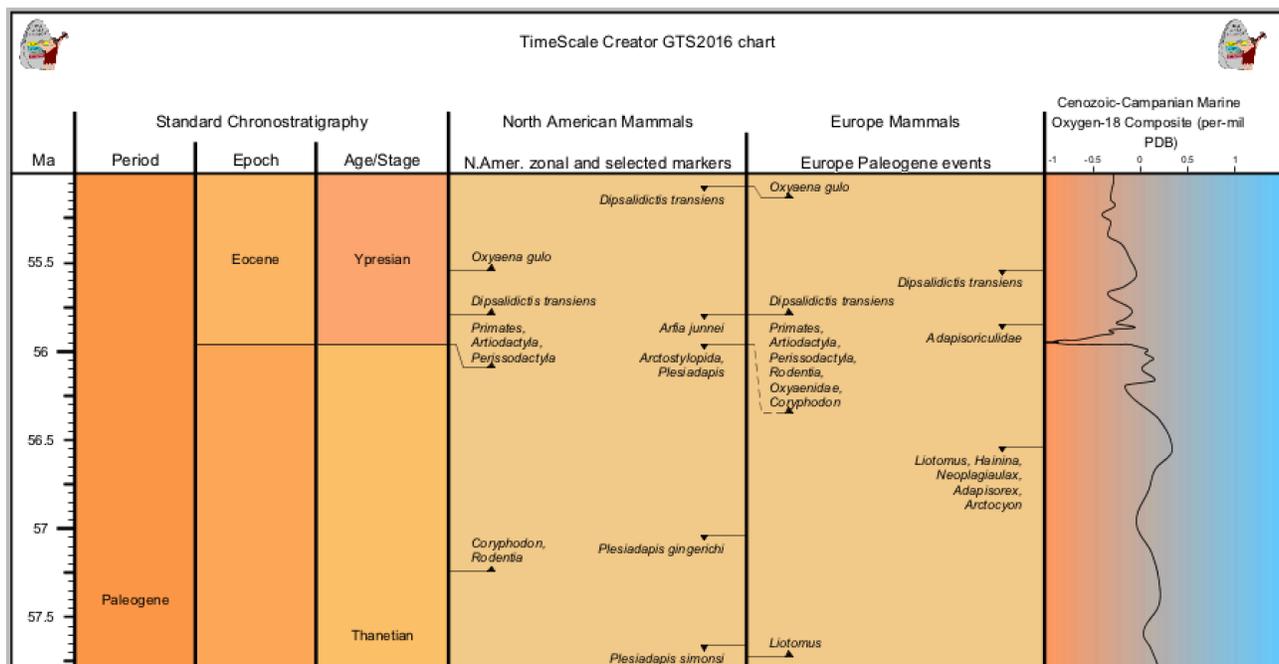
(4) This is interesting. Think about the plot, and answer the following:
- ***What was the general temperature trend of deep-waters from 58 million-years-ago until the base of the Eocene?***
- ***What happened to bottom-water temperature at the time that Primates appeared in North America and Europe?***
- ***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 ***Phanerozoic-Proterozoic Carbon-13 Composite***.

As we did with Oxygen, highlight the name *Phanerozoic-Proterozoic Carbon-13 Composite* to bring up the menu of display options. Change the Range to be (**-1** to **3**); turn on Show Scale (and make Step as **1**). Turn <u>OFF</u> *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 Large igneous provinces.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, *Tribrachiatus 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 *Tribrachiatus 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:
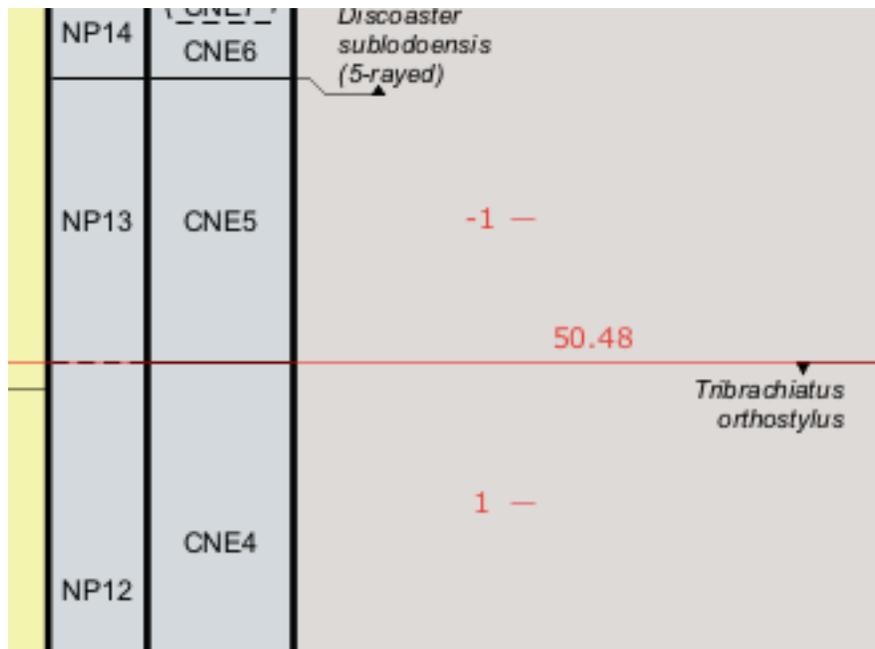
Do the same for the FAD of *Tribrachiatus orthostylus*. It is about 50.4 Ma.

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 Microtax (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:
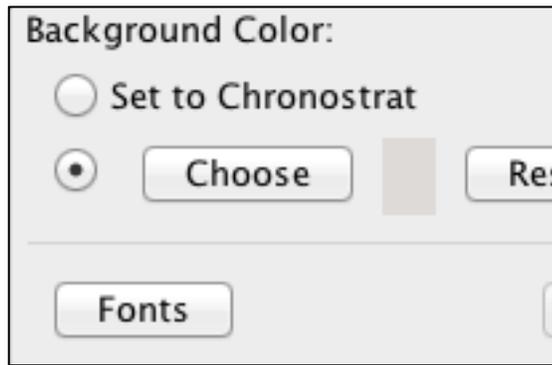
Activate the "Age Label:" option set which currently has Arial 6 as the font. Increase this to Arial 10. Do the same for the NP column. Generate, and the numerical age labels are now easier to read:
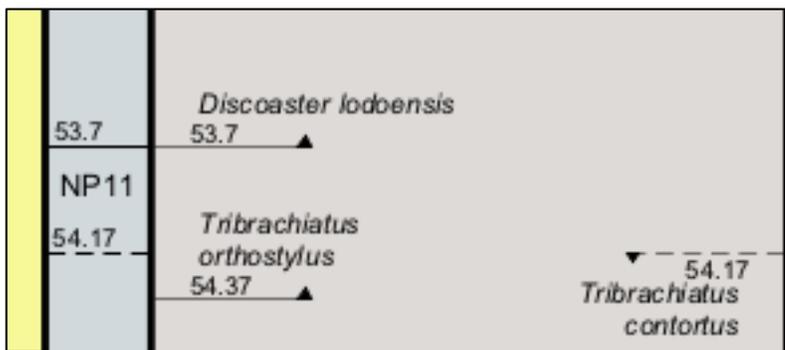
The ages in this option are displayed as 2-decimals. You also have options to make these in a different color.

So, from this method, what are the FAD/LAD ages for *Tribrachiatus 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:
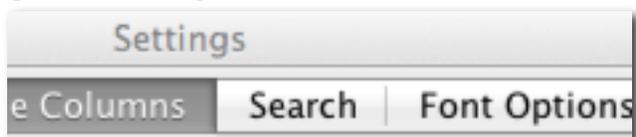
Open Search, and we'll input the last name of our nannofossil, plus turn **ON** the "Select 3Ma around event for chart generation:
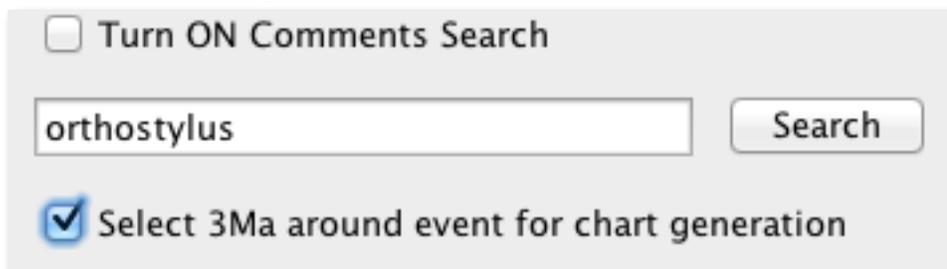
Tap "**Search**" button, and you receive (1) full name of the taxa and type of column in which it is found (e.g., *Tribrachiatus orthostylus* was found only in an Event column in our case), (2) The partial name of that column (e.g., Tethyan Nanno Zone markers – but only the first part is shown), (3) 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.
☑	Tethyan Nanno Zon...	50.5	LAD	Additional Info
☑	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.
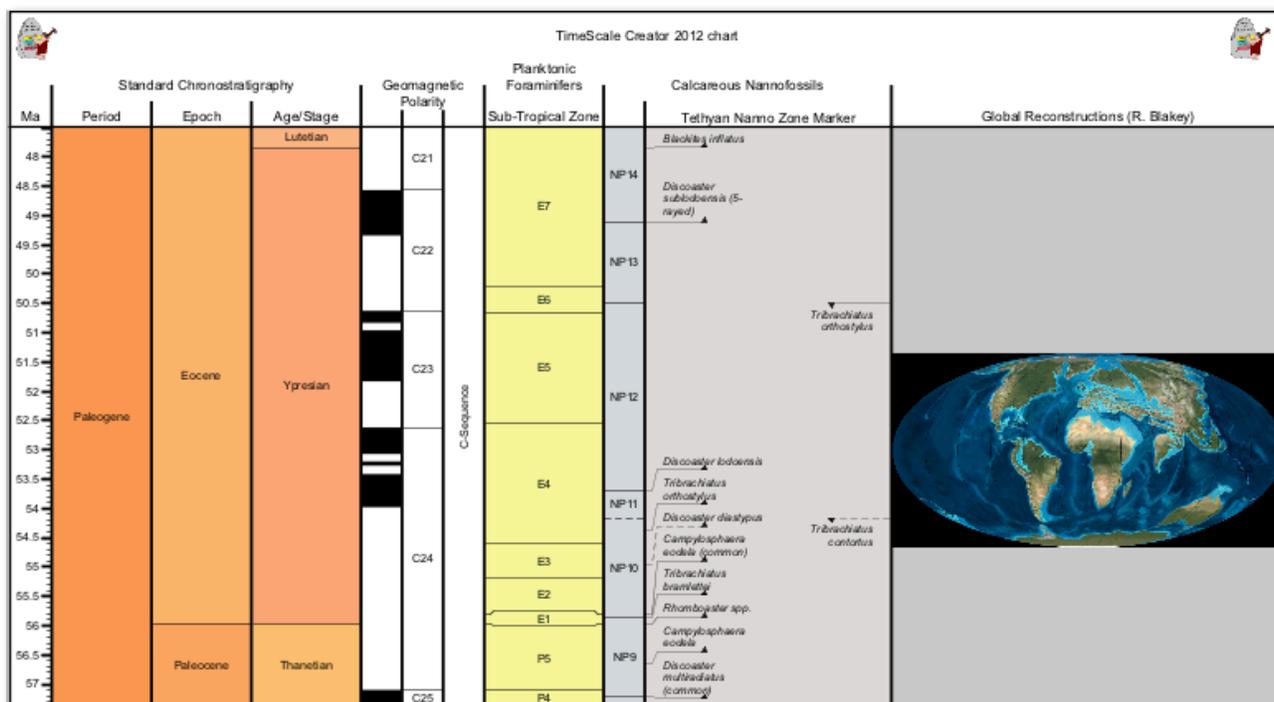
Other Search options

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., *Wetzeliella 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 *Wetzeliella gochtii*, click the "Additional Info" button.

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 *Wetzeliella gochtii* hot-link, and **Dinoflaj** will open in a browser to provide a drawn image of this dinocyst:

Weizelella goorni

If desired, one can always see its placement within a TSCreator chart by clicking "Add to Chart", and the appropriate columns will be automatically activated.

In this way, one can search the TSCreator internal (or added external) datapacks to locate columns with desired fossil taxa, zones, lithologic formations and other items; obtain the numerical ages; and in many cases, use the "additional information" to activate links in the popups to external servers to provide more information without even generating a single on-screen chart.

Feel free to play with this Search system before we go to the next parts!

Part 2 – Using Datapacks
(with evolution displays, map-interfaces, etc.)

Now, let's use *TimeScale Creator* to explore some interesting geologic events:

Datasuite #1 – Mappacks, and Oil in Australia and in North Sea

We will first use an Australia datapack, then a British one

(1) **Resetting display; Downloading and adding Australia Datapack**
Under FILE (top-left of menu bar); click "***Replace Data with Default Datapack***". This will
clear all your settings.
At the TSCreator https://timescalecreator.org website, under Datapacks menu, scroll down
and open the tab for "*Australia*", read the description, and **download** *(save, ideally to the
desktop for easy opening)* "***Australia Mappack***". This joint product with Geoscience
Australia contains lithologic columns for all major Australian basins for the past 2.5 billion
years, plus all major biostratigraphy zonations and sets of tectonic reconstructions (a total of
nearly 500 columns!). We will use only a small portion.

In TSCreator, use **FILE** (upper-left of top menu) to ***Add Datapack***, and add this Australian
one. It will take a few moments to load, because there are nearly 500 columns!

Choose Time Interval of **140** to **180** Ma; with vertical scale of **1**.

First, we will turn OFF our previous column sets –
Under ***ChooseColumns***, turn **OFF**   "*Marine Macrofossils (Mesozoic-Paleozoic)*",
                                            "*Microfossils*", and
                                            "*Global Reconstructions*".
Also, turn OFF "*Geoscience Australia – Biozonation Datapack*".

Turn **ON** "***Geoscience Australia – Lithostratigraphy of Phanerozoic Basins.***
Under this ***Geoscience Australia – Lithostratigraphy of Phanerozoic Basins***, open
"*Greater NW Shelf*" to turn ON "*NW Australia tectonics*" and "*Bonaparte Basin*" (and turn
off all other basins).

Now, go to Settings, click "***Map Points***" (upper-right button on top menu), which will open
a set of maps.
Click the Australia base map (top one). Bonaparte Basin is at the top, with a submap at the
leftmost square. Click it to open that sub-map.

● ● ●	Settings		
Choose Time Interval	Choose Columns	Font Options	Map Points
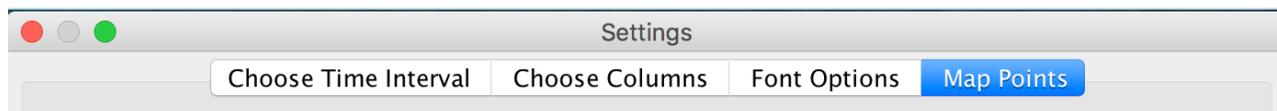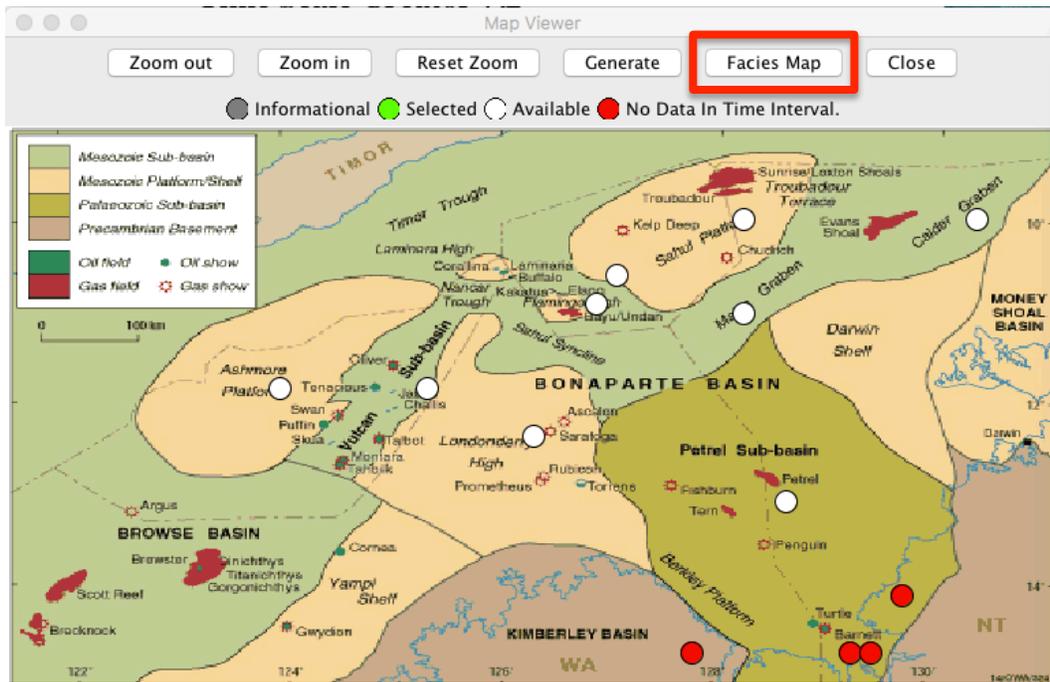
To get a quick preview of the lithologies of the various wells, click "**Facies Map**". A new window will open with a time slider. As you move the slider through time you will see the lithologies changing in the well dots. With the "Dot" slider you can adjust the size of the circles representing the wells.

Play a little with the slider. This will work on all submaps.
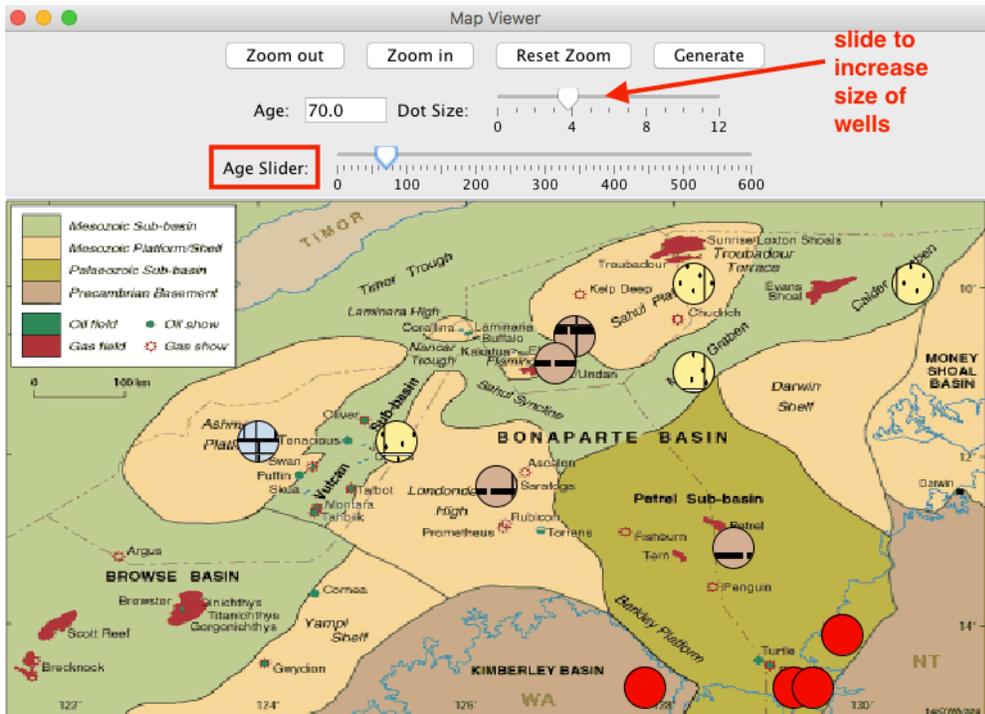
Close this map

For the next exercise we want only the *Petrel* and *Vulcan* sub-regions -- when you hover your mouse over a dot, then a pop-up will tell you the name. The *Petrel* and *Vulcan* should be "green", and click off (*turn white*) the other sub-regions. Close these map windows. ***Generate***.

[GENERAL NOTE: If you get a warning of "Don't Panic" after Generate, then try Generate Chart again. Sometimes JAVA, especially the Windows version, doesn't clear its memory usage very efficiently. SEE LAST PAGE for details.
On some Windows operating systems, you may need to completely close the JAVA to free its memory usage, and restart the program. You will notice this problem if the program becomes slower and slower to display charts.]

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(2) **Offshore NW Australia oil-gas field example**

This is a display of the geology in offshore Northwest Australia, an area that is becoming a major gas-oil exporter to China and other regions. What you see are sands (*dotted-yellow*) and dark-clays (*dashed brown*). Columns next to these changes in rock types with time displays levels with discoveries of oil (*green* symbols) and gas (*red* symbols). The clayey Frigate Shale and Lower Vulcan Formations are organic-rich source rocks for these Jurassic oil-gas reservoirs. The oil-gas migrated both up (into Upper Vulcan) and down (into Montara Formation).

Let's get some additional information. Using the "Choose Columns" menu under Settings, open Bonaparte Basin, then Bonaparte Basin Lithostratigraphy subdirectory. Open "*Vulcan Sub-basin*" sub-subdirectory, and turn ON "*Vulcan Sub-basin Wells*".
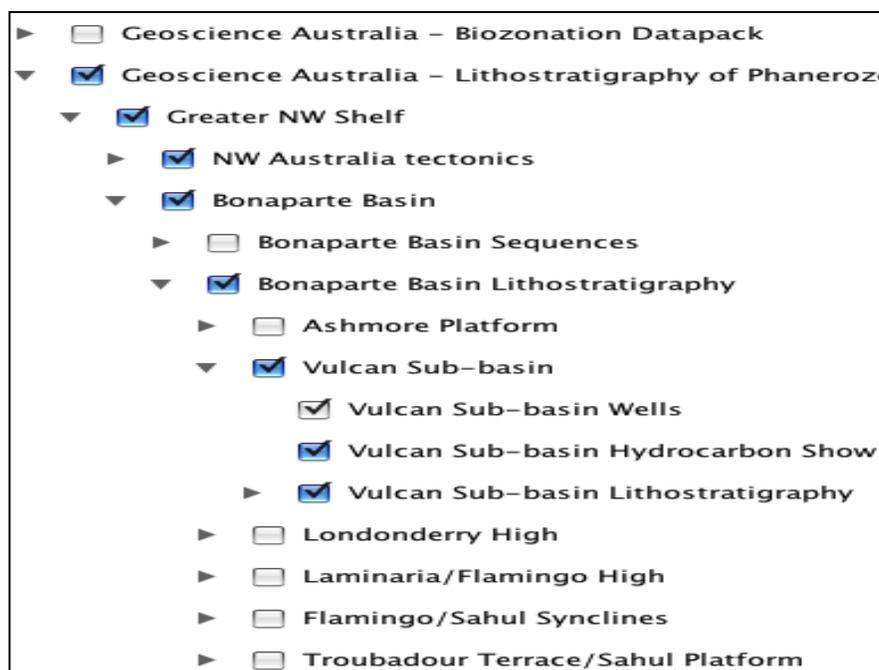
Under the main "*Choose Time Interval*" of Settings, active "***Mouse-Over***".
 Generate.and click on the Bonaparte-Basin title. In the pop-up window, click on the basin report. This opens a website at Geoscience Australia, and a summary of that basin is presented. You can click on geologic summaries, sub-basin location maps and other items.

EXPLORE …*(At the moment the Australia website is changing, therefore some of the links don't work)*
Now, back to *TimeScale Creator* – use the mouse to click on one of the rock units. Clicking on its internal hot-link sends another request, in this case as a search-call to their Oracle database for information on the rock formation. *[Below is a "simplified" version (many of the oil-gas wells are removed for clarity).]*
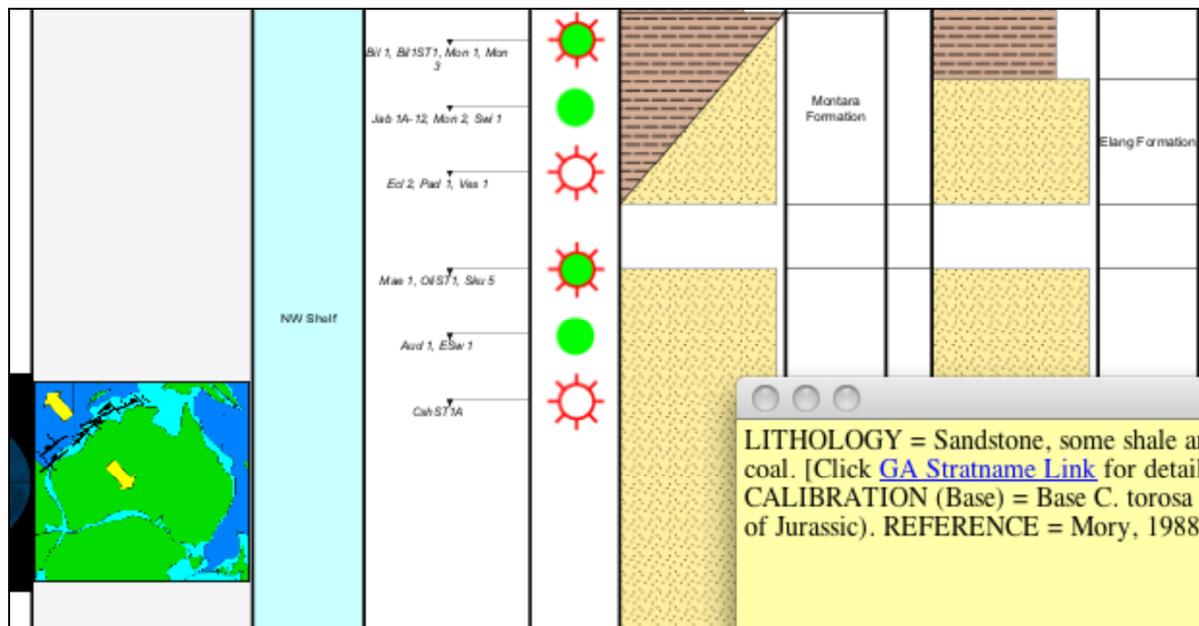
Try this with one of the well-names, and access a separate Oracle database of well reports. The tectonic column (the "light-blue" one) events are linked to FrOG Tech summary reports on each episode. Try clicking "NW Shelf". *[NOTE: FroGTech is revising their website, therefore this link might be inactive at times.]*
In this fashion, the on-screen display is a "GATEWAY" via geologic age into information stored on the Geoscience Australia and other computer databases.

(3) **Offshore NW Australia oil-gas field example**

Let us look at why there was this change from dark shales to sands.
To save space, turn **OFF** *NW Australia tectonics*, and *Geomagnetic Polarity*.
Turn **ON** *Sequences, Sea-Level* … directory, then open its *Sequences, Onlap and Sea-Level Curves* sub-directory, turn on *Phanerozoic T-R Cycles (2nd order)* sub-subdirectory, turn on *Phanerozoic Sea-level Synthesis* subdirectory. Select *Mean Sea Level*.
The T –R Cycles show a cartoon of global sea-level changes, in which the Blue-color indicates rising/falling ocean levels.
Turn **ON** the ***Phanerozoic-Proterozoic Carbon-13 Composite*** (in the *Stable Isotopes directory, Carbon-13 curves and events* subdirectory*)*; then, scroll down and turn ON Show Scale (with *Step* as **2**).
Turn off the *Oxygen-18 curve*.
Generate.
[Below is a partial version (with vertical scale set to 0.5 to emphasize trends).]
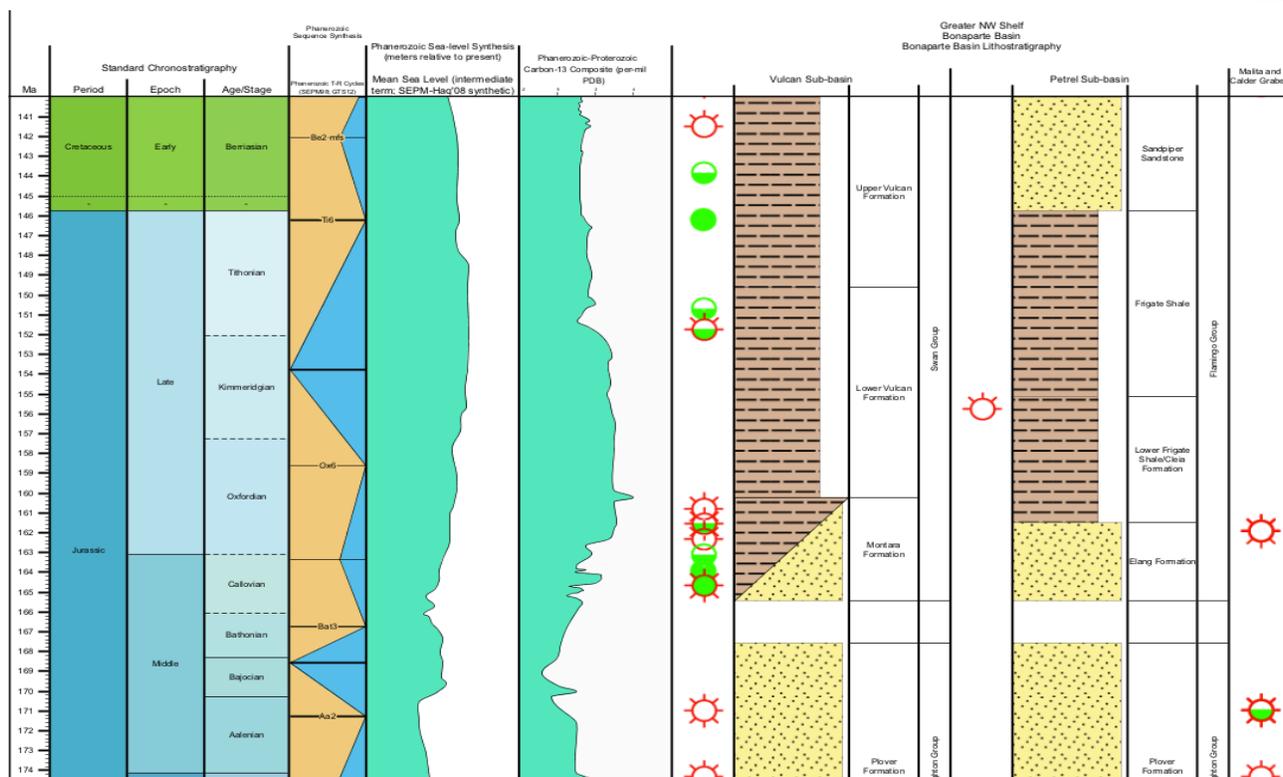
- *What was sea-level doing during the formation of the Frigate Shale?*
- *What was it doing during the Sandpiper Sandstone or Upper Vulcan?*

A major sequence boundary near the Bathonian-Callovian boundary corresponds to a "gap" in the accumulation of sands on the NW Australia shelf. This suggests a global lowstand of sea-level exposed the shelves in many regions, and it is considered a major sequence boundary.

(4) **Carbon balance and sea-level.** A rising sea-level enhances the trapping of clays and the accumulation of organic material on continental shelves. The buried organics contain a greater proportion of "light" C-12 (relative to "heavy" C-13) than the ratio in seawater. Therefore, the seawater undergoes a relative enrichment in C-13, which is recorded in carbonates. In the plot above, C-13 increases to the right. The rise of Carbon-13 is during the Callovian through early Oxfordian (peaking in mid-Oxfordian) as the sea level was undergoing a long-term rise and flooding onto global shelves.

In NW Australia, the main pulse of clay-rich sediment accumulation was during the Kimmeridgian, when sea-level was near its peak. These clays partially capped the migration of hydrocarbons from the underlying organic-rich deposits of Oxfordian; therefore some of the oil-gas may have accumulated in the underlying sands.

(5) **Was this unique to Australia?**
Let's find out, by adding Britain, half-way around the world.
First, turn **OFF** *Vulcan Sub-basin*, and also turn OFF our *Isotopes* column.
From the TSCreator website, download from *British Isles* the "*BritishMappack_Public_GTS2016_15July2016.mdpk*". **Add** this to your set – this British suite will be at the bottom of your Columns listing. Go to the **Map-points interface**, and

activate Britain location map from the **World Map** (top of set). Use this map to turn off the columns other than **North Sea (S)** and **Hampshire** basin. *Generate*.
<u>Wow</u>, this is fascinating. If the column widths of the **British lithology** is too narrow, just find the "Hampshire Basin and North Sea in the **Choose column** menu and change the column width.

- ***What was sea-level doing during the formation of the Kimmeridge Clay?***

In the early part of Late Jurassic, the British region of North Sea saw a change from underlying sand-rich or carbonate-rich sediments into the Kimmeridge Clay. This, just like the Australian Lower Vulcan Formation (!), is also an organic-rich claystone, and is the source-rock for the famous North Sea oil-gas fields.
As in Australia, some of this oil-gas migrated to fill the underlying sands –further north, these "Brent Group" sands are the reservoir for one of the first major North Sea fields to be developed in the mid-1970s.
Then, when sea-level retreated toward the end of the Jurassic, river deltas built outward and dumped their sands onto the continental margins (Petrel sub-basin of Australia's Bonaparte Basin and Britain's Hampshire Basin; but an interval of non-deposition in southern North Sea). Some of these river-delta deposits also became the future oil-gas reservoirs that received the maturing hydrocarbons from the underlying organic-rich clays.
The combination of a rising global sea-level and burial of organic-rich sediments during the "Oxfordian-early Kimmeridgian" time, followed by the deposition of sands or other shallow-water deposits during the latest-Jurassic drop in sea-level led to the oil-gas riches of other regions, including Saudi Arabia and Siberia. This mid-Late Jurassic is an unusual interval of Earth's history – such a vast quantity of carbon was buried around our planet during the rising and cresting global sea-level.

[NOTE: If you have been loading and replotting datapacks continuously to this point, it is recommended that you <u>Exit TSCreator</u>, and re-start it "fresh". This will clear the memory usage by JAVA. Otherwise, the next image-heavy suites may cause the JAVA system to slow or even stop.]

Datasuite #2 – <u>Evolution of Paleogene Planktonic Foraminfers</u>

(1) **Resetting display; Downloading and adding Foram-Evolution Datapack**
If you haven't started TSCreator "fresh", then under FILE (top-left of menu bar); click "***Replace Data with Default Datapack***". This will clear all your settings.
At the TSCreator https://timescalecreator.org website, under Datapacks menu, open the tab for "*Planktonic Foraminifer Evolution through Paleocene-Eocene*", read the description, and **download "PaleogeneForamsEvolution_GTS2016_wMikrotax_15Oct2018.dpk"**. This joint product with C. Liu contains a branching evolution model for the diversification of planktonic foraminifers during Paleocene-Eocene (after their near extinction at end-Cretaceous).
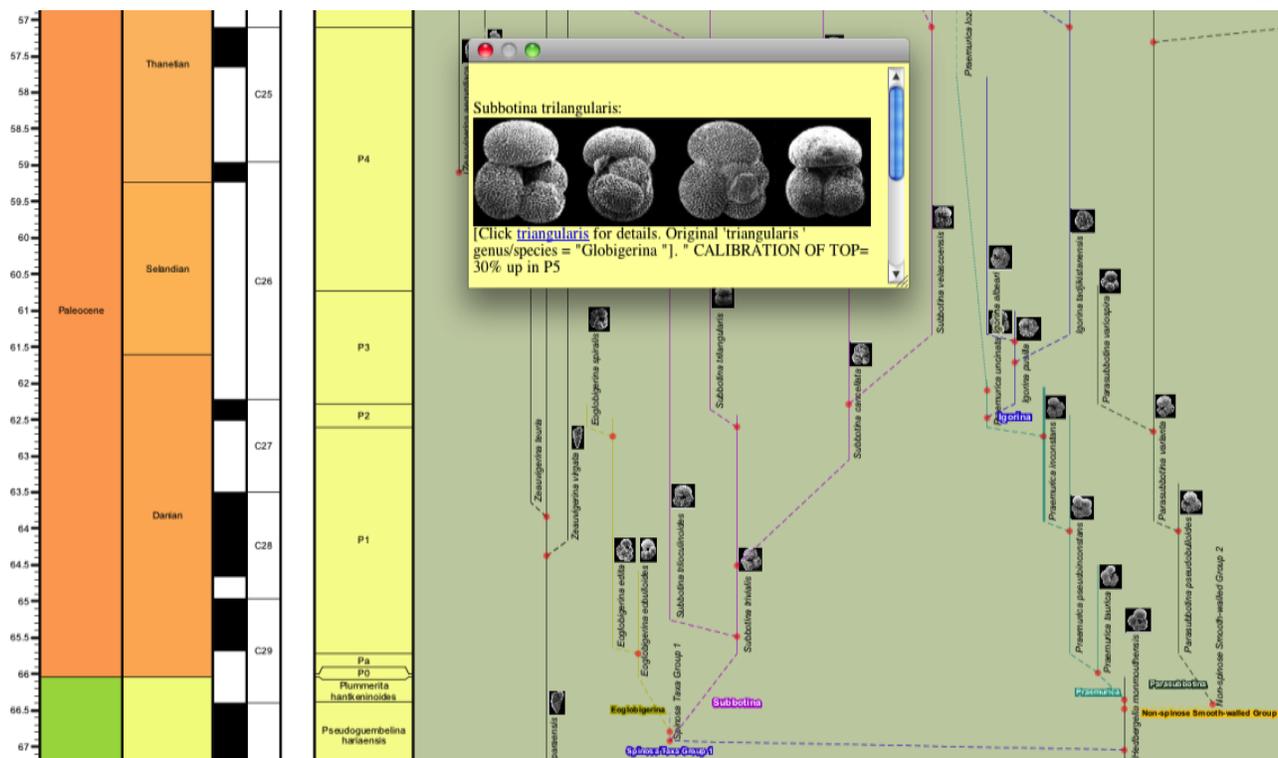
In TSCreator, use **FILE** (upper-left of top menu) to ***Add Datapack*** for this one.
Choose Time Interval of **40** to **70** Ma; with vertical scale of **3**.
Turn ON ***Add Mouse-over***.
First, we will turn OFF some of our default column sets -- Under ***Choose Columns***, turn
OFF "*Marine Macrofossils (Mesozoic-Paleozoic)*", "*Calcareous Nannofossils*" (which is
under *Microfossils*), and "*Global Reconstructions*".
Generate

(2) **Pop-ups and links**
The screen is filled as TSCreator fits the entire chart to your window. Therefore, to explore
this set, click "1:1" or other Zoom (menu of display option buttons at top-left).
The range of each foraminifer species is shown, plus its inferred evolutionary branch from
its parent. The thumbnail images give a general view; but if you click onto the Foram name,
then a pop-up opens with a much larger image:
Click on ***Globigerina officinalis***, the one in the upper-left of the suite. This has a larger
image with 3 views. The popup gives calibration information, plus a "Click **officinalis** for
details" – click, and a browser window should open to the appropriate taxonomy page for
this species as hosted by Mikrotax. Close the pop-up.
Now, use a **RIGHT**-mouse click (WARNING – ONLY RIGHT-CLICK at this point) onto
the RED-DOT (node) at its branch from its parent (inferred to be the long-ranging *Subbotina
roesnaesensis*). A window opens with the calibration of the branch. Close the pop-up.
Now, on that same node, use a **LEFT**-mouse click, which will collapse that branch of
Globigerina officinalis. The image re-generates, and it automatically returns to the
approximate zoom-setting and position. The Red-node is now flashing, indicating that there
is a hidden branch.

(3) **Priority settings, and Conserve space**

Return to SETTINGS menu (Choose Columns), and Highlight the "*Paleogene Planktonic Foraminifer Evolution*" column (at bottom of directory). The set of display options to the right includes "**FTree Priority Enable, Value:**", which is default-off with "10". Set this to be **ON**, with value of 8.   **Generate**.

Click 1:1 display-button, and scroll around the new chart.

We had assigned "priority" values to the individual foram ranges/branches such that only the "main parents" are shown. These arbitrary "main parents" were given Priority setting of 10 or 9; secondary branches a priority of 7; and single "end-twigs" a priority of 5 or 3.

If you click on a blinking node at this high-priority-only chart, then its full-detail branch will open up. Try it.

These priority-display options can be installed for any set of zone, event or range/evolution datasets.

If one draws an evolutionary-diagram by hand, then it is common to draw "new" branches reaching over "dead" ones. This space-saving option is also available in TSCreator in a simple form.

On the "*Choose Time Interval*" of the Settings menu, at the bottom are special options.

Click the "***Conserve Chart Space in Family Tree Plotting***" option, and **re-generate** your Foram Evolution chart. You should see that the horizontal scaling becomes much more compact. Try changing the Priority setting of the highlighted "*Paleogene Planktonic Foraminifer Evolution*" to a lower value, such as "4", and re-generate to see this display method.

Sometimes when using the "***Conserve Chart Space in Family Tree Plotting***" option the far right species might be cut off. To make sure you can see these species highlight "*Paleogene Planktonic Foraminifer Evolution*" and adjust the **"Margin"** to a higher number. In our case a "Margin" of 20 displays the whole chart.

Turn on **"Show Age Labels"** to see the ages of all the nodes and events. To adjust the distance of the age labels from the branches use the "Age Pad". Higher numbers move the ages away from the branch.

Datasuite #3
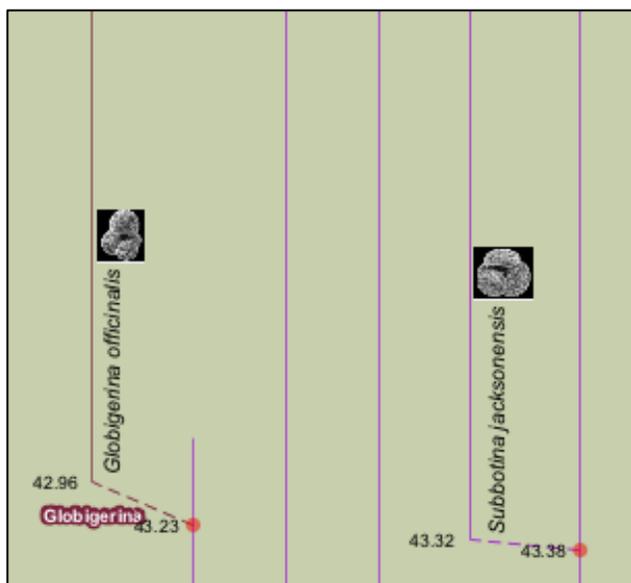
Rise and Fall of Pyramid-builder Civilization

Oxygen isotopes in Ice Cores

At the TSCreator https://timescalecreator.org website, under Datapacks menu, open the tab for **"Human Culture"**, download **HumanCulture_Encoded_Feb2018.txt**.

(1) Load Human Civilization time scale – Under FILE, click "***REPLACE** Data with Datapack*", and find/load the file "**HumanCulture_Encoded_Feb2018.txt**".
This replaces the geological scales with a new one of selected archeology and ice core information. This database has been compiled from both archeology sources and the independent international drilling of Antarctic and Greenland ice cores. *[NOTE: it is only a preliminary sketch of what will become a major dataset in the future.]*

(2) Under Settings, choose the interval spanning the Bronze Age (**3.2** ka top; **5.5** ka bottom); and a **vertical scale** of **8**.
Under *Choose Columns*, turn OFF everything, **except** *Age, Stage, Egypt, Egyptian Intervals* and *Middle East to India* – leave these ON. ***Generate***.

(3) Notice that the end of the Old Kingdom (pyramids) is close to the end of the Akkadian civilization in Mesopotamia; and there is a gap before the Middle Kingdom and Assyrian. Let us see what may have caused this.

Let's use oxygen-isotopes from Ice Cores from Greenland and North Atlantic ice-rafted debris episodes to see what may have caused the rise and sudden fall of the Pyramid dynasty.

 (4) In Settings, click ON *Ice-Rafting* and *Greenland GRIP Oxy-18*. Highlight the name *Greenland GRIP NGrip Oxy-18 (b2k)*, and activate the *Show Scale* (scroll down) with a Step of **1**. Under **Fonts** set the size for the scale to **10**. ***Generate***.
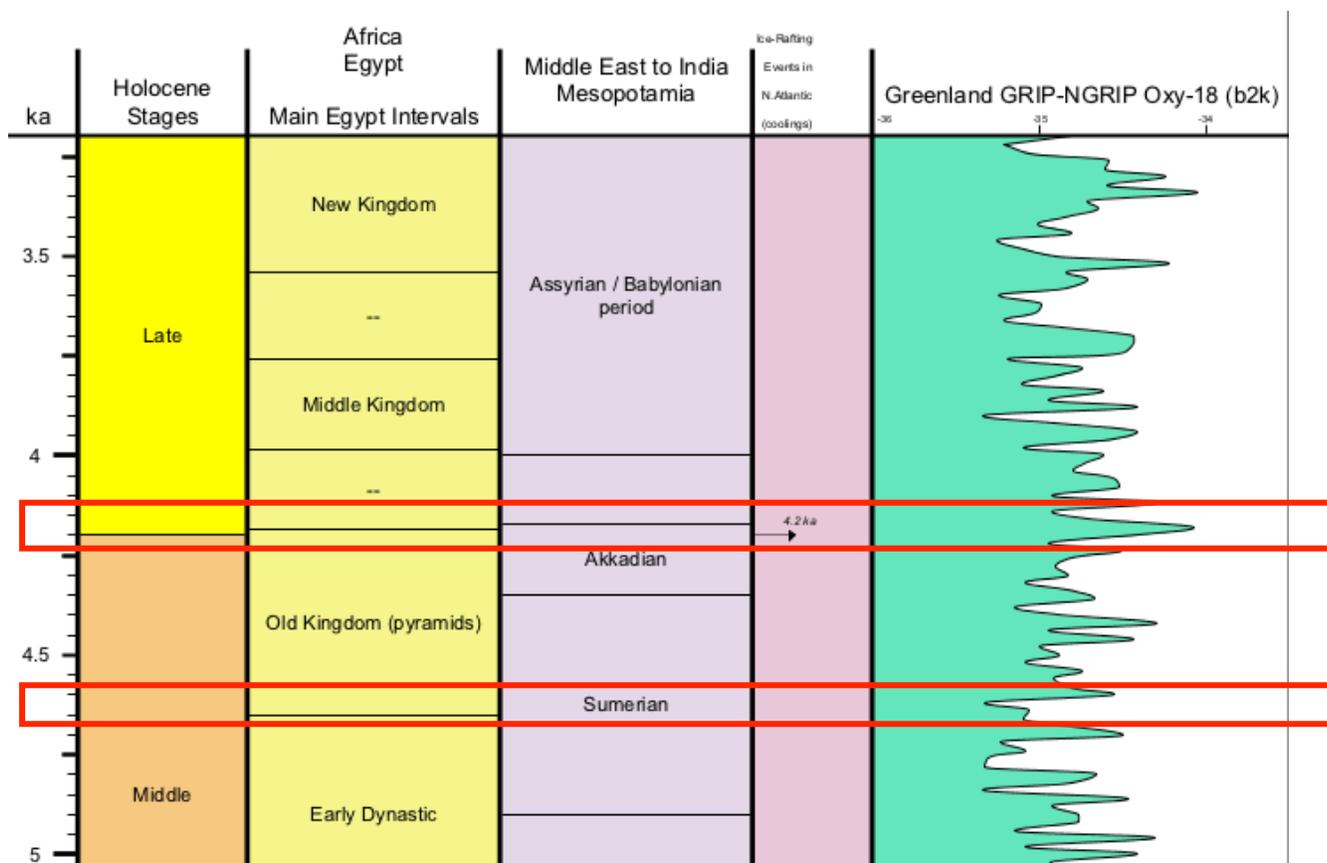
Background:

See diagram above, where dramatic events in human history are marked in red.

> NOTE: A **decrease** in Greenland Oxygen-18 (*hence more Oxygen-16 in the snow fall*) is a shift to **LEFT** in the diagram. The Scale is -36 (**left**) to -34 (**right**)

A **colder** climate in Greenland is associated with a greater "snow-out" of moisture before the storms reach the center of its ice-cap (from where the ice-cap was drill cored). Oxygen-18 is progressively removed during snowfall; therefore, the remaining moisture reaching central-Greenland is more depleted in Oxygen-18 (more negative in values). A Decrease in Greenland Oxygen-18 is a shift to **LEFT** in the diagram, therefore is interpreted to imply that Greenland became colder. It is thought that the cold episodes that affected Greenland probably affected the entire northern hemisphere, including the region of Egypt and Mesopotamia.

In contrast, a Greenland **warming** (more Oxy-18 in the snowfall; a shift to the **Right**) is sometimes associated with a surge in glacial icebergs, causing "Heinrich" levels rich in ice-rafting debris further south in the North Atlantic.

What climate events occurred near the beginning of the Old Kingdom?

In Egypt and Mesopotamia , a cooler climate is also a drier one, because the driving factor for summer rains in the highlands is lessened. This reduces the flow of the Nil and Tigris-Euphrates rivers.

A common model is: an important initial motivation for the origin of large organized societies was the need to engineer water systems of irrigation and reservoirs in a drying climate.

What climate events occurred shortly before the collapse of the Old Kingdom and of the Akkadian Empire in Mesopotamia?
What possible scenario for why the Old Kingdom and the Akkadian Empire simultaneously collapsed?

Societies could collapse for one of 2 reasons:
  a. if the climate became even drier and thirsty citizens questioned the effectiveness of their leaders association with the "gods", and
  b. if major floods began to wipe out the crop land and homes leaving people hungry.

NOTE on this 4.2 ka event. We invite your speculation "from what you've learned" or other ideas. This is still controversial. Indeed, IF this was a "typical Heinrich event", then as documented by Bond et al. (1992), not only does the presence of left-coiling foraminifera *N. pachyderma* indicate the deep southward invasion of polar water during the time of an Heinrich event, but the drop in surface salinities was probably significant enough to temporarily shut down thermohaline circulation in the North Atlantic, thereby causing another type of cooling episode in the North Hemisphere.

The "4.2 ka" ice-rafting event seems to correlate with a temporary surge of cold-climate or arid-climate indicators in some regions; but flooding in others (e.g., China). Therefore, paleoclimate geoscientists are actively working to decipher what actually happened to Earth's climate and the reason for the collapse of major civilizations at this dramatic time!

NOTE: One can also input datapacks using "Replace" in units of "meters" or other unit for stratigraphic outcrops and cored holes. If one has flagged the scale of a datapack in units other than "Ma", such as "m" or "ft", then it opens as a separate distinct set of columns separated from the other datapacks, or these can be cross-plotted against a geologic time scale for use in depth-age conversion.

This completes our tour of a couple of the many datapacks of TimeScale Creator – a visualization system for both built-in and external databases of Earth's history.

Part 3 – Making Datapacks with images, lithology columns, etc. (Note: self-made datapacks with more than 3000 characters only work with TSCPro)

For convenience, and for the needed images for Exercise #2, download "*Basic TimeScale Creator Workshop*" from the **Download** page at our website, and un-zip it to use the individual files and image-folder.

EXERCISE #1 – Making your own datapack for microfossil zones and events

(1) **Gulf of Mexico, Rupelian**
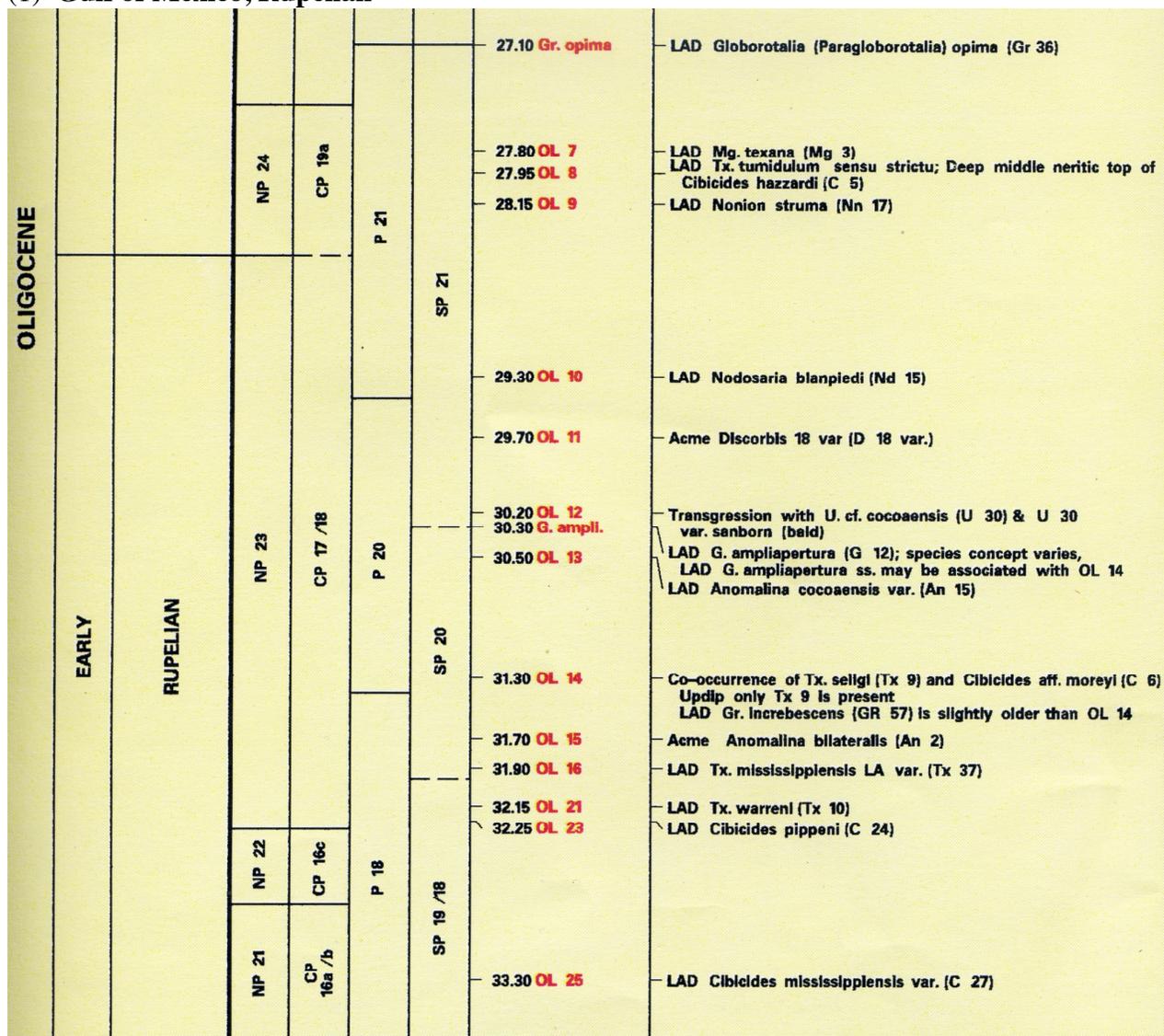
We will use the Foraminifera markers of Shell Offshore Inc. (Michael Styzen, published by Gulf Coast Section of SEPM in 1996; *although he released a revised version later*). This is a scan of just the Rupelian portion of that chart. We will make a datapack for (1) the SP "standard zones" of Shell, and (2) Shell's "OL" foraminifer markers, which are a combination of benthic and planktonic taxa. Details on all types of columns are in the detailed main Manual (*200-page PDF at the download page of website*).

(2) **Set-up**

TSCreator uses tab-delimited text files. This format was selected so that users can make entries in EXCEL columns, then do a separate "save-as" export as tab-delimited text. Alternatively, one can use Word, and save the file as text, but this can be more tricky to easily see the tab-columns.

We will make 3 data columns: ***Shell SP zones (a block column)***, ***Shell Foram markers (an event column with simple arrows)***, ***Shell Foram details (and event column with separate FAD and LAD arrows)***.

The format for data is quite simple.

(a) A **header** that gives the column type (*and optional settings for color, width, etc.*).

(b) A set of **items** with their **ages** (*and optional dashed boundaries, pop-up comments, etc.*)

IMPORTANT: The column sets must be separated by at least one blank row.

(3) **Block (zones)**

We will enter the three SP zones with the age of their bases.

Prepare the following [*NOTE: you can just copy-paste each set into Excel; **BUT**, if you do this from a PDF, then **REMOVE the line-returns** that Acrobat adds to the text-insert into those cells, otherwise it creates a mess. For example, if you copy-paste from a PDF the item "SEPM chart by Mike Styzen (1996)", then remove the PDF-returns after "chart", "Mike" and "Styzen".*]

NOTE: The downloaded "*TSCreator Datapack-making items.zip*" contains a WORD file "*RupelianDatapack_DocVersion_forCutPaste.doc*" that will avoid such copy-paste errors from a PDF version.

A	B	C	D	E	F	G
format version**:**	1.3					
date**:**	16/01/2012					
Shell SP zones	**block**	50	255/255/0			SEPM chart by Mike Styzen (1996)
	TOP	27.1				
	SP 21	30.3		NOTE: LAD of G. ampli.		
	SP 20	32.0	dashed	NOTE: definition uncertain	222/255/0	
	SP 19 /18	33.8				

The first two lines are no longer needed. You only need a header if you prepare an outcrop or use other age units, like we did for the Human Culture datapack.

Then, a ***blank*** row.
The "Shell SP zones" are a block-type format. Let's use a default width of 50; and give it the bright-yellow color of Shell's logo (RGB is 255/255/0). The seventh column (column G) can have a pop-up comment for the column title.
Each zone is entered, then its Age (as given on this SEPM chart). Notice that the lower boundary of SP21 and SP20 are dashed on the chart – but, to see how this option works, just put "dashed" after the SP20 (which has no indicated foraminifer marker). The next column (E) is for pop-up comments. For fun, let's give zone SP 20 a light-green color (the RGB code in column F).

(4) **Datums – only simple arrows**
Next, let us enter the OL "markers" as EVENTS. The column type is "event" (small letters), and the options for sets of markers are "LAD", "FAD" and "EVENT". We will call these "EVENT" for now.
After a blank-row (***IMPORTANT to have a blank row separating each new header***!), then enter:

A	B	C	D	E	F	G
Shell Foram markers	**event**	60	255/255/0		**on**	SEPM chart by Mike Styzen (1996)
EVENT						
	OL 10	29.3				
	OL 11	29.7				
	OL 12	30.2				
	G. ampli.	30.3				
	OL 13	30.5				
	OL 14	31.3				
	OL 15	31.7				
	OL 16	31.9				
	OL 21	32.15				
	OL 23	32.25				
	OL 25	33.3				

The column-header above used a slightly wider width (60). Because the data-heavy event-type columns have a default of "off" to avoid accidental overcrowding of screen displays, then we've inserted an override of "**on**" in column F of the header.

(5) Datums – both LADs and Events
Similarly, let's compile the details of these events. There are two types used by Shell – LADs of markers, and a set of EVENTS of acme's, co-occurrences, and transgression.

After a blank-row (***IMPORTANT to have a blank row separating each new header***!), then enter:

Shell Foram details	event	200	255/255/0		on	SEPM chart by Mike Styzen (1996)
LAD						
	Nodosaria blanpiedi	29.3				
	G. ampliapertura	30.3	dotted	species concept varies		
	Anomalina cocosensis var.	30.5				
	Tx. mississippiensis LA var.	31.9				
	Tx. warreni	32.15				
	Cibicides pipeni	32.25				
	Cibicides mississippiensis var.	33.3				
EVENT						
	Acme Discorbis 18	29.7				
	Trans. with U. cf. cocoaensis	30.2				
	Tx. sellgi and Cibicides aff. moreyi	31.3				
	Acme Anomalina bilateralis	31.7				

We have long taxa names, therefore a generous width of 200 units is used (column header line). The LAD of *G. ampliapertura* is apparently vague, therefore its marker will be **dotted**, and a pop-up comment is added to explain this. Note that any pop-up comments for either datums or blocks must be in column E.

Now, **SAVE this Excel sheet as EXCEL**; and then Save-As "TEXT (**tab-delimited**)" format. Use a name such as "*Shell_Rupelian_Forams.txt*". Then close EXCEL **without** saving again.

Saving from EXCEL (or other application) – For convenience for fast loading/locating, save to the desktop. **Always save your Excel sheet AS EXCEL format first**; and only then save as "Text (Tab-delimited)" with a new name. *[NOTE, when Excel saves as "Text (Tab-delimited)",*

> *Microsoft tries hard to convince you that you really didn't want to do this. Keep answering "Okay" and "Yes", then after doing that save-as-text, and finally Closing the file, answer "Don't Save" (yes, that is correct) to retain the .txt format.] [NOTE2: If you save as "Unicode 16 (UTF-16)", then all international characters, such as ñ, î, è, ô, etc. will be preserved and displayed in TSCreator, however the size of the resulting .txt file is twice as large due to 16-bit usage.*

(6) **Insert into *TS_Creator***

Let us re-set the *TS-Creator* to clear the previous datapack.

Under "File", click "***Replace Data with Default Datapack***".

Now, let us load the new Shell one that you've made – Under File, click *Add datapack*.

For the chart, we have a dense set of data. Therefore, under Settings (Time Interval), use Top of 29 Ma, Base of 34 Ma; and a Vertical scale of 4.

Click **Generate**.

Voila !! It should look like the diagram below:
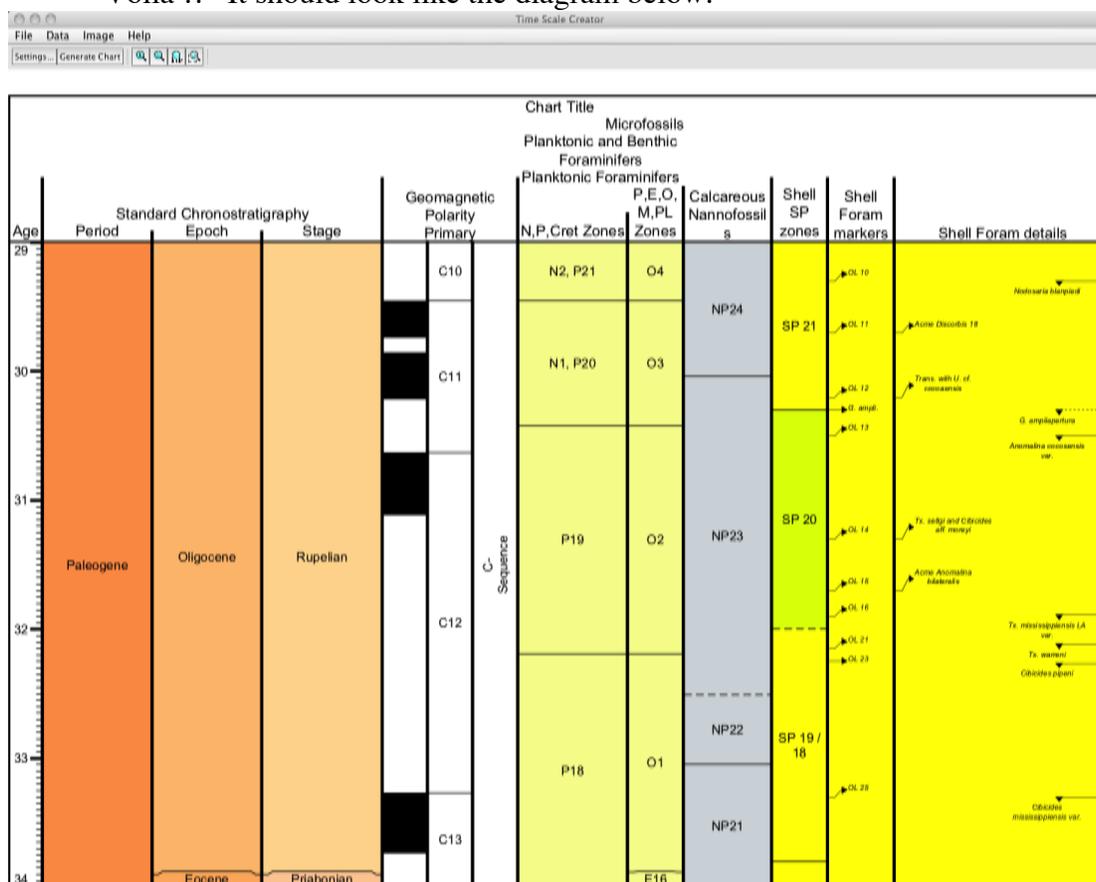
We hope this is what you get, because it should work the first time. If not, then you may see an error message indicating a problem with a certain line. This is the same line as in the Excel file, and you can open that Excel file again to see what format might be wrong. Don't panic; just look at the instructions again, or ask us!

Just in case, we've provided a working version as "*ANSWER -- Shell_RupelianForams.txt*" in the downloaded "***Basic TimeScale Creator Workshop***" folder.

EXERCISE #2 – Adding IMAGES to events and popups
Calcareous Nannofossil marker events of Late Jurassic of North Sea – from Bown & Cooper
(2000; in Paul Bown' book "Calcareous Nannofossil Biostratigraphy", with images of the
nannofossils from their NannoTax website.

**NOTE: You will need to download the zip'd file "*Basic TimeScale Creator Workshop*" –
see Top Lines of this Part 3. It contains "*LateJurassicNannos_Exercise2_template.xls*" and a
folder with images, "*LateJurassic_Nannotax_Images*". Unzip it (!!), to access the files directly.**

---

(1) **Preparing datapack with Age-calibrations**
        Open the Excel file "*LateJurassicNannos_Exercise2_template.xls*". It has 3 sheets –
(i) *Master Chronostratigraphy*, which is the GTS2012 timescale for Boreal stages and ammonite
zones, (ii) *Nannos*, which is a skeleton that you will finish, and (iii) *Output*, which is a mirror to
selected columns in the "*Nannos*" sheet.
        The provided Excel template has 2 worksheets open. Use the "Window -> Arrange ->
vertical" in Excel to view these side-by-side.

[NOTE: **Opening "Part 3" templates from Excel (Exercises 2 and 3) in Window's Excel** – In
some versions of Excel, oddly, to see the dual-window files, you must then Click "**View**" in the
upper Excel menu, then "**Arrange All**" (middle of that menu), then "**Vertical**".   Stretch the
window to be able to see more of the two sheets; and you may need to scroll UP to see the
uppermost entries.
        For Exercise#2 in Part 3 (Adding Images) – It will be easier to **MOVE** the folder
"*LateJurassic_Nannotax_Images*" **to your Desktop**. This will allow you to save your Excel
output from "*LateJurassicNannos_Exercise2_template.xls*" directly into that Image-heavy folder,
followed by open it from within TSCreator.

        In the diagrams of Paul Bown's book, the placement of selected Nannofossil FAD/LAD
datums of Tithonian/Kimmeridgian are "drawn" relative to Boreal ammonite zones. We will use
the GTS2012 ammonite scale to calculate the corresponding ages by inserting a simple Excel-
equation that uses the *Master Chronostratigraphy* table for the ages of those Boreal zones.
        In your Excel table, each entry for the nannofossil datums [either its appearance (*FAD*) or
extinction (*LAD*)] has an entry with this relative placement from the base of a Boreal ammonite
zone according to Paul Bown. Your first task is to compute the corresponding numerical Age value
based on the ages for these ammonite zones.

        The first one, LAD of *Stephanolithion atmetos,* has been "wired" so Excel computes it for
you (*look at row 12*):

Stephanolithion atmetos	Stephanolithion atmetos <img align="middle" width="40" src="Stephanolithion_atmetos_SEM.jpg">		X	**NJ18**	147.97	Stephanolithion atmetos <img align="middle" src="Stephanolithion_atmetos_SEM.jpg"> (NANNOTAX image) [Click: Stephanolithion atmetos]. CALIBRATION = 90% up in fittoni Zone.	90% up in fittoni Zone.

        The Datum Calibration column indicates that this event is **90% up** in the *fittoni* ammonite
zone.

In the Master Chronostratigraphy sheet, you see the following ages for the **Base** of *V. fittoni* and its Top (which is the **base** of the next-higher *P. albani* zone):

58		**Progalbanites albani**	147.93
59		**Virgatopavlovia fittoni**	148.35

Therefore, the age of the LAD of nannofossil *Stephanolithion atmetos* would be the relationship:

Base-of-Fittoni (*minus*) **90%** of the **Duration-of-Fittoni-zone**.

The *Base-of-Fittoni* is Excel cell **C59**; therefore, the *Duration-of-Fittoni-zone* is equal to its **(Base – Top)**, or Cell **C59** – Cell **C58**.

If you highlight the "147.97" computed age in the Nannos Excel sheet for this LAD, you will see that the Excel-equation is using the cells in the Master Chronostratigraphy:

```
='Master Chronostrat'!C59-0.9*('Master
Chronostrat'!C59-'Master Chronostrat'!C58)
```

Or, (148.35 - 90% * (148.35 - 147.93)
        = 147.97 (Ma)

How to enter the equation into Excel:
Highlight the cell for entering the computed age
Type **=**
Click on base-fittoni **age cell** (148.35) in Master chronostrat
Type   **-0.9***(then click on base-fittoni **age cell** (148.35) in Master chronostrat
Type   **-** *(minus)*
Click on base-albani **age cell** (147.93) in Master chronostrat
And, finally close the equation with **)**, Then, hit *return*.

The advantage of using Excel-equations is that if the age-scale changes in the future, or the calibrations are revised, then one merely inserts those future values, and the computed ages of events are automatically updated. We use this inter-linking to master-chronostratigraphy for all datapacks of TSCreator, even including isotope curves.

Using this Excel-equation method, compute the remaining ages for Nannofossil datums according to their relationship to Boreal ammonite zones. These are all the cells that have a pending "*For Excel Equation*".

(2) **Attaching images to on-screen and popup entries**
The method of attaching an image to a "name" is an HTML statement "*img*" with the pointer to the image.
If the image is in the same directory as the TSCreator datapack text file, then one merely needs to give the image-name. In our example, we will put the finished Nannofossil output text into the folder "*LateJurassic_Nannotax_Images*" that has the suite of images for our fossils.
Look at Column B. This is the method of "concatenating" (merging) the information from the "fossil-name" and the source (*src*) of the "image-name", plus the required HTML flags that

specify that this will be an image-call, set the image-size to be a small (40-unit) thumbnail version, and center it after the fossil-name.

Stephanolithion atmetos <img align="middle" width="40" src="Stephanolithion_atmetos_SEM.jpg">

NOTE on "Concatenate"

If you have not used the method of Concatenate in Excel, you will discover that it is a very powerful and time-saving method for merging information. It can even be combined with logical "if-then" statements and other features.

A quick explanation for this example. If you Highlight the entry "**Stephanolithion atmetos <img align="middle" width="40" src="Stephanolithion_atmetos_SEM.jpg">**", you will see that the equation is:

=CONCATENATE(A12," ",I4,J12,J4)

The Concatenate take the text in Cell A12 (Stephanolithion atmetos) with a " " (blank space), then the text in Cell I4 (<img align="middle" width="40" src=">). The dollar signs in this I4 implies that a fixed Cell I4 will be used whenever this equation is pasted elsewhere; whereas the non-dollar-sign "A12" implies a relative-placement, such that when the equation is pasted in the next line (13), then it will point to Cell A13 instead. The information in Cell I4 has "<" to flag TSCreator that the next items are HTML syntax, then "img" indicator that the instructions are to place an image with align="middle" for centering relative to the fossil name text (our Cell A12), with a thumbnail size of width="40". The image-file src=" will be the next item.

The next items in the Concatenate are the relative Cell J12 (Stephanolithion_atmetos_SEM.jpg), which is the name of the image-file (which must be within double-quotes, hence the " after src=; followed by a double-quote and end-of-HTML flag: "> (which is stored in fixed Cell J4).

When one pastes this Concatenate in the next lower line; then it will automatically use the fossil name in Cell A13, and the image-file in Cell J13; but still use the fixed HTML commands in Cell I4 and J4, or: =CONCATENATE(A13," ",I4,J13,J4)

In this way, we don't need to keep typing in the elaborate information on how to designate image placement, the names of the image sets, etc.; but can put the elements into a nice organized suite of cells and columns, and merge these as desired.

In column G, a more complex Concatenate is done to combine the fossil-name, fossil-image (similar to what we did above, but with no "width" to enable a full-size photo) and a construction for making a URL (using "*href*" flag) to the appropriate web-subpage at the Nannotax website.

FILL DOWN the other entries in Column (copy-paste the first cell into the lower Blank ones) the same type of Excel-concatenate for the fossil events, and similarly with the pop-up concatenate for those cells in Column G.

This information is auto-mirrored to the "*Output*" sheet.

(3) **Outputing the Nanno.txt file, and using it from within the image-folder**

FIRST, save your Excel file! Then open your output sheet.

Only then, do a Save-As for the "**Output**" sheet – saving as .txt format – with a name such as "*LateJurassicNanno_Output.txt*". Alternatively, one can copy-paste this information directly into a text-editor from Excel, then save as .txt.

Close your files without saving again.

Move this *LateJurassicNanno_Output.txt* file into the directory "***LateJurassic_Nannotax_Images***" that contains the fossil images.

Re-set the *TS-Creator* to clear the previous datapack.

Under "File", click "***Replace Data with Default Datapack***".

Now, let us load the new Nannofossil one that you've made – Under File, click *Add datapack*, then locate and open the directory "***LateJurassic_Nannotax_Images***" and add the *LateJurassicNanno_Output.txt* file.

Select a time-interval of **144** to **157** Ma, and a Vertical scale of **2**.

Turn **ON** "*Mouse over*" (for seeing popups)

Turn **OFF** the *Marine macrofossils* column, and the *Reconstructions* column.

Under *Microfossils*, turn **OFF** *Planktonic and Benthic Forams*, and open *Calcareous Nannofossils* to turn ON Boreal Nannofossils.

Generate.

The pop-ups will have larger images, and the links to Nannotax should be active. Congratulations!
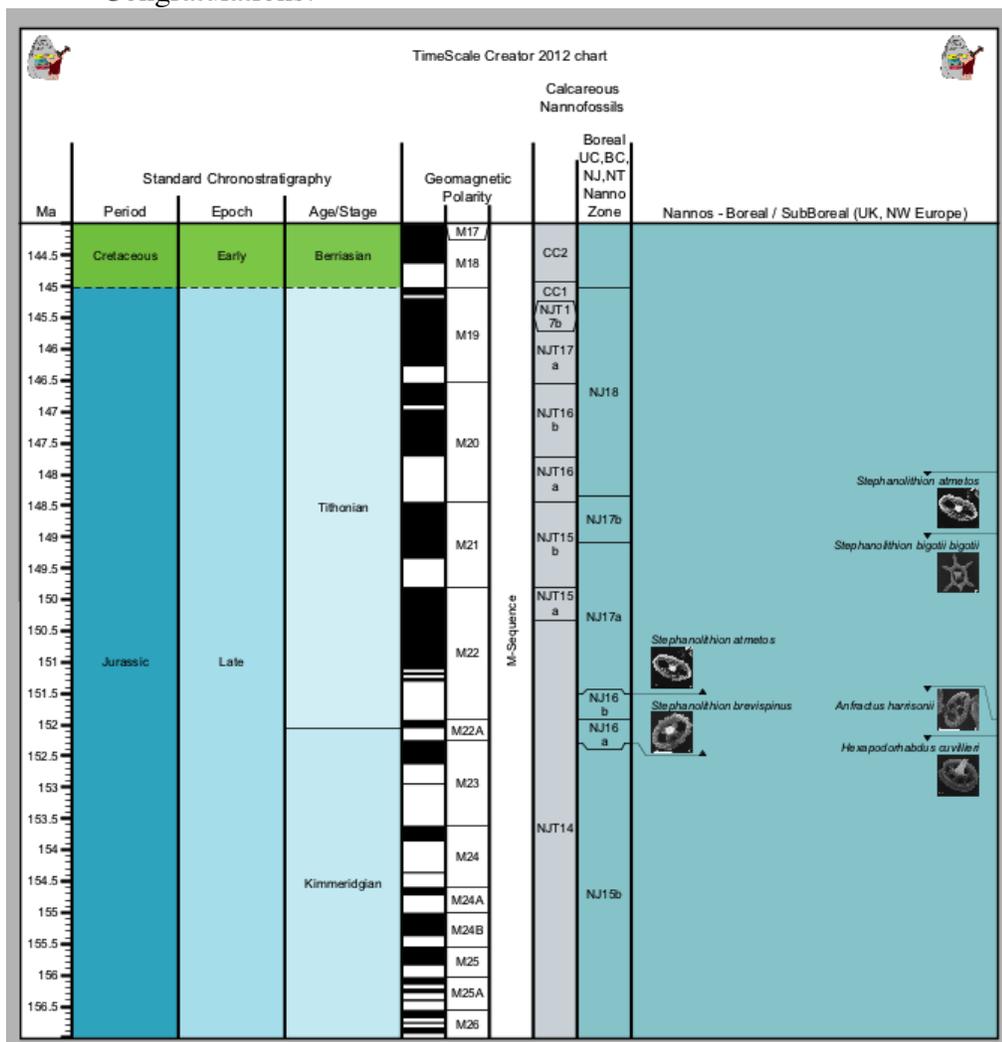
EXERCISE #3 – Making a litho-stratigraphy (rock column) datapack

FIRST: Re-set the *TS-Creator* to clear the previous datapack.
Under "File", click "***Replace Data with Default Datapack***".
The Public version of TSCreator has a 3000-character limit to uploaded datapacks (unlike the Pro), and your Nannofossil one was nearly 2500. Therefore, we need to allow the program to load your new one.

The provided Excel template for Exercise 3 has 2 worksheets open. Use the "Window -> Arrange -> vertical" in Excel to view these side-by-side.

(1) **Center of Norwegian-Danish Basin of North Sea**
In keeping with our "Late Jurassic oil-gas" theme from the Australia-North Sea datapack and Boreal nannofossils, we will use the Norwegian-Danish part of the North Sea.
In the following diagram, the rise and fall of sea level is seen quite dramatically by the "retreat" (rising sea level) and "advance" (falling sea level) of the sands from river deltas. The high sea level during the Tau Formation also has organic-rich oil-gas source rocks shown by black dots near its base.
We will compile a lithology column for just the center of this basin.

Our lithologies and the pattern-names are:

Flekkefjord Fm. = Dark grey shales with some limestone stringers. We will use "***Continental marl***" pattern (limestone in clay)
**Sauda** Fm. = Silty claystone to siltstone. We will use *Siltstone* pattern
**Tau** Fm. = Dark grey organic-rich non-calcareous shales (***Claystone***)
Egersund Fm. = Dark grey shales and siltstones. We will use "***Sandy claystone***" pattern.
Sandnes Fm. = glauconitic sandstone. We will use "***Sandstone***" pattern.

Lithology Column - center of Norwegian-Danish Basin
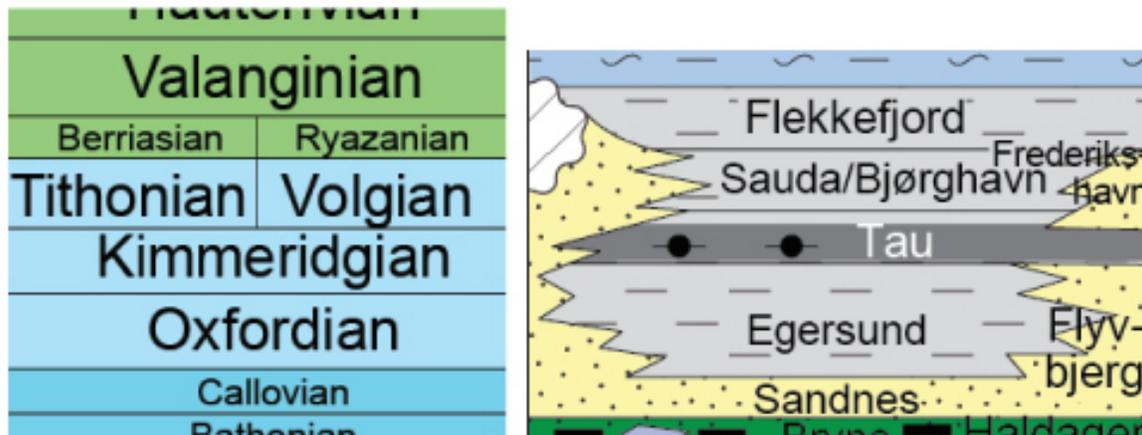
Our central-basin "reference hole"

"TOP"
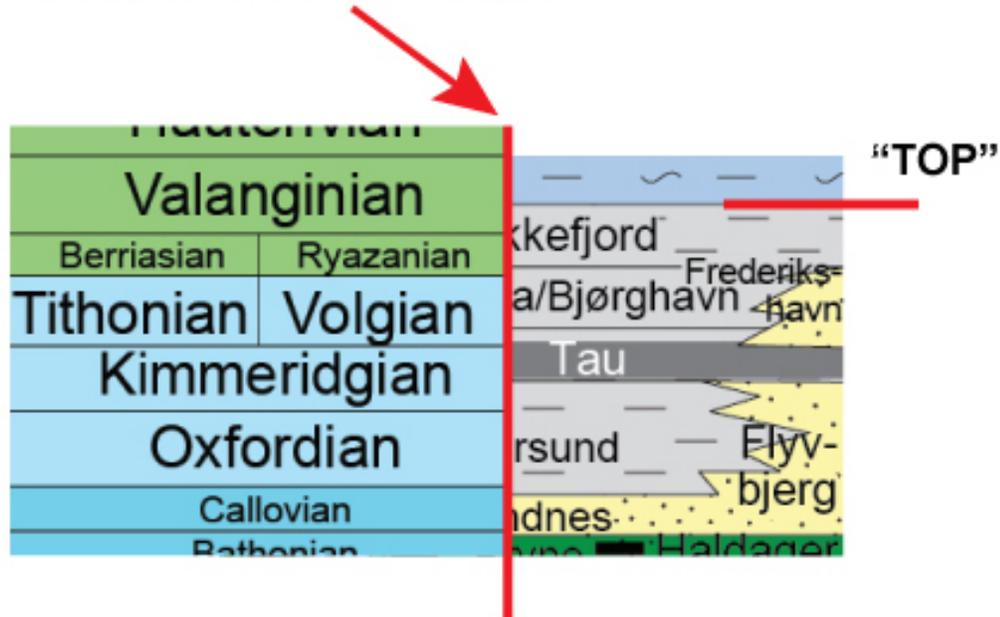
Norwegian-Danish Basin (Egersund, Tau, Sauda and Flekkefjord Formation) together form a single group, the Boknfjord Group. {NPD Bull.3}

The Sandnes Formation belongs to the Vestland Group.

(2) **Set-up for TSCreator formation-age set.** [NOTE: For the workshop, we have included a partly-formatted, partly-filled-in Excel worksheet.]

Norwegian-Danish basin -- Central column						
Group	**Lithology pattern (TSC)**	**Formation**	**Base Age (Ma)**	**Pop-up text**	**Lithology**	**Calibration & Comments**
Boknfjord Group	Primary					
	Top		137.04	LITHOLOGY= . Top of section. CALIBRATION= 50% up in Valanginian	Top of section	50% up in Valanginian
	Continental marl	Flekkefjord		LITHOLOGY= Dark shale with limestone stringers. CALIBRATION=	Dark shale with limestone stringers	
	Siltstone	Sauda		LITHOLOGY= Silty claystone to siltstone. CALIBRATION=	Silty claystone to **siltstone**	
	Claystone	Tau		LITHOLOGY= Dark grey organic-rich shales. CALIBRATION=	Dark grey organic-rich **shales**	
	Sandy claystone	Egerrsund		LITHOLOGY= Dark grey sandy shales. CALIBRATION=	Dark grey sandy **shales**	
Vestland Group	Primary					
	Sandstone	Sandnes		LITHOLOGY= Glauconitic sandstone. CALIBRATION=	Glauconitic **sandstone**	

Column "A" – Group:
As you saw for British and Australia, the TSCreator puts a "grouping" name next to the names of a set of component formations. The program recognizes this name by a "Primary" flag in the 2nd column.

Norwegian-Danish basin suite of Egersund, Tau,. Sauda and Flekkefjord formations together form a single group, the **Boknfjord Group**. The underlyng sandstone of Sandnes formation is the uppermost **Vestland Group**.

=> Therefore, our "*Primary*" label will be "Boknfjord Group" above "TOP" of Flekkefjord, then a "Vestland Group" *Primary* label between Egersund and Sandes formations.

Column "B" – Lithology pattern
There are a total of 248 lithology patterns built into TSCreator. The downloadable manual (2019 version) has a table of these (at the end of Section 1). For this simple example, we have provided the desired names. *[NOTE: These are just "names of patterns", and are not meant to be formal lithologic nomenclatures. One merely selects a pattern that you'd like to use to represent the actual lithology schematically on the final simplified column.]*

Column "C" – Formation
This is the name to be placed next to the lithology pattern in the final diagram.

Column "D" – Age

In the diagram, the age of each formation is shown relative to geologic stages as used in the North Sea. Therefore, to compute the age of the base of that formation (except for "top" of diagram, we only use bases), then one uses the placement of that basal-boundary relative to a master-age scale for those geologic stages. Below are those ages from *Geologic TimeScale 2012*:

Boreal (high-latitude) geologic stages used in North Sea region				
	TOP	133.88	From GTS2012 summary	
	Valanginian	140.20	From GTS2012 summary	153/211/106
	Ryazanian	144.10	Base of Chetaites sibericus / Praetollia maynci	140/205/96
	Volgian	152.06	Base of E. magnum	217/241/247
	Kimmeridgian	157.25	Same as base-Baylei (based on Skye GSSP proposed definition)	204/236/244
	Oxfordian	163.47	Base of Q. mariae ammonite zone. GSSP is not yet decided.	191/231/241
	Callovian	166.07	Base of B. bullatus ammonite zone. GSSP is not yet decided.	191/231/229

Therefore, because the "top" of the Flekkefjord is approximately mid-way (50% from base) in the Valanginian, then its numerical age is the **Base Valanginian** (140.20 Ma) **minus** 50% of the **duration** of the Valanginian *[0.5 * (140.20 – 133.88) = 3.16 myr)]*, hence 137.04 Ma.

Column "E" – Pop-up text

When one clicks on the formation pattern, we want to see a pop-up with the details on the lithology, plus the information on how the basal age was derived.

For this purpose, we have entered the separate information on these two items in columns "F" and "G", then merged that information by using Excel's command of "CONCATENATE".

For the "top" of the Flekkefjord, this "merge cells" equation is:

=CONCATENATE("LITHOLOGY= ",F7,". CALIBRATION= ",G7)

Such Excel "merge information" commands are very useful.

(3) Compute Ages of Bases of each Formation

Your first task – By using the diagram, Fill in the "age of base of formation" relative to the geologic stages, THEN use the reference Boreal age scale to compute those numerical ages.

You can either use a calculator, or, preferably, as we did for the Nannofossil datums, include the "*geologic stage age table*" as a separate sheet in the Excel workbook, and use Excel to compute the ages for you based on percent-up within each geologic stage.

THEN, use the CONCATENATE command to prepare the pop-ups for each item.

When you complete this table, then SAVE your Excel sheet (with date, name, etc.)

(4) Mirror and save as text output

Our last step is to extract the pattern-formation-age-popup information from the table, and add the header for a "facies" (rock type) column.

You can either copy-paste into a text-program (e.g., TextEdit in Mac) and add the header, or prepare a mirror sheet within Excel and save as tab-delimited text:

Norwegian-Danish basin -- Central column	facies	100	255/255/255	
Boknfjord Group	Primary			
	Top		137.04	LITHOLOGY= Top of section. CALIBRATION= 50% up in Valanginian
	NOR Marl	Flekkefjord	*[you are computing]*	LITHOLOGY= Dark shale with limestone stringers. CALIBRATI(
	Siltstone	Sauda	*[you are computing]*	LITHOLOGY= Silty claystone to siltstone. CALIBRATION=
	Claystone	Tau	*[you are computing]*	LITHOLOGY= Dark grey organic-rich shales. CALIBRATION=
	Sandy claystone	Egerrsund	*[you are computing]*	LITHOLOGY= Dark grey sandy shales. CALIBRATION=
Vestland Group	Primary			
	Sandstone	Sandnes	*[you are computing]*	LITHOLOGY= Glauconitic sandstone. CALIBRATION=

Optional -- you can also add a mirror of our geologic stages, although TSCreator already has these
built-in (including colors):

Boreal stages	block	100	148/206/212	notitle	
	TOP	133.88		From GTS2012 summary	
	Valanginian	140.20		From GTS2012 summary	153/211/106
	Ryazanian	144.10		Base of Chetaites sibericus / Praetollia maynci	140/205/96
	Volgian	152.06		Base of E. magnum	217/241/247
	Kimmeridgian	157.25		Same as base-Baylei (based on Skye GSSP proposed definition)	204/236/244
	Oxfordian	163.47		Base of Q. mariae ammonite zone. GSSP is not yet decided.	191/231/241
	Callovian	166.07		Base of B. bullatus ammonite zone. GSSP is not yet decided.	191/231/229

Select interval of **140** to **166 Ma**.

Your results, when placed against international stages, will be approximately:

Time Scale Creator 2012 chart
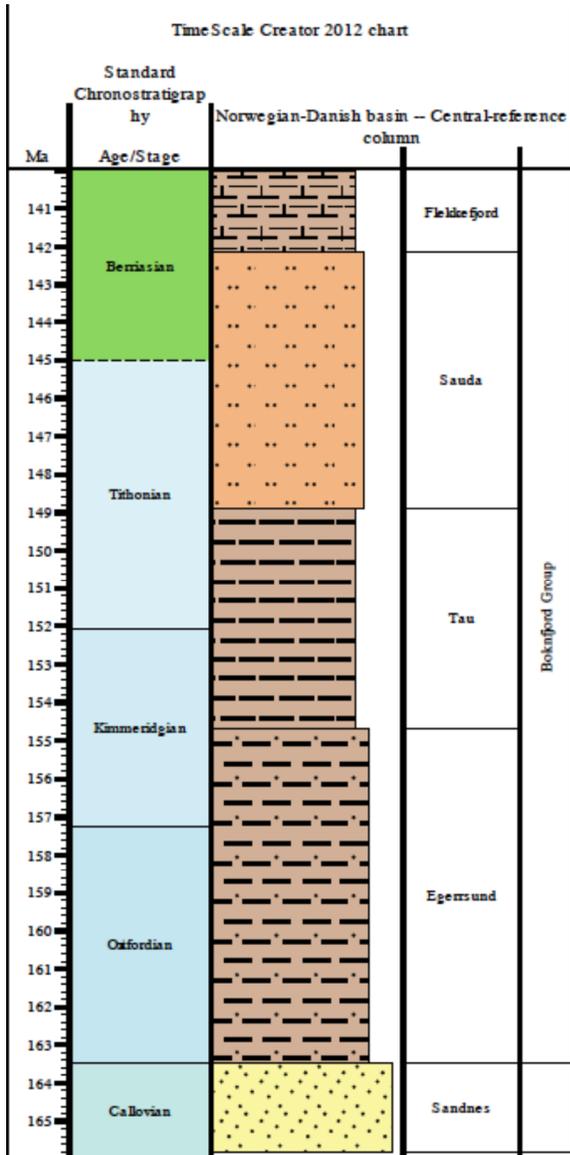
Part 4 – TS-Creator On-Line

TSC-Lite

Now, let's use a browser interface into two new *TimeScale Creator* user-interfaces:

Internet-system #1 – TSCreator "Lite"

(1) **Open a browser -- https://timescalecreator.org/tsclite/index/index.php**
    This may also be found as a Tab "TSC-Lite" at the top of the regular TSCreator website.

This TSCreator is initially intended for educational and general-audience usage.

(2) **Nannofossils – with Images and Nannotax links**
    In the top menu, set ages to be **120** and **140**; and Vertical Scale to be **2**.
    Turn on "*Enable Popups on Generated Chart*"
    Turn on (turn Green) the red-dot on **Nannofossil zones**.
    Generate;   Click the 1:1 icon. Explore.
    The result is similar to when one downloads the TSCreator datapack "Calcareous Nannofossils with Images" to "add" into the main TSCreator program. An advantage to the TSCreator server system is that many datasets can have active images for immediate delivery.
    Click on any Nanno, and you'll get a pop-up with larger images, plus a direct link to Nannotax for this species.

This system will work nicely on iPad, and even on iPhone – one can enlarge images with one's fingers.

(3) **Dinosaur evolution – with Images and links**
       At the top of the image, click "***Back to Chart Settings***"
       For the age settings, use **110 to 200**, with a vertical scale of **0.5**

       Click "**off**" the Nannofossils, and Click "**on**" **Mesozoic Reptiles** – this is the evolution of dinosaurs and their relatives. The full evolution of vertebrates is a very large datapack that can be downloaded for the full TS-Creator.
       Click "**off**" the **Magnetic Polarity** and turn "off" **Reconstructions** (bottom of set)
       Generate;   Click the 1:1 icon. Explore.

       The left-most set (with grey background) is a schematic evolutionary diagram. The other columns are ranges of selected dinosaurs and relatives of different groups.
       Click on any range, and a pop-up appears with information (especially for the selected range sets). Many of these are also linked to external sites for more information.
       As always, this is a work-in-progress.

(4) **Hominids – with Images and links** *(if you wish to explore more)*
       At the top of the image, click "***Back to Chart Settings***"
       For the age settings, use **0 to 5**, with a vertical scale of **6**
       Click "**off**" the **Mesozoic Reptiles**, and Click "**on**" **Humanoids** – this is the ranges of our ancestors, plus tool cultures.
       Generate;   Click the 1:1 icon. Explore.
       The images (and links) are provided by the Smithsonian and American Museum of Natural History.

       Our goal is to eventually have images for ALL fossil groups. Your contributions and assistance would be very welcome!

Additional items -- Selected display options; "out of memory", etc.

Saving Display Parameters (Settings) – Once you've created a screen display that you like, then under ***Settings***, there are bottom-buttons that enable you to **SAVE …** a "*Settings file*" that contains the necessary instructions for TimeScale Creator to recreate that display, 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. This setting option is also useful to standardize diagrams (fonts, arrangements, etc.).

       Details on the many other capabilities and display options are illustrated under "*Features*" in the ***Help*** menu (main window).
       Have fun exploring the data sets and graphic options, and we hope that you will find this suite useful for reference and generating base-graphics for your research and teaching.

NOTE: *The free public TimeScale Creator does not allow you to save charts after a datapack has been added. Only the PRO version allows saving charts after uploading other datasets. See our PRO page for other features, and how to get the PRO version (which comes with a large selection of datapacks).*

     A word of advice during exploring – there are numerous <u>close-spaced</u> Foram and Nanno events in the Neogene in the current database (and an abundance of Sequences in the glacial-pulsed **Pleistocene**), so the auto-adjust software sometimes has problems to display these details unless a vertical scale of at least **4** cm per 1 million years. A similar high-density of detail occurs with the brief North American ammonite zones in the Campanian-Turonian interval and ammonite subzones within much of the Jurassic-Cretaceous. Therefore, we have placed some of this dense-detail into "additional" columns with the lesser-used secondary events, plus shorten the genera names for the ammonites and other taxa.

Getting a blank Screen after Clicking Generate:
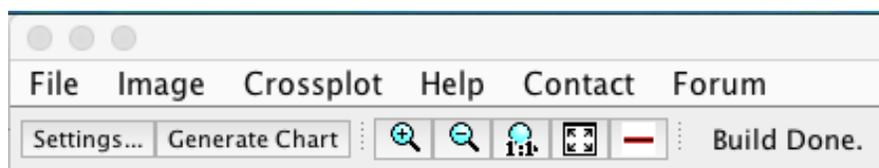
If you get this error, just hit **Generate** again and the display should work.

     A MEMORY problem that may occur -- The default Java installation on some operating systems limits the amount of memory a program can use. This Java default may cause the program to occasionally display **out of memory** (especially with large or information-heavy displays after several iterations). **DON'T PANIC!** If this happens, a message will appear on the screen -- you can still save the *Settings* file to regenerate the on-screen display, and usually can save the non-displayed SVG graphic file to be opened in another graphics program or Firefox-type browser. If "***Out of Memory***" appears, then the *TimeScale Creator Pro* will also explain how to increase the Java memory allocation. In many cases, hitting "**GENERATE**" again will solve the problem! If that doesn't work, then before you restart *TSCreator* to clear Windows-memory, save your current settings (See above for SAVE/LOAD) to not loose much time.

     In addition, on Window machines, the screen refresh will become slower and slower – again, the same JAVA problem in not clearing memory – so, save settings, then close and re-start JAVA and *TS-Creator* again.

     We welcome your suggestions for major and minor improvements in the default database, visualization graphics, and overall system! Please convey your ideas, desires and critical evaluations to us at *jogg@purdue.edu*.

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Database coordinator – **James Ogg**
     [professor emeritus, Dept. Earth & Atmos. Sci., Purdue University, Indiana; jogg@purdue.edu]
     and former *Chair, Subcommission on Stratigraphic Information, International Commission on Stratigraphy*. Visualization software developed by students of Purdue University