Geologic TimeScale Foundation

25 July 2016

Dear TSCreator User:

We have mounted the **TSCreator 6.8 and 7.0** for you:
There are both **.jar** (for Mac/Linus) and **.exe** (for Windows) versions. *[NOTE: If you have a problem opening the .exe; then first try updating your Java; and, if that doesn't work, then contact us.]*

Currently, the new TSCreator 6.8 and 7.0 are similar software enhancements; but with different internal datapacks. TSC 7.0 has the new GTS2016 age model/calibrations; but TSC 6.8 is the older GTS2012 set. *[In case you are wondering what happened to TSC 6.7 that was to have been released last year, our students wanted to finish adding many more features, therefore we decided to delay it until the simultaneous release of the GTS2016 age model in TSC 7.0.]*
TSC 7.0 internal dataset now includes 440 columns (35 are curves) grouped into 140 directory/subdirectory clusters; a total of 51,000 data entries. The full listing of columns (a PDF table) is posted on the TSCreator website.

This letter briefly describes some of the main features. **Not all of these features are available in the public TSC version** (If you are interested in getting a "TSC Pro" license, please contact us jog@purdue.edu).

(I) TSC 7.0 updated age model (GTS 2016) and new/revised data columns.
(II) TSC 6.8/7.0 software program enhancements
(III) New datapacks (Australia, North Sea-Norwegian Sea, etc.)

(I) TSC 7.0 updated age model (GTS 2016) and new/revised data columns.

GTS 2016 was developed for "A Concise Geologic Time Scale" (Ogg, Ogg, Gradstein; Elsevier Publ., ca. 240pp; published June 2016). An effort was made to include new ratified GSSPs, verified cycle-scaling, consensus biozonations/datums, isotope curves, and selected other developments since the publication of GTS2012; but minimize revisions of the age model unless required by major advances.

A full list of the difference in stage boundary ages of GTS2016 versus GTS2012 is an appendix at the end of this newsletter; but there are also many updated calibrations of datums, new zonations, and other revisions.

A few of the numerous major enhancements and new columns are:

(1) **Cenozoic** (*selected*): Eocene is fully cycle-scaled following Westerhold et al. (2014, *Orbitally tuned timescale and astronomical forcing in the middle Eocene to early Oligocene*, Climate of the Past, **10**: 955-973. and 2015 *Astronomical calibration of the geological timescale: Closing the Middle Eocene gap*, Climate of the Past, **11**: 1181-1195"). A new Cenozoic nannofossil zonation and refinement of datum calibrations is modified from Backhouse et al. (2012, *Biozonation and biochronology of Miocene through Pleistocene calcareous nannofossils from low and middle latitudes*, Newsletters on Stratigraphy, **45**: 221-244) and Agnini et al. (2014, *Biozonation and biochronology of Paleogene calcareous nannofossils from low and middle latitudes*, Newsletters on Stratigraphy, **47**: 131-181). Carbon and oxygen isotope events are itemized.

(2) **Mesozoic** (*selected*): GSSPs for Santonian, Albian, Oxfordian, and Toarcian; and base-Cretaceous working definition. Improved cycle-scaling of Maastrichtian-Campanian, Valanginian-Hauterivian, and Early Triassic (many sources). Revised Cretaceous sequences (Haq, 2014, *Cretaceous eustasy revisited*. Global and Planetary Change, **113**: 44-58). Revised ammonoid zones and calibrations (e.g., Reboulet et al., 2014. *Report on the 5th international meeting of the IUGS Lower Cretaceous Working Group, the Kilian Group*. Cretaceous Research, **50**: 126-137;).

(3) **Paleozoic** (*selected*): High-resolution cycle-scaled Pennsylvanian through earliest Permian stages, sequences, conodonts, benthic foraminfers and ammonoid zonations (e.g., Schmitz and Davydov, 2012. *Quantitative radiometric and biostratigraphic calibration of the Pennsylvanian–Early Permian (Cisuralian) time scale and pan-Euramerican chronostratigraphic correlation*. Geological Society of America Bulletin, **124**: 549-577. Heckel (editor), 2013. *Pennsylvanian Genetic Stratigraphy and Biostratigraphy of Midcontinent North America*. Stratigraphy, **10**: 126 pp). Paleozoic ammonoids updated from Korn et al. (2015, *Ammonoid Paleobiology: From macroevolution to paleogeography*; Springer Publ.). Base Cryogenian is officially set as base of first global glacial at 720 Ma (not 850 Ma).

(4) **General** (selected): Nannofossil popups linked to *Nannotax3* website. Composite Carbon-13 and Oxy-18/temperature curves compiled from many sources. Large Igneous Provinces (LIPs) and Major impacts are linked to individual episodes on appropriate websites. Alternate Precambrian divisions and history of crustal evolution are included.

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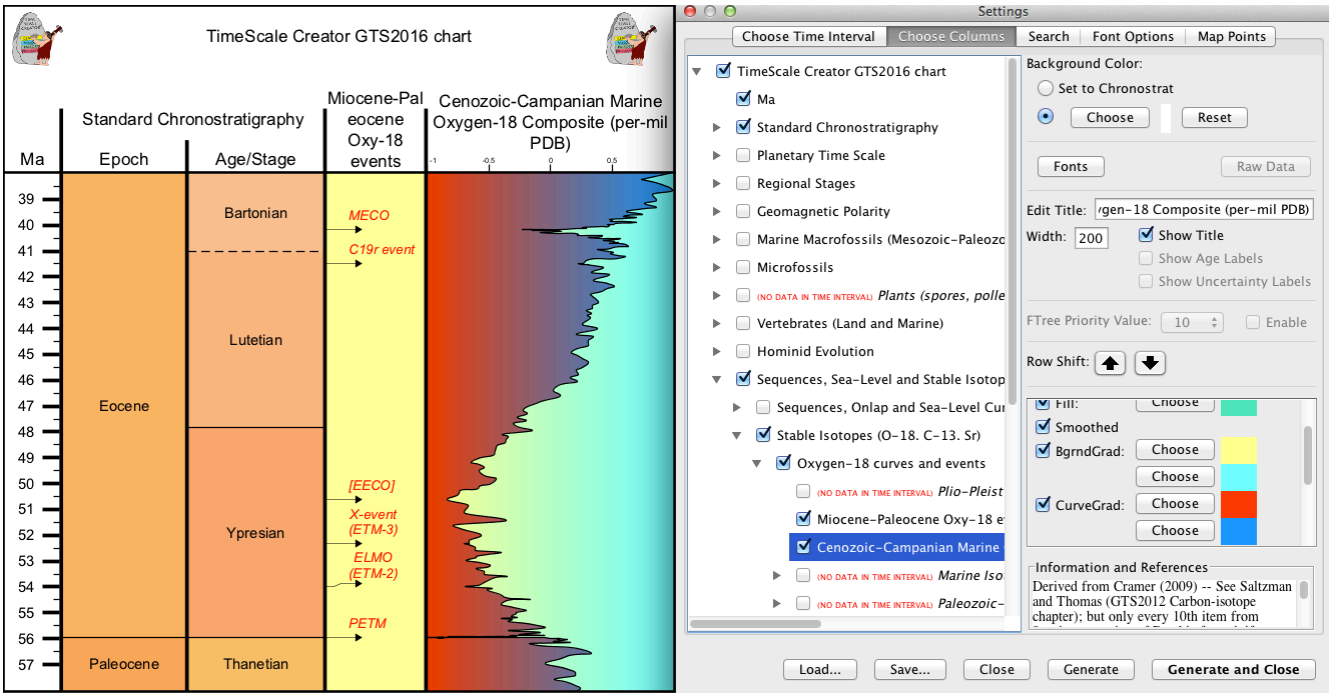
(II) TSC 6.8/7.0 software program enhancements

(1) GRADIENT-FILL (Point curves) – The new TSC 6.8/7.0 supports Gradient-fill of a Background or the Fill of a Curve; (e.g., a "temperature" type gradient).

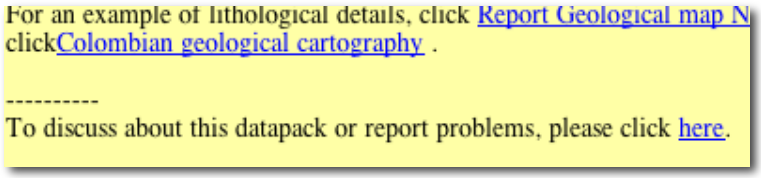


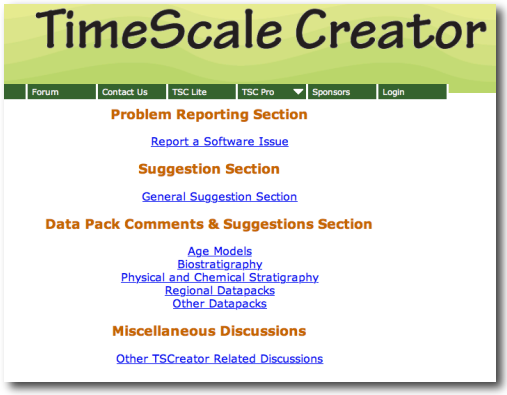
To use a gradient fill, go in the menu to find the curve-column; then highlight it to bring up the menu of options. In the middle part of that menu suite, scroll down below the "show scale" to get to "Gradient". You can select the end-members for a two-tone fill to the Background, and to the Curve-

fill. For Curve-fill, the "Fill" must be checked above the Gradient set. *[NOTE: Set-Scale and other options are below the Gradient-selection set.]*

(2) Contact Us – direct link between Popups and TSCreator website "forum"

At the bottom of each popup is automatically a Hot-URL-link to a new Forum page at the TSCreator website:



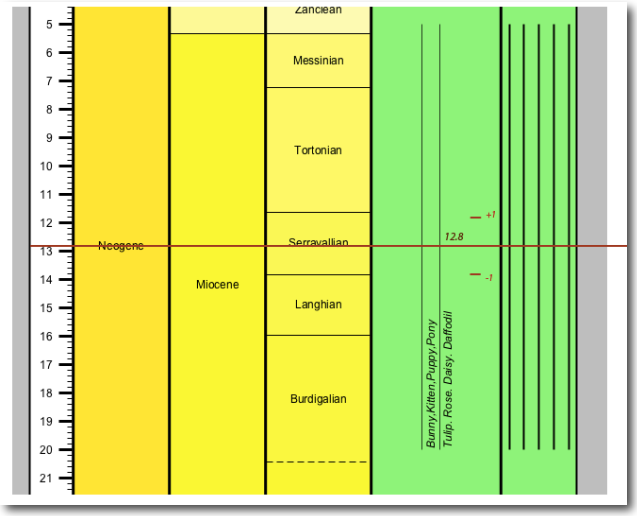


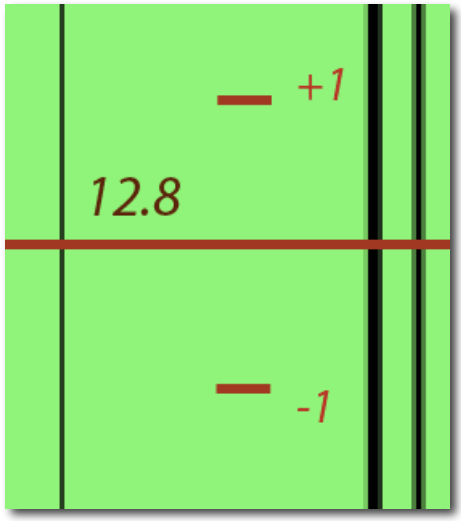
You can also enter this Forum directly at the website. The comments go directly to us, and then we "authorize" these to be displayed.

We will strive to provide feedback, and you can see earlier comments/discussions.

(3) "Red line" – when in large chart – now shows "scale"

One can turn on a "Red line" overlay using a button-icon at the top of TSCreator display. This is useful for showing the age/depth when zooming into large charts. This system now has a semi-smart set of "scale markers" (-1/+1; converts to -10/+10 if using a larger scale, etc.), so one knows the approximate time-separation or depth-separation while looking at events in the middle of the chart.





(4) Synonyms are now supported (for Searches)

Inevitably, some of the "standard names" of one's set of data is not the standard used by others.

You can now attach a "column" of type "synonym". These will be included in the Search results (*one pass only to avoid circular reasoning*).

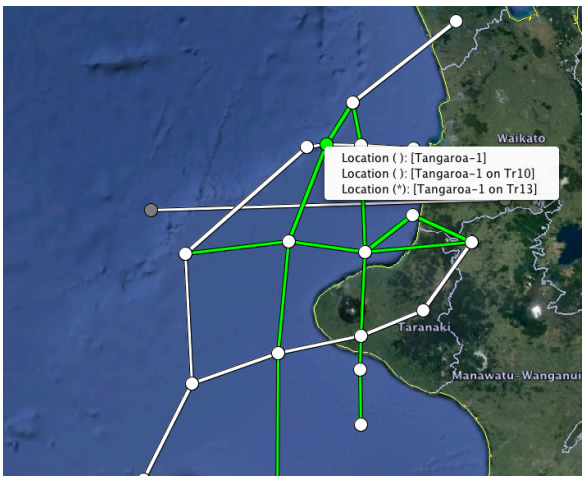
Other words [TAB] **synonym** [TAB] 100 [TAB] 255/255/255 horse [TAB] pony clay [TAB] claystone Tom [TAB] Tommy rock [TAB] brick rock [TAB] pebble rock [TAB] stone chicken [TAB] hen

As you can see the form looks pretty easy and clean. When doing a Search for "pebble", then results will be returned for entries containing "pebble" and also for "rock". But, a search for "rock" will only return results for Rock (unless you include a separate "pebble [TAB] rock" entry).
This is just a sample of the datapack, you can add as much as you wish. Just don't forget **first** column is "Standard Name", **second** column is a **synonym**.

(5) Map-packs – Selected among overlapping points

In some mappacks, there are intersecting transects or other causes of overlapping points.

Now, in the map-interface, when you Right-click with the mouse on one of these overlaps; you can select which column to activate:



NOTE: A right-click brings up the name of each location point in any case.

(6) Uploading LAS format files (downhole logging data)

Under "open datapack" is now the option to open a ".las" file, that is commonly used for downhole logging data, such as natural-gamma, resistivity, and density.

This will activate a conversion to a set of TSCreator-format "point/curve" columns; in addition to automatically displaying the data on the graphics. You have options for the default settings (curve fill, background color, smoothing, margins, etc.) for saving the converted LAS file.

Typical LAS input file:

```
~Version Information Section
~
~
~Curve  Information Section
~
~
DEPTH.x0
COLUMN1.x1
COLUMN2.x2
COLUMN3.x3
COLUMN4.x4
...
COLUMNn.xn
~ASCII Log Data Section
        DEPTH_DATA      COLUMN1_DATA    COLUMN2_DATA    COLUMN3_DATA    COLUMN4_DATA    ......  COLUMNn_DATA
```

Is converted to TSCreator set of Point-curves:

```
age unit:       AGE_UNIT

LAS log output: COLUMN1.x1 COLUMN2.x2 COLUMN3.x1 COLUMN4.x4 ... COLUMNn.xn

COLUMN1.x1
        COLUMN1_DATA
           ....

COLUMN2.x2
        COLUMN2_DATA
           ....

COLUMN3.x3
        COLUMN3_DATA
           ....

COLUMN4.x4
        COLUMN4_DATA
           ....

.....

COLUMn.xn
        COLUMNn_DATA
```

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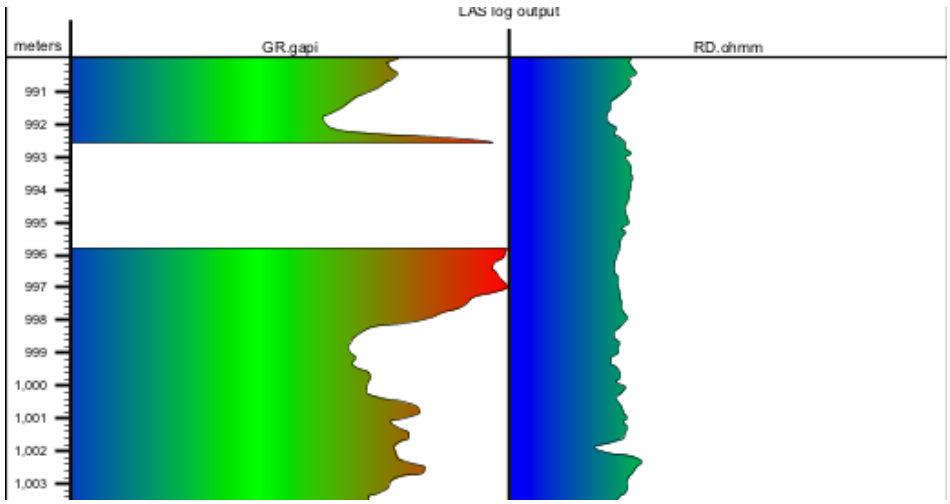
VISUALIZING and MAKING DATAPACKS – More Options

(7) CURVES with Gaps



To designate a GAP in a data curve, just insert the word “GAP” or “gap” one [TAB] after the data-value. Normally, this position is used for any comments; but the program will recognize the “gap”, and therefore cause the Curve to “*plunge to 0*”. An example is shown above; and a typical usage of “GAP” is given below:

```
Composite 8 to 20 Gap Test    point   150     255/245/230    notitle on      Data provided by I. Raffi
nopoints       255/0/0 nofill  2       3.5     smoothed
        8.973   2.77
        8.979   2.92
        ........
        9.062   2.96
        9.067   2.76
        9.076   3.08    comment
        19.085  2.82    GAP
        19.094  2.86
        19.103  2.79
        19.112  2.86
        19.121  2.92
        19.130  2.66
        19.139  2.93
```

NOTE, that this type of "gap" method works fine for Gamma logs, resistivity, or other data sets that have positive values; but the "*plunge to 0*" is unsuitable if you have negative values (e.g., isotopes or relative sea-levels). In those cases, one will need to use curve-segments, in which each one is a "point-overlay" data-column that overlays the initial "point" one (with same width and margin settings; but curve fill/color can be different if desired):

```
Upper part      point 150     255/245/230    notitle on      Data provided by I. Raffi
nopoints        255/0/0 nofill  2       3.5     smoothed
        8.973   2.77
        8.979   2.92
        ........
        9.062   2.96
        9.067   2.76
        9.076   3.08

Next part       point-overlay       150     255/245/230    notitle on      Data provided by I. Raffi
nopoints        255/200/0       nofill  2       3.5     smoothed
        19.085  2.82    GAP
        19.094  2.86
        19.103  2.79
        19.112  2.86
        19.121  2.92
        19.130  2.66
        19.139  2.93
```

[NOTE: The image above was a beta-version for a tri-color gradient-fill; but we decided that it was too complex for easy user interfaces; therefore only a two-color gradient is currently supported.]

(8) Foreign characters are now displayed in Popups (including within Lithology popups)

A long-standing problem with "simple text" is that it is not standardized in format among Excel (Microsoft), JAVA, SVG, Unix, DOS, etc. In particular, the "txt" saved from Excel, even using Unicode 16, is not the same "txt" when saved from a "dumb" text-editor, nor what Java expects to receive.

We have now tried to have the JAVA routines in TSCreator read the type of ".txt" from Excel (if saved as Unicode 16 format) and recognize those foreign characters and "odd" marks. *Known exceptions are the symbols of "<" and ">", because Java/SVG uses these as command-line characters, and we can't do anything about this.*

Therefore, we hope that any Excel/Word file, if saved as Unicode 16 "text" (albeit, the datafile becomes twice the size), will preserve display of all characters when

(9) Displaying a Member column and Wavy-contacts in Lithology columns

As requested by several users, you can now display "MEMBERS" and have contacts with WAVY lines in Lithology columns.

Those two new features are Tab-separated after the regular facies-format:

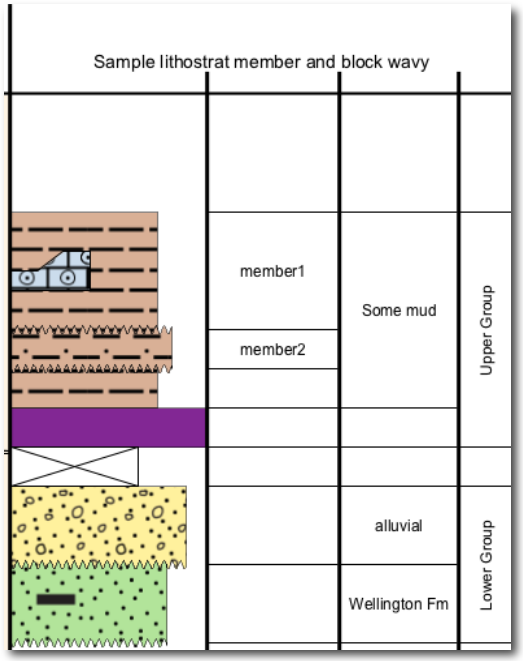
PATTERN / Formation-Name / Age / Popup / Member-name / Wavy (or dotted/dashed)

Where "/" denotes a TAB.

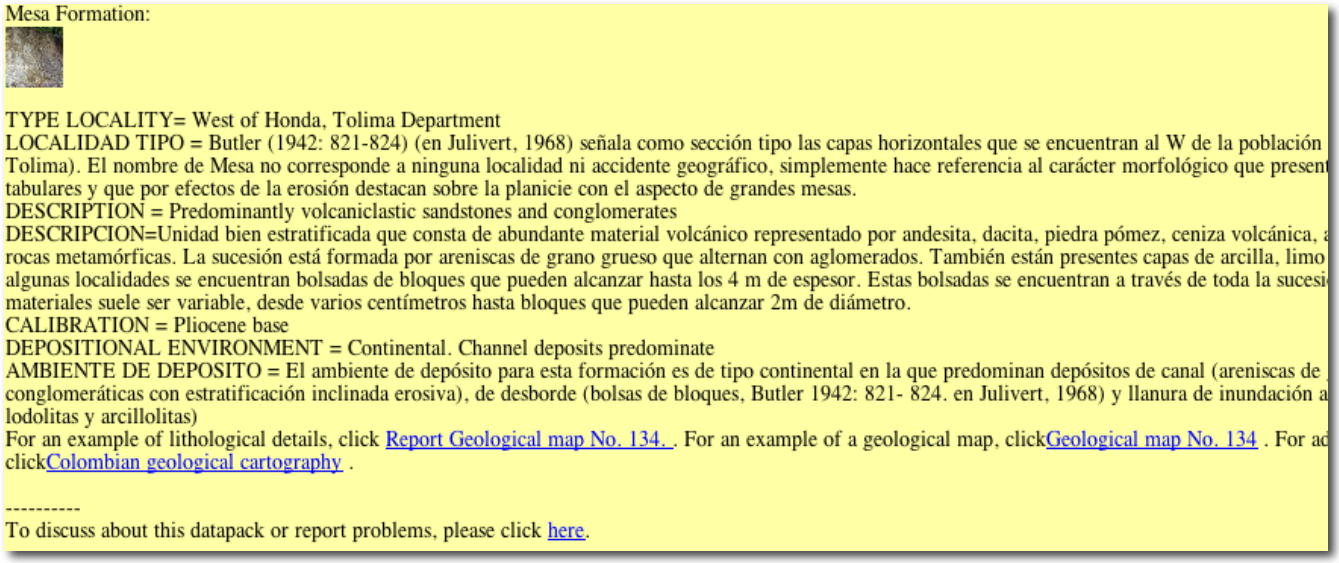
The "Member" column is Default-off; and turning it ON in the menu will display it between the PATTERNS and the Formation-Names

Example (the Arrows are tabs):

```
Sample lithostrat member and block wavy→facies   →   150¶
Upper Group Primary¶
   →   TOP →    →   3¶
   →   Claystone → Some mud → 6  →     →   member1  →  wavy¶
   →   Sandy claystone → Some mud → 7  →     →   member2  →  wavy¶
   →   Claystone → Some mud → 8  →  Name spans set¶
   →   CS dark purple →    →   9  →  Comment -- weird soil ??¶
   →   Primary  →     →     →   [NOTE: Space in first column]¶
   →   Gap →    →   10¶
Lower Group Primary¶
   →   NZ Conglomerate → alluvial  → 12 →     →     →  wavy¶
   →   NZ Coal sandstoneWellington Fm  →  14 →     →     →  wavy¶
¶
Lms wedge → freehand-overlay→150¶
POLYGON  →  closed   →     →   Oolitic limestone¶
   →   61  →  4¶
   →   40  →  4¶
   →   20  →  4.5¶
   →   -1  →  4.5¶
   →   -1  →  5¶
   →   20  →  5¶
   →   40  →  5¶
   →   61  →  5¶
```



You can also insert Images within Popups in Lithology facies (click on Formation or Member names), using the same format as with Popups with Events/Blocks (e.g., `Mesa Formation:<br> <img align=""middle"" src=""F1.png"" height=""40""><br>)`. The following example also shows preservation of non-English language characters (e.g. `señala como sección tipo`).


Mesa Formation:

TYPE LOCALITY= West of Honda, Tolima Department
LOCALIDAD TIPO = Butler (1942: 821-824) (en Julivert, 1968) señala como sección tipo las capas horizontales que se encuentran al W de la población
Tolima). El nombre de Mesa no corresponde a ninguna localidad ni accidente geográfico, simplemente hace referencia al carácter morfológico que present
tabulares y que por efectos de la erosión destacan sobre la planicie con el aspecto de grandes mesas.
DESCRIPTION = Predominantly volcaniclastic sandstones and conglomerates
DESCRIPCION=Unidad bien estratificada que consta de abundante material volcánico representado por andesita, dacita, piedra pómez, ceniza volcánica, a
rocas metamórficas. La sucesión está formada por areniscas de grano grueso que alternan con aglomerados. También están presentes capas de arcilla, limo
algunas localidades se encuentran bolsadas de bloques que pueden alcanzar hasta los 4 m de espesor. Estas bolsadas se encuentran a través de toda la sucesi
materiales suele ser variable, desde varios centímetros hasta bloques que pueden alcanzar 2m de diámetro.
CALIBRATION = Pliocene base
DEPOSITIONAL ENVIRONMENT = Continental. Channel deposits predominate
AMBIENTE DE DEPOSITO = El ambiente de depósito para esta formación es de tipo continental en la que predominan depósitos de canal (areniscas de
conglomeráticas con estratificación inclinada erosiva), de desborde (bolsas de bloques, Butler 1942: 821- 824. en Julivert, 1968) y llanura de inundación a
lodolitas y arcillolitas)
For an example of lithological details, click Report Geological map No. 134. . For an example of a geological map, clickGeological map No. 134 . For ad
clickColombian geological cartography .

To discuss about this datapack or report problems, please click here.

(10) Adding open-format "*uncertainty*" to displayed ages

One can display Uncertainty in an indicated age (or depth) for a Block/zone or Event; and the input format is now "open" (not only numbers). The "uncertainty" entry is displayed after the Age within parentheses.

Example:

```
Tortonian  /  11.63  / (line type) / (popup) / (RGB) / (priority) /  +/-0.3
Serravallian  / 13.82  /  / (popup) / 255/255/89   /  / unknown
```

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(11) Enhancements to Cross-plot and Depth-Age conversion

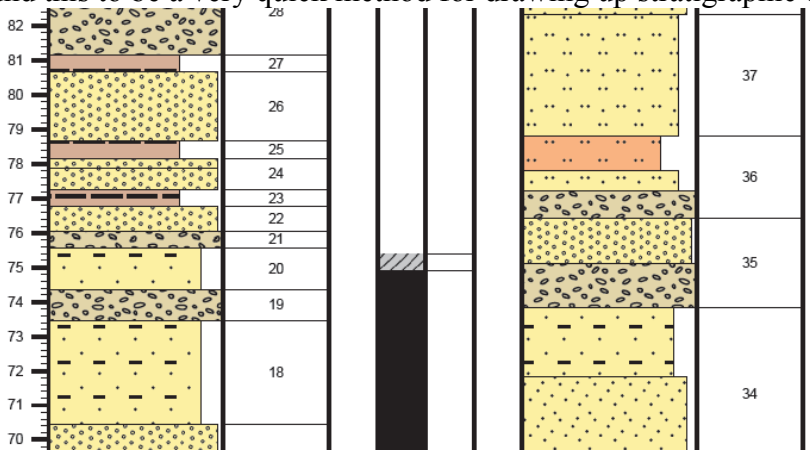
(a) OUTCROPS (stratigraphic "up")

Until now, the crossplot system (and rest of TSCreator) only supported borehole-type data (depth measured down).

You can now upload Outcrops measured "up" by indicating the flag "*outcrop*" in the top headers:

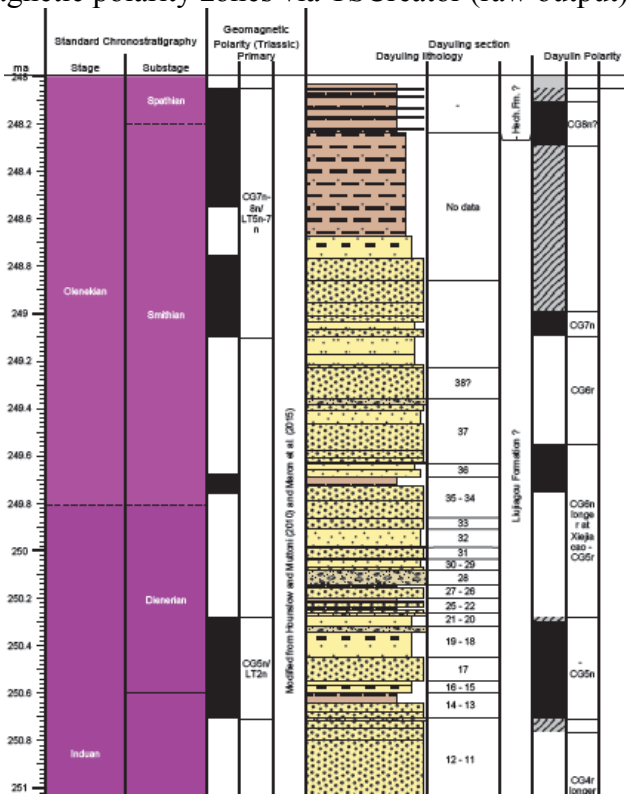
date: [TAB] 16/12/2009
outcrop: [TAB] ON
age units: [TAB] Upmeters
Chart title: [TAB] This is my outcrop near Purdue

We have found this to be a very quick method for drawing up stratigraphic columns in the field.



You can also do Cross-plots of Outcrops (measured "up") against age-scales; and do a "depth" to age conversion of that outcrop. All the "outcrop up" values are maintained, and converted.

Here is part of that outcrop after doing a time-conversion (Crossplot) using cross-correlation of the bases of some of the magnetic polarity zones via TSCreator (raw output):



(b) Auto-match "zones"

Until now, the auto-match system for Depth-to-Age markers only looked at Event columns for same-name matching.

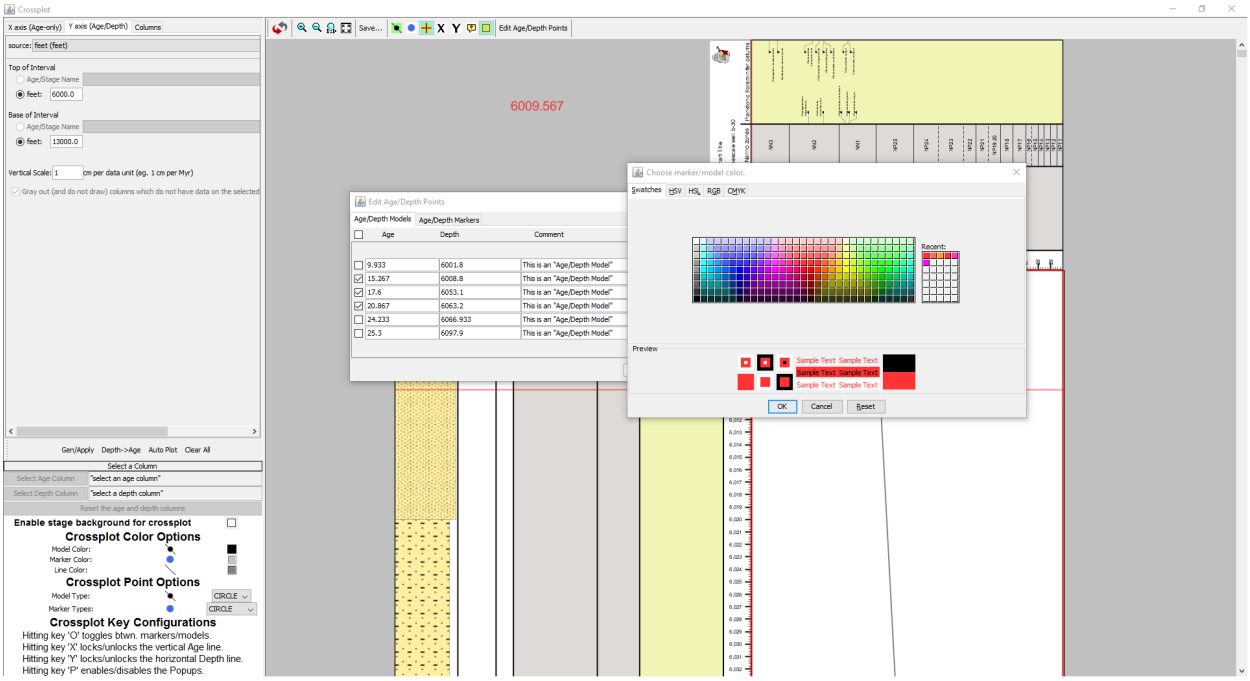
You now have the option to match "block columns" (zones, stages, etc.), including auto-match. The markers on the Crossplot for this type of marker is a rectangle (versus circles with top/dash/base lines for FAD/Event/LAD).

(c) Automatic transfer of "marker names" when doing auto-match.

If you let the cross-plot do an auto-match of same-name FAD/LADs between a reference time scale and a borehole or outcrop; then those names are automatically attached to the markers in the saved file. The same is true if you select one of those markers for the Depth-to-Age control points; then the name of that fossil event is automatically attached to that control-point in the file for easy reference.

(d) Color selection for multiple markers

The default colors in cross-plot for auto-matching events/zones is the background color for their TSCreator column (e.g., "nannofossils" were usually against light gray background columns). Fine for that type of graphics, but very dull for cross-plot of the different taxa. You can now assign bright colors to these markers using the "Show Marker" pop-up window selected from top of Cross-plot screen. The system used to require one-by-one changes; but now you can select all the entries that you wish to be a specific color, then clicking on the color panel and choosing the desired color, then clicking *apply* will change all the entries that were selected into the chosen color.



(e) Accumulation rates

When doing a Depth-to-Age conversion, the system automatically attaches an Accumulation Rate curve based on the sets of Depth-Age constraints. You can access this calculated data at the top of the saved file.

(f) Re-loading Saved Cross-plot files of markers and age-control points

The option to save-out cross-plot data of markers and age-control points was always available; but now you can re-load in those sets if you wish do later modification of the depth-to-age conversion.

Minor fixes to annoyances or bugs include:

(1) Overwrite warning when saving SVG, PDF, etc.

When saving SVG, PDF or Bitmap files with TSCreator, if the inputted file name already exists in the designated folder, a prompt will now appear to notify users that the old file will be replaced and ask for confirmation from the user.

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Some past enhancements (reminders of some useful features):

(1) Arabic, Chinese, etc.

Different languages for displaying menus can be selected (under Help).

(2) Options to install default time-interval and scaling

[NOW in TSC 6.8/7.0, this also works for Outcrops, Boreholes in meters, Ka, etc.]

In the initial headers of datapacks, one can specify time-interval and vertical-scaling defaults. For example, to pre-set a zoom-in for part of the Oligocene, then:

SetTop: *[TAB]* 25
SetBase: *[TAB]* 32
SetScale: *[TAB]* 5

(3) Event-column – changing font-color for names

For event columns (FAD/LAD), one can now use the Font menu to change the color of all these event-names from the default black-color. *[An example is on the 2nd page of this "What's New" in 6.8/7.0 next to the Gradient fill.]*

(4) Format/Date and other initial datapack headers are optional

We found that a common "error" was wrong formatting of the "top lines" in a datapack that indicated the format-version, date, etc. Therefore, all of these "top lines" are now optional. One can begin a datapack immediately with the data column information.

(5) Mappacks support hot-links to subdirectories

On mappacks, most items were hot-links to data columns (shown as a circle) or to a transect (shown as a line-segment connecting the lat-long end points). Now, one can also have hot-links (shown as a square) to turn on/off individual subdirectories of sub-regions. The Geoscience Australia mappackhas this for all sub-maps.

The format uses a "Lat-Long" (or X-Y) instruction where to locate these hot-link squares:

```
HEADER-SUBDIR  [TAB]  NAME  [TAB]  LAT  [TAB] LON
SUBDIR  [TAB] Perth basins  [TAB] -26  [TAB] 110
SUBDIR  [TAB] North Perth Basin Phases  [TAB] -26.5  [TAB] 110
```

(6) Multiple datapacks can be simultaneously uploaded as a compressed file

If one wishes to upload multiple datapacks (including multiple mappacks), then compress these into a single zip-file with the extension ".zip".

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(III) New datapacks (selected)

(1) Australia

Geoscience Australia has released a major update of its offshore hydrocarbon basin stratigraphy, seismic-stratigraphic reference scales, and revised dating of biostratigraphic zonations (especially palynology). The Australian datapack from Geoscience Australia includes a map-pack interface, extensive pop-ups about all calibrations, columns for major oil-gas wells in each basin, reference wells (depth-to-age converted) for Browse Basin, and a full Precambrian basin suite. This is probably the most data-intensive datapack in the TSCreator library for users. A stand-alone version of the Australian datapack pre-installed in TSCreator (Public version) is available from Geoscience Australia (e.g., Andrew Kelman -- andrew.kelman@ga.gov.au) in both GTS2012 and GTS2016 age models.

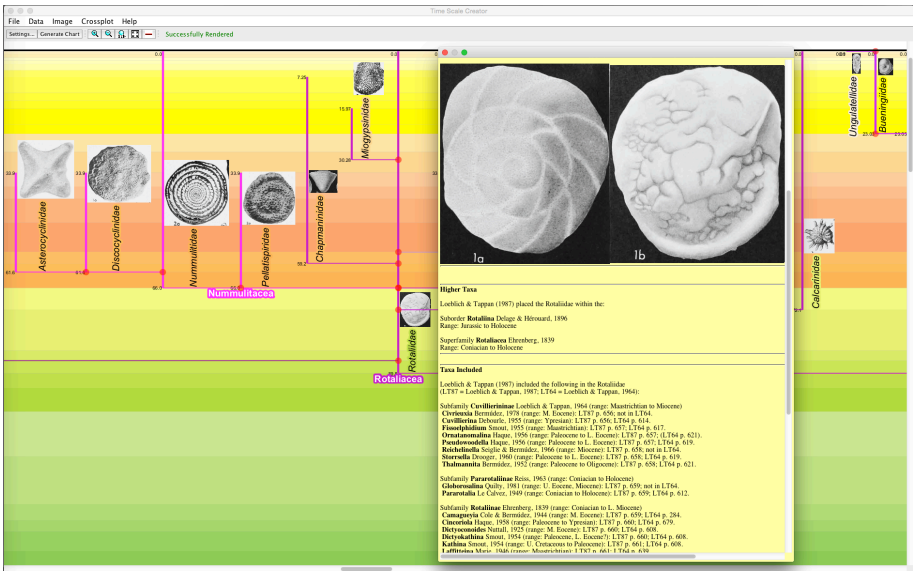
(2) Nannofossils with images

In coordination with Nannotax (Univ. London; Jeremy Young; Paul Bown, Jackie Lees; http://ina.tmsoc.org/Nannotax3/) , the Nannofossil datapack has images of all major Triassic through Present taxa at the appropriate event datums. The popups have larger images (both SEM and Visual), with links to its webpage at Nannotax3 website with extensive details, additional images and taxonomy.

In the near future, we will have a similar system for planktonic Foraminifers as those "Chronos" databases are migrated to the Nannotax system.

(3) Foraminifer Evolution available soon

Barry Fordham (Canberra, Australia) has compiled an extensive well-documented evolution of Foraminifers (at the family level), with images provided by permission of Treatise on Invertebrate Paleontology.



(4) Africa and South America Basins available soon

This major "*Western Gondwana*" datapack with map interfaces currently includes most major basins in Africa and in eastern South America (especially Brazil and Colombia). Rebecca Bobick coordinated the project and compiled most of the African basins (with many more to go), and visiting students from Brazil and Colombia compiled those regions. We will continue to enhance this datapack during the coming year.

As always, we appreciate any requests that you may have for software enhancements, user interfaces or reference datapacks.

Thank you,

James Ogg (TSCreator coordinator; etc.)
Gabi Ogg (TSC website; etc.)
Aaron Ault (Purdue Computer Engineering)
Felix Gradstein (GTS Foundation Chair)

With: Andy, Nag, Jason, Rebecca, David, Xinjie, Yunchao, Estefania, Marcos, Connor, Wendy, and many other Purdue computer-engineering and geoscience students.

Modified ages of stage boundaries in GTS2016 relative to *GTS2012*

Chronostratigraphic unit	**Age in GTS2016**	*Age in GTS 2012*	Summary of required update
Middle Pleistocene	**0.773**	*0.781*	enhanced accuracy
Calabrian	**1.80**	*1.806*	enhanced accuracy
Gelasian	**2.58**	*2.59*	enhanced accuracy
Priabonian	**37.97**	*37.7*	changed marker for base
Bartonian	**41.03**	*41.15*	revised cyclestratigraphic dating
Campanian	**84.19**	*83.6*	revised radio-isotopic dating
Santonian	**86.49**	*86.3*	changed marker for base
Coniacian	**89.75**	*89.8*	enhanced accuracy
Albian	**113.14**	*113.0*	placement change for boundary
Hauterivian	**134.7**	*133.9*	revised ammonite and cycle-stratigraphy
Base-Cretaceous	**145.7**	*145.0*	Working group voted on alternate definition (base of Calp. Zone B)
Oxfordian	**163.1**	*163.5*	revised boundary definition
Toarcian	**183.7**	*182.7*	revised radio-isotopic dating
Pliensbachian	**191.36**	*190.8*	revision of stage boundaries
Sinemurian	**199.4**	*199.3*	revision of stage boundaries
Hettangian	**201.36**	*201.31*	revised radio-isotopic dating
Anisian	**246.8**	*247.1*	revision of stage boundaries
Olenekian	**249.8**	*250.0*	revision of stage boundaries
Induan	**251.902**	*252.16*	revised radio-isotopic dating
Changhsingian	**254.15**	*254.2*	revised radio-isotopic dating
Kungurian	**282.0**	*279.3*	revised spline-fit
Gzhelian	**303.4**	*303.7*	revised cyclestratigraphic dating
Kasimovian	**306.7**	*307.0*	changed marker for base
Moscovian	**314.6**	*315.2*	changed marker for base
Stage 3 (base of Series 2)	**ca. 520**	*521*	implied precision on this estimate is removed
Stage 2	**ca. 530**	*529*	implied precision on this estimate is removed
Cryogenian	**720**	*850*	Official change of boundary definition