TimeScale Creator datasets *(thematically ordered) GTS2016 age models*

51,000 datalines; in 443 columns (are curves) that are grouped into ca. 150 directories/subdirectories. Most text entries have pop-ups with calibrations, sources and comments.

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
Standard International Chronostratigraphy			14 columns
Standard Chronostratigraphy	Eon, Era, Sub-Era, Period, Sub-period, Epoch, Sub-epoch, Age/Stage, Substage	Present - Hadean	GSSP definitions and graphics are at http://stratigraphy.science.purdue.edu (Geologic TimeScale Foundation; mirrors to server at Purdue Univ. engineering). GSSPs are formalized by the International Commission on Stratigraphy (www.stratigraphy.org).
Alternate Precambrian Chronostratigraphy	Era, Period, Marker events	Ediacaran-Hadean	Van Kranendonk et al. (2012), In: The Geologic Time Scale 2012
GSSPs *(boundary stratotypes)*	Ratified, plus current (2016) working versions	Present - Cryogenian	Mouse-Over option brings up windows with details on each ratified or potential boundary, plus direct URL links to GSSP documentation for each section (details, location map, stratigraphic section) at http://stratigraphy.science.purdue.edu (Geologic TimeScale Foundation)
Planetary		11 columns	Tanaka, K.L. and Hartman, W.K. (GTS 2012) Planetary time scale.
Moon	Periods / Epochs / Events	Present - 4.6 Ga	
Mars	Periods / Epochs / Events	Present - 4.6 Ga	
Venus	Periods / Events	Present - 4.6 Ga	
Mercury	Periods / Events	Present - 4.6 Ga	
Regional Stages		47 columns	From GTS2012 period-chapters, plus other selected regions. [See extensive pop-up windows explaining disagreements or uncertainties in calibrations.]
Jur-Cret boundary regional stages - British and Boreal	**British** regional Stages / Substages	Ryzanian-Kimm.	Jur-Cret boundary = GTS2012 Jurassic chapter (original was compiled by Sven Backstrom, via Felix Gradstein, ~1995), with revised calibrations aided by Mikail Rogov (2011)
	Boreal regional Stages / Substages	Ryzanian-Kimm.	
North America regional units	Series / Stages	Cret - Precambrian	CRET = GeoWhen (compiled by R. Rohde; at stratigraphy.science.purdue.edu); ; Permian from Henderson (2012); Carboniferous from Heckel (2015) and Davydov (1996; GTS2004; GTS2012), Silurian from GeoWhen (compiled by R. Rohde; at stratigraphy.science.purdue.edu); Ordovician from Webby et al (2004) and Cooper-Sadler (GTS2012); Cambrian from Peng and Babcock (GTS2012)
	Type Mississippian Lithostratigraphy (USA) / Mid-continent conodont markers	Carb.	Generalized from Heckel et al., 2005; with additional correlations by Paul Brenckle, written commun., October 2006)
	California	Cenozoic	GeoWhen (compiled by R. Rohde; at *www.stratigraphy.org*)
Iberian-Morocco regional units (Cambrian)	Series / Stages	Cambrian	Geyer and Landing (2004), A unified Lower - Middle Cambrian chronostratigraphy for West Gondwana. Acta Geologica Polonica, 54 (2), 179-218.
Western European and British regional units	**W. Europe-British** Series	Cret - Cambrian	Cret = Traditional series-level divisions; Perm-Carb = Davydov (GTS2004) and German Stratigraphic Commission (2002); Ordovician = Webby et al (2004); Cambrian = Shanchi Peng (chair of subcommission, to J. Ogg, Dec. 2005)
	East Avalonian Series (Cambrian)	Cambrian	
	W. Europe Stages / Substages	Perm - Cambrian	Perm-Carb = Henderson (GTS2012) and Davydov (GTS2004/GTS2012) and German Stratigraphic Commission (2002); Ordovician = Webby et al (2004); Cambrian = Peng (GTS2008/2012)
	British Substages	e. Carb.	Menning et al (2006), plus advice of Peter Jones (Aust. Natl. Univ.). *[See extensive pop-up windows explaining disagreements or uncertainties in calibrations.]*

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
German Basin Triassic Lithostratigraphy	Main Germanic Triassic Facies (generalized) / Folge divisions or Members		LithDesc (partly Feist-Burkhardt, S., et al., 2008. Triassic. In: The Geology of Central Europe. See also Triassic Fossils (with strat) at www.palaeo-online.de. Early Triassic Folge are considered to be 100kyr periodicity by Backman, Menning, Kozur, Szurlies and others
Baltoscania regional units	Series / Subseries / Stages / Substages	Sil. - Ordov.	Silurian = partly based on Estonian conodont summary in Männik, 2007, Estonian J. Earth Sci., 56:35-46. Ordovician = Webby et al (2004)
Russian and Ural regional units			***NOTE: See the extensive RUSSIAN BIOSTRAT DATAPACK for Russian regional zones and stages (part of PRO suite)***
	Russia Platform regional units == Series / Stages / Substages or horizons / Permian horizons (pre-2005 and Carb sub-horizons	Jur-Cret, Perm-Carb, Cambrian	Jur-Cret boundary = GTS2012Jurassic chapter and Groupe Francais d'etude du Jurassique (1997); Permian = Kotlar and Pronina-Nestell (2005) with fusulinid-ages from Davydov/Henderson (GTS2008/2012), Permian "East-European Stratigraphic Scale 2005" is from Kotlyar and Pronina-Nestell (2005; Permophiles - This scale removed a system of horizons, which are indicated in the comments for each Stage.); Carboniferous = Menning et al. (DCP 2006); Cambrian = Peng and Babcock (GTS2012)
	Donets Basin sub-units -- Substages or horizons / Sub-horizons	Carboniferous	Parlty from Menning et al. (DCP 2006) inter-calibrations to Russian stages
	N-E Siberia (Carboniferous)		Parlty from Menning et al. (DCP 2006) inter-calibrations to Russian stages
	Kazakhstan	Cambrian-PreCambrian	Peng and Babcock (GTS2012)
Tethyan regional units (Permian)	Stages (Pamirs) / Stages (Salt Range)	Permian	Davydov (GTS2004) and Henderson (GTS2012)
East Asian regional units	**South China** -- Series / Stages	Jur-Camb.; Precamb.	Permian-Carb from from Henderson (GTS2012) and from Menning et al, 2006; except Late Carboniferous from Zhang and Zhou (2007; Carb-Perm Congress); Ordovician from Webby et al. (2004); Cambrian series from Shanchi Peng (2003) and Peng and Babcock (GTS2012)
	Yangtze Platform Triassic Lithostratigraphy - Formations; South China cycles	Triassic	Late Triassic = Longchang, Guizhou (mainly Enos et al., 2006 GSA SpecPaper); Middle = Yongningzhen and Guandao, Guizhou (mainly Lehrmann et al., 2015 Jour Asian Earth Sci.); Early = Chaohu, Anhui (calibration by Mingsong Li et al., 2015. EPSL)
	North China, E. Yunnan -- Epoch / Age-Stage	Cambrian	Shanchi Peng (2003) Chronostratigraphic subdivision of the Cambrian of China. Geologica Acta, 1: 135-144.
	Japan -- Stages	Neogene, Cret.	GeoWhen (compiled by R. Rohde; at *www.stratigraphy.org*)
Australia and New Zealand	**Australia** -- Stages	Cenozoic; Ordov.-Camb.	John Laurie (GeoScience Australia, to Jim Ogg, 2007 through 2012)
	New Zealand chronostratigraphy -- Series, stages, substages, abbreviations	Present - Camb.	NOTE: Suites are in "standard" NZ color scheme. [See extensive pop-up windows with stage definitions.]. Table 1.3 in Cooper et al (2004); with Cenozoic-Cretaceous updates and possible calibrations to magnetic chrons provided by Andrew Boyes (and Chris Hollis) at GNS (pers. commun. to J.Ogg; Nov'11 and Aug'12; and remarks incorporated into GTS2012 regional chart)
African	South Africa	PreCambrian	GeoWhen (compiled by R. Rohde; at *www.stratigraphy.org*)
Geomagnetic Polarity		5 columns	
Composite polarity scale for Phanerozoic	Polarity chrons	Present - Cambrian	GTS2016 composites for Cenozoic-Late Jurassic C- and M-sequences from chapter on geomagnetic polarity time scale; Middle-Early Jurassic is outcrop compilation (see GTS2012 chapter); Late Triassic Newark provided by Dennis Kent in June 2005 (after Kent and Olsen, 1999) tied to CAMP basalts at top-Triassic, Middle and Early Triassic outcrop after Hounslow and Muttoni (2010), Szurlies (2007) and Li (2016), Late Permian after Steiner (2006). Early Permian-Ordovician = modified slightly from compilations in GTS04 and GTS08 Concise GTS (e.g., Ordov-Late Camb = Pavlov and Gallet, 2005); but Late Cambrian revised in GTS2012 by Peng and Babcock. Middle and Early Camb = Kirschvink and Rozanov, 1984; Kirschvink, 1978 as revised by Peng and Babcock in GTS2012. And more sources -- see GTS2012 and 2016 chapters for each period.
	Geomagnetic Excursions during Quaternary Period	Quaternary	Use VERTICAL SCALE of 5x or higher! Compilation by Brad S. Singer (2014; A Quaternary geomagnetic instability time scale. Quaternary Geochronology, 21: 29-52)

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
Other Jurassic and Triassic oceanic and outcrop reference scales	Crussol. Poland, England Kimm-Oxf-Callov, Spain Bath-Bajo	Lt. Jur.	Polish-England Oxf-Kimm composite from Przybylski, Ogg et al. (2010. with unpublished uppermost Kimm continuation at Crussol, and Callov from Rachel Gipe (2013. Purdue Univ. thesis), and Spain Bath-Bajo from Steiner-Ogg 1987
	Pre-M26 Deep-Tow Models -- Deep-tow upward projection to sea surface model	M.-Lt. Jur.	Seafloor signal and Upward projection to sea-surface anomaly model. M27-M37n = Sager et al. (1998) with reinterpretation and M37r-M45 extension by Tominaga et al. (2008)
	Late Triassic outcrop magnetostratigraphy	Lt. Tri.	Modified from Triassic composite of Hounslow and Muttoni (2010)
Main Mesozoic-Paleozoic Macrofossil Groups			
Ammonoids	17 columns		
Ammonoids (Mesozoic)	**Tethyan** Zones / Subzones	Cret - Tri.	Revised using Klug et al. (2015) "Ammonoid Paleobiology" book (Springer); with initial sources being CRETACEOUS = Thierry et al. (in Hardenbol et al., SEPM charts, 1998), with GTS2004 and Kilian Group (2004-2015) revisions; JURASSIC = Groupe Francais d'etude du Jurassique (1997); TRIASSIC = Mietto and Manfrin (in Hardenbol et al., SEPM charts, 1998), with GTS2004 and Kozur (2003 and pers. commun., 2006. 2010) and Marco Balini (2010) revisions; Permian = Low-Latitude suite from Kozur (2003), but see Permian suite (under Paleozoic ammonoids) by Henderson (2012).
	North American Western Interior Zones / Close-spaced zones	Late Cret.	W.A. Cobban (in Hardenbol et al., SEPM charts, 1998), with GTS2008/2012 revisions. Intervals with close-spaced (less than 0.3 myr) zones have a separate column to avoid over-crowding.
	Sub-Boreal Zones / Subzones	Cret - Triassic	Revised using Klug et al. (2015) "Ammonoid Paleobiology" book (Springer); with initial sources being CRETACEOUS = J. Thierry et al. (in Hardenbol et al., SEPM charts, 1998), with GTS2004 revisions; JURASSIC = Groupe Francais d'etude du Jurassique (1997) and Mikail Rogov (pers. commun., etc., 2010-2011; TRIASSIC = P. Van Veen (in Hardenbol et al., SEPM charts, 1998) and Balini (2010).
	Boreal Zones / Subzones	e.Cret. - Trias.	Revised using Klug et al. (2015) "Ammonoid Paleobiology" book (Springer); with initial sources being GTS2004 Jurassic chapter *(original was compiled by Sven Backstrom, via Felix Gradstein, ~1995)*, and Groupe Français d'Étude du Jurassique (1997)
Ammonoids (Paleozoic)	Ammonoid zone abbreviation / Zone name / Major Paleozoic ammonoid markers	Permian - Devon	Revised using Klug et al. (2015) "Ammonoid Paleobiology" book (Springer); with initial sources being NOTE: Paleozoic zonations are not as well-standardized as for the Jurassic. PERMIAN = Davydov et al., 2004, Kozur, 2003, and Henderson, 2005, 2012); CARBONIFEROUS = GTS2004 and GTS2012 diagrams (Davydov et al., 2004, 2012), DEVONIAN = Becker and House (2000) and Becker (GTS2012).
	Boreal zone (Perm-Carb Cis-Urals)	Perm-Carb	Revised using Klug et al. (2015) "Ammonoid Paleobiology" book (Springer); see above for other sources
	Carboniferous USA mid-continent ammonoid zone / subzone	Carboniferous	David Work for GTS2008; and Boardman-Work (2013) for USA Pennsylvanian
	Devonian ammonoid Geno-zone / Geno-zone name / Subzone name	Devonian	Devonian zonations, taxa names and relative age-calibrations (relaive to conodont "master" scale) are based on Thomas Becker's detailed chart (2010/2011; which was partly incorporated in GTS2012)
Conodonts	14 columns		See GTS2016 for additonal sources. Main suites are TRIASSIC = Tethyan zones of Kozur'03 with Early Triassic modified after Orchard'07; PERMIAN-CARBONIFEROUS = GTS2012 diagrams of Henderson and of Davydov (zones used for Spline-fit of this age scale); DEVONIAN = Becker (GTS2012) suite used for spline-fit age model; SILURIAN = "Standard" of Mike Melchin in GTS2012; ORDOVICIAN = North Atlantic conodont zones (Figure 2.2 in Webby et al. (2004; The Great Ordovician Biodiversification Event); with ages (and some zones) modified by Roger Cooper (chart of Nov'2010 for GTS2012). Cooper's placement relative to Australia "Conop/spline-fit" zones is used here.); CAMBRIAN = South China zones by Chen et al (2010 pers. commun. to J.Ogg; during sessions at Nanjing Inst. Geol. Paleont.) as scaled by Peng and Babcock (GTS2012 graphics)
Conodont zones (general)	Conodont zonation (selected)	Tri.-Camb.	
	Conodont subzones (Devonian; Ordovician)	Dev., Ordov.	Devonian conodont zonations, taxa names, and relative age-calibrations (relative to conodont "master" scale) are based on Thomas Becker's detailed chart (2010/2011; which was partly incorporated in GTS2012). ORDOVICIAN = North Atlantic conodont zones (Figure 2.2 in Webby et al. (2004; The Great Ordovician Biodiversification Event); with ages (and some zones) modified by Roger Cooper (chart of Nov'2010 for GTS2012). Cooper's placement relative to Australia "Conop/spline-fit" zones is used here.)
	Conodont major markers	Tri.-Camb.	TRIASSIC = mainly Orchard and Tozer (1997) and Kozur (2003); PERM-CARB = GTS2012 diagrams of Henderson and of Davydov; DEVONIAN = Thomas Becker (GTS2012)

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
Conodont zones (regional and alternate)	British Columbia Triassic conodont zones	Triassic	(Orchard & Tozer '97; Orchard '07 and '10; with Early and Middle Triassic as diagrammed by Orchard (Fig. 9 in Lehrman et al., 2015)
	South China generalized Triassic zones	Triassic	Early Tri = Chaohu modified; Mingsong Li cycle-scalings -- but it seems each S. China section uses a variant; very confusing! Middle Tri = Guandao (Lehrmann et al., 2015); Carnian = generalized (no agreement yet)
	E. Tri. Zones of Sweet	Triassic	
	Permian-Carboniferous other conodont zonations -- Permian conodont zones (and number) of Davydov'04; Carboniferous of Lane'08 and Russian'06 / North American Mid-Continent conodont zones and datums (Carboniferous)	Perm-Carb	Zones are from GTS2008 update to Davydov'04 using recommendations of Rich Lane (2008) and Russian biostratigraphy chart (2006) which referenced: Postanovlenia MSK ..., 2003
	Devonian other conodont zonations -- MN (Montagne Noire) set and regional Zones / Subzones; Conodont Index species	Devonian	Thomas Becker's detailed chart (2010/2011; which was partly incorporated in GTS2012).
	Ordovician North American Midcontinent Conodont Zones	Ordov.	Figure 2.2 in Webby et al. (2004; The Great Ordovician Biodiversification Event); with ages (and some zones) modified by Roger Cooper (chart of Nov'2010 for GTS2012). Cooper's placement relative to Australia "Conop/spline-fit" zones is used here.
	Cambrian Australian Zones / Datums	Camb.	From Australian time-scale diagrams (Laurie et al.; calibrated to their regional stages, in turn calibrated to scaled China stratigraphy by Peng and Babcock, GTS2012)
Graptolites	11 columns		Numerical age standards = Cooper & Sadler, 2005
Graptolite Zones (composite)	Graptolite Zones (general)	e. Devon. - Ordov.	This hybrid Ordovician Australian and "standard" Silurian suite was used to scale the Ordovician-Silurian (Cooper, Melchin, Sadler in GTS2012). Devonian zonations (relaive to conodont "master" scale) are based on Thomas Becker's detailed chart (2010; delivered to Gradstein and Ogg, and partly used in GTS2012)
	Australian Ordovician Zone abbreviation and Subzones -- 3 columns	Ordov.	Numerical ages = Tied to Spline-CONOP12 table; about Base of Silurian assumed for top of Bo5 zone. Biostratigraphy; VandenBerg & Cooper 1992; Cooper and Lindholm 1990.
	Graptolite markers (Ordov., Dev.)	Dev., Ordov.	ORDOV Biostratigraphy from VandenBerg & Cooper 1992. Numerical ages = Cooper & Sadler, 2005, as interpreted by John Laurie, May 2007 (Pers. commun.); DEVON = Thomas Becker's detailed chart (2010/2011; which was partly incorporated in GTS2012).
Regional Graptolite zones			Figure 2.1 in Webby et al. (2004; The Great Ordovician Biodiversification Event)
	North American graptolite zones	Ordovician	
	Chinese graptolites -- Zones / Subzones	Ordovician	
	British graptolites -- Zones / Subzones	Ordovician	
	Baltoscandia graptolite zones	Ordovician	
Trilobites and pre-Trilobite biostratigraphy	13 columns		NOTE: Includes Small Shelly Fossils, and some Archaeocyaths
South China trilobites	Pelagic trilobites (**Agnostids**); S.China	Cambrian	Zonal scheme from Peng (2003; Geol. Acta, 1:135-144 (www.geologica-acta.com:8080/geoacta/pdf/vol0101a14.pdf); but modified by Peng, 2007 to J.Ogg; and Peng, Jan2011 to G.Ogg); Ages based on Peng and Babcock (Concise GTS 2008; GTS 2012)
	Benthic trilobites (**Polymerids**); S.China	Cambrian	
Siberia trilobites	Main Siberia set / Alternate Siberia set	Cambrian	Zonal schemes from Peng and Babcock (GTS2012) with ages based on placement relative to S.China trilobite zone "primary" (Jan2011 to G.Ogg)
Australia trilobites		Cambrian	Zonal schemes from Peng and Babcock (GTS2012) with ages based on placement relative to S.China trilobite zone "primary" (Jan2011 to G.Ogg)

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
Laurentia trilobites	Main Laurentia set / Alternate Laurentia set	Cambrian	Zonal schemes from Peng and Babcock (GTS2012) with ages based on placement relative to S.China trilobite zone "primary" (Jan2011 to G.Ogg)
Archaeocyaths, Acritarchs	Archaeocyath Zones (Australia; middle Cambrian)		
	Acritarch zones (Australia)		
Early Paleozoic Biotic Events and Divisions	5 columns		
	Devonian crisis episodes	Devonian	Becker GTS2012
	Silurian Major Biotic Events	Silurian	Bioevents -- graptolite (G) and conodont (C) from Melchin (Aug'11) using (Jaeger, 1991; Jeppsson, 1998; Melchin et al. 1998, Jeppsson et al., 2006)
	Ordovician Time Slices (plus Alternate set (Berry et al., 2004))	Ordov.	Bergstrom et al (Lethaia, 2009); Berry et al (2004)
	Major **Cambrian** markers	Cambrian	Peng and Babcock (GTS2012) with ages based on placement relative to S.China trilobite zone "primary" (Jan2011 to G.Ogg)
Other Marine and Lacustrine Macrofossils			
Belemnites	5 columns		Main source = R. Combemorel (in Hardenbol et al., SEPM charts, 1998)
	NW Europe Zones / Subzones	Cret - Jur.	
	Balto-Scandia Belemnite Zone (Lt. Cret.); **Tethyan** (Oxf-Haut)	Cret - Jur.	
	Tethyan Belemnite subzone (Lt.Jur.)	Lt. Jur.	
	Russian platform zones (Lt. Cret.)	Lt. Cret.	
Bivalves (Inoceramids, Pelecypods, etc.)	13 columns		
Cretaceous Inoceramids	**N.Amer.** inoceramid Zones / Close-spaced Zones	Lt. Cret.	N.Amer. U.Cret. = Cobban et al., 2006, USGS report. Europe-Russia = A.V. Dhondt (Inoceramids) and Paul van Veen (Triassic pelecypods) (in Hardenbol et al., SEPM charts, 1998); Other columns from A.V. Dhondt (Inoceramids) and Paul van Veen (Triassic pelecypods) (in Hardenbol et al., SEPM charts, 1998)
	Western European Inoceramids	Lt. Cret.	
	Aquitaine Inoceramids	Lt. Cret.	
	Central European/ Russian Platform Inoceramids Zones / Markers	Lt. Cret.	
Triassic Bivalves	**West Tethys** bivalve zone	Triassic	Ranges are from Chris Roberts, pers. commun., Aug 2007; for Triassic time scale special publication of 2010; Zones are McRoberts'10; but problem fitting zone names and ranges (many inconsisent usages?)
	North America bivalve zone	Triassic	
	Boreal bivalve zone	Triassic	
	Triassic Bivalve ranges - Genera / Species	Triassic	Ranges are from Chris Roberts, pers. commun., Aug 2007; for Triassic time scale special publication of 2010
Siberian Pelecypod	Zone / Subzone	Lt. Tri.	Paul van Veen (Triassic pelecypods) (in Hardenbol et al., SEPM charts, 1998)
Conchostracans	Conchostracan Zones / Zonal markers	Triassic	Kozur and Weems (2010); as modified by Weems and Lucas (2015); Heinz Kozur (pers. commun., 2011)
Brachiopods	**Tethyan** Brachiopod Zone / Subzone	m.-e. Jur.	B. Laurin (in Hardenbol et al., SEPM charts, 1998)
	Boreal Brachiopod Zone / Subzone	Lt.-m. Jur.	
Rudists	**Western Europe** datums	Cretaceous	J.-P. Masse and J. Philip (in Hardenbol et al., SEPM charts, 1998)
	Periadriatic datums	Cretaceous	

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
Ostracodes and Dacryonarids	**Boreal** Ostracode datums	Present - Tri	J.-P., Colin et al. (in Hardenbol et al., SEPM charts, 1998)
	French Ostracode Zones / Subzones	Jurassic	J.-P., Colin et al. (in Hardenbol et al., SEPM charts, 1998)
	Tethyan Ostracode datums	Present - Jur.	
	Devonian Ostracode Zone / Subzone / Datum	Devonian	Devonian Pelagic ostracode zones are from Groos-Uffenorde et al (2000; Cour. Forsch.-Inst.Senckenberg 220:99-111; http://www.jstor.org/view/00223360/ap040327/04a00090/0). Relative calibration to conodont zones was revised by Thomas Becker (2010; diagram to J.Ogg) from Groos-Uffenorde summary figure (page 104).
	Dacryoconarid Zones	Devonian	Dacryoconarids are tentaculites -- an extinct genus of molluscs. The taxonomic classification is uncertain, but some group them with pteropods. Relative calibration to conodont zones was revised by Thomas Becker (2010; diagram to J.Ogg).
Microfossils			
Planktonic and Benthic Foraminifers	35 columns		
Planktonic Forams	8 columns		NEOGENE = Berggren et al. (1995a,b), with revised age calibrations from Lourens et al. (GTS2004 appendix) and Erik Anthonissen (GTS2012 appendix; also for Paleogene). PALEOGENE = Berggren et al. (1995a,b) with age updates from Berggren and Pearson (2005) and Wade et al. (2010). CRETACEOUS = May 2011 meeting of Late Cretaceous microfossil working group (UCL) modifying ODP Leg 171 and other scales, plus communications from Brian Huber and others
	Sub-Tropical Zone / Subzone	Present - Cret.	Sub-Tropical Zones/Subzones from Wade et al., 2011
	N,P Zones (Cenozoic)	Cenozoic	Blow, 1979; Berggren & Miller, 1988; Berggren et al'1995
	Formal Foram Zone name / Subzone name	Cenozoic	
	Foram Zone Marker	Present - Cret.	
	Other Foram FAD/LAD	Present - Cret.	
	Additional Neogene and lesser Paleogene Foram FAD/LAD	Cenozoic	Mainly events not in Wade et al'11; but tabulated in Lourens et al'04 (esp. Medit.) or Berggren et al'95. Plus, events in Wade et al'11 that seemed relatively minor.
Benthic Foraminifers	27 columns		
Larger Benthic Forams	Tethyan Shallow Benthic Zones (SBZ, etc.) / Markers	Cenozoic; Jur-Trias.	Various authors in Hardenbol et al (SEPM charts, 1998): [SBZ set of Oligocene-Miocene = B. Cahuzac and A. Poignant. plus detailed Paleocene-Eocene = J. Serra-Kiel and L. Hottinger -- Larger foram vs Planktonic zone diagram sent by R.Speijer, Feb'11 for GTS2012. Cenozoic zone details from Working Group on Larger Foraminifera (SBZ zones): http://cenozoicforaminifera.com/. Upper Cretaceous = M. Bilotte. Lower Cretaceous = Annie Arnaud Vanneau. Jurassic & Triassic = B. Peybernes.]
	Other Larger Benthic Foram datums	Present - Cret.	
	Jurassic benthic foram datums (Bassoullet'97)	Jurassic	Jean-Paul Bassoullet -- chapter on "Les Grands Foraminiferes"; in Groupe Français d'Étude du Jurassique (1997)
Benthic Foram Letter stages (East Indies)	Letter-stage / Benthic Foram Stage Datum (Philippines) / Other datums	Cenozoic	Matsumaru, Kuniteru, 2011. A new definition of the Letter Stages in the Philippine Archipelago. Stratigraphy, 8 (no. 4): 237–252.
Fusulinids and Benthic Forams (Carb-Perm)	Benthic Foram zone Abbreviation / Name	Perm - Carb	Scheme of Davydov (GTS04)
	Standard Permian-Carboniferous fusulinid zone	Perm - Carb	Perm = Shen-Henderson (Perm. Subcomm. Chart, 2013; assuming names of events are also names of zones); Carb = Zones are from Russian chart (2006) which referenced: Postanovlenia MSK …, 2003
	Major Benthic-Foram Markers	Perm - Carb	Perm = Henderson, 2012; Carb = Davydov, 2004
	Boreal (Urals) Benthic Foram Zone	e. Perm - Carb	Davydov (1996, Carb-Perm chapters in GTS2004, unpublished zonation table to GTS2004, and unpublished Permian correlation chart)
	Tethyan Benthic Foram Zone		

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
	N.Amer. Mid-Continent Zone / Assemblage / Marker	Perm - Carb	MISS = Paul Brenckle (pers. commun., October 2006; and in Lane and Brenckle, 2005), PENN = unpublished ExxonMobil'01, PERMIAN = Davydov (1996; 2001)
	Other N.Amer. Mid-Continent	Perm - Carb	Ross and Ross (1988, 1995b)
	North American Cordilleran Zones / Assemblages / marker	Carboniferous	Paul Brenckle (pers. commun., October 2006; and in Lane and Brenckle, 2005)
Smaller Benthic Forams	Boreal Cret Smaller Foram Markers / Datums	Cretaceous	F. Magniez-Jannin (in Hardenbol et al., SEPM charts, 1998)
	Tethyan Jurassic Zones / Subzones / Markers (Ruget&Nicollin'97)	Jurassic	Christiane Ruget and Jean-Pierre Nicollin -- chapter on "Les Petits Foraminiferes Bentiques Degages"; in Groupe Français d'Étude du Jurassique (1997)
	Tethyan Jurassic Zones / Markers / Other Datums (SEPM'98)	Jurassic	F. Magniez-Jannin and C. Ruget (in Hardenbol et al., SEPM charts, 1998)
North Sea Microfossil Zone	North Sea zone / event	Mesozoic-Cenozoic	Gradstein et al. -- see NORLEX datapack for extensive update, images, etc.
	Deep-water agglutinated foraminifers	Mesozoic-Cenozoic	Gradstein et al. -- see NORLEX datapack for extensive update, images, etc.
Calpionellids	Zones / Datums	E.Cret. - Lt. Jur.	J. Remane (in Hardenbol et al., SEPM charts, 1998), with GTS2004 revisions.
Calcareous Nannofossils	18 columns		
Tropical and Mid-latitude Calcareous Nannofossils	NN,NP,CC,NJT,NT Zone / Subzone	Present - Lt. Trias.	NEW CENOZOIC = Backman-Agnini et al. (2012; 2014) -- Low and middle latitudes. Neogene-Olig = direct astronomical age; Eocene-Paleocene = proportions within C19r-C29r ; NEOGENE = mainly Lourens et al. (GTS2004 tables); PALEOGENE = Composite of ODP studies, plus Berggren et al. (1995a, b) -- reviewed and enhanced by Paul Bown, June 2011. Late CRETACEOUS = mainly Late Cret. working group (London, June2011), which modified Burnett (1999) and Erba et al (1995) as tabulated by ODP Leg 171B Init. Repts. (Table 2, p. 17-18). Middle and Early CRETACEOUS = compiled by Jim Bergen, based on publications by Tim Bralower et al (1995), J. Bergen (1994) and Eric de Kaenel. Tethyan Early-Middle Jur zones from Mattioli and Erba (1999); Late Jur zones from Casellato, 2011. See NannoTax links for individual taxa images, etc.
	CN,CP,NC Zone / Subzone	Present - Cret.	
	Ceno-Nanno Zone - zone, zone-name	Cenozoic	Backman-Agnini et al. (2012; 2014) -- Low and middle latitudes. Neogene-Olig = direct astronomical age; Eocene-Paleocene = proportions within C19r-C29r
	UC Zone / Subzone (Lt. Cret.)	Lt. Cret.	
	Tethyan Nanno Zone Marker	Present - Lt. Trias.	
	UC Tethyan Subzone Marker (if not NC-CC)	Lt. Cret.	
	Other Tethyan Nanno FAD/LAD	Present - Jur.	High-resolution *(need expanded vertical scale)*; mainly Lourens et al. (GTS2004/GTS2012 tables)
	Additional Plio-Pleist datums	Present - Piocene	
Boreal Nannofossils	Boreal UC,BC,NJ,NT Nanno Zone / Subzone	mid-Cret - Lt. Trias.	NEOGENE = mainly Lourens et al. (GTS2004 tables); PALEOGENE = Composite of ODP studies, plus Berggren et al. (1995a, b) -- reviewed and enhanced by Paul Bown, June 2011. Late CRETACEOUS = mainly Burnett (1998); Early CRETACEOUS = mainly Bown et al. (1998); JURASSIC = Bown and Cooper (1998); TRIASSIC = Bown (1998).
	Boreal NK Zones / KN Zones	Late Cretaceous	
	Boreal Nanno Zone Marker	mid-Cret - Lt. Trias.	
	Boreal Nanno subzonal and other markers	mid-Cret - Jur.	
Dinoflagellate cysts, Acritarchs and Chitinozoans	16 columns		
Dinoflagellate cysts			
Dinoflagellate Cysts (N.Atl./Boreal)	N. Atl./Boreal Dinocyst Zone / Subzone	Present - Lt. Trias.	CENOZOIC = mainly J. Powell in GTS2004 (Neogene and Paleogene figures). CRETACEOUS = mainly J.-C. Foucher and E. Monteil (in Hardenbol et al., SEPM charts, 1998). JURASSIC = Poulsen and Riding (2003). TRIASSIC = P.A. Hochuli (in Hardenbol et al., SEPM charts). SEPM Boreal Dinoflagellate Cysts compiled in SEPM chart by J.-C. Foucher and E. Monteil (1998 publ. Date)

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
	N. Atl./Boreal Dinocyst zonal and selected markers	Present - Cret.	
	Other Boreal, NW Europe Dinocyst datums	Present - Jur.	
	Additional DTS dinoflagellate taxa (Boreal Mesozoic)	Present - Jur.	Events not on SEPM'98 chart but tabulated in earlier compilations. Use with caution.
Cenozoic dinocysts of NW Europe (SEPM'98)	NW Europe dinocysts	Cenozoic	Williams et al. (Cenozoic charts in Hardenbol et al., SEPM 60, 1998)
Dinoflagellate Cysts (Tethyan)	Cenozoic Tethyan Dinocyst datums (high-res.)	Cenozoic	"W" = Low-lat, w. N.Atl., "I" = Italy; Williams et al. (Cenozoic chart in Hardenbol et al., SEPM charts, 1998); Neogene: Mediterranean and North Atlantic; Paleogene: Mediterranean
	E.Cret.-Jur. Zones	mid-Cret - Lt. Jur.	E. Monteil (in Hardenbol et al., SEPM charts, 1998)
	Tethyan Mesozoic Dinocyst zonal and other major markers	mid-Cret - Trias	*(Triassic is mainly S.Hemis.)*; E. Monteil (in Hardenbol et al., SEPM charts, 1998)
	Other E.Cret. Tethyan Dinocyst markers	e. Cret.	E. Monteil (in Hardenbol et al., SEPM charts, 1998)
Chitinozoa			ORDOV = Webby, 2004, Fig. 2 in The Great Ordovician Biodiversification Event; SILURIAN = Standard Chitinozoan Zone (from subcommission); DEVONIAN = from Becker (GTS2012 figures)
Ordov-Silur-Devon Chitinozoan Zones		Dev.-Ordov.	
Other Ordovician Regional Chitinozoan zones	Baltoscandia Chitinozoan Zone / Subzone	Ordovician	Figure 2.2 in Webby et al. (2004; The Great Ordovician Biodiversification Event); North America was in main zonal scale.
	North Gondwana Chitinozoan Zone	Ordovician	
Acritarchs	Acritarchs (Devonian)	only Devonian so far	Thomas Becker's detailed chart (2010/2011; which was partly incorporated in GTS2012).
Siliceous Microfossils	15 columns		
Diatoms			NEOGENE = mainly Maruyama (2000; Table 3). PALEOGENE = partly from J. Barron (in Hardenbol et al., SEPM charts, 1998)
	North Pacific Diatom Zone / Datums	Cenozoic	
	Neogene/Paleogene **Antarctica** Diatoms	Neogene	
	Neogene; **Equatorial Pacific** Diatoms	Neogene	
Radiolarians			CENOZOIC = Chris Hollis (GTS2012) plus Sanfilippo and Nigrini (1998), Nigrini and Sanfilippo (2001). MESOZOIC = partly from P. de Wever (in Hardenbol et al., SEPM charts, 1998), but Triassic includes some of Kozur (2003).
Cenozoic-Jurassic Radiolarians	Radiolarians (Low Latitude) Zone / Marker / other Datums	Present - Cret.	
	Other Neogene Radiolarian datums (not used on PEAT table)	Neogene	
	Radiolarians (southern high latitude)	Present - Cret.	
Triassic-Permian Radiolarians	Tethyan Radiolarian Zone / Subzone	Tri. - Perm.	Triassic Radiolarian zones are from Kozur'03 tables. Kozur (Jan 2006) provided additional details, especially on zonal boundary datums. [GTS04 -- Triassic RADIOLARIAN events of general Europe were compiled by Patrick de Wever for the Triassic Chronostratigraphy chart of Hardenbol et al. (SEPM, in press, 1996).]
	N.Amer. Radiolarian Zone / Subzone	Triassic	Carter (1993), Kozur (2003)
	Major radiolarian events (Triassic)	Triassic	
	Cis-Ural Radiolarian zone (Permian)	Permian	Kozur (2003)

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
Charophytes and Calcareous Algae	4 columns		Charophytes from J. Riveline (in Hardenbol et al., SEPM charts, 1998), and Early Cretaceous Green Algae from J.-P. Masse (in Hardenbol et al., SEPM charts, 1998)
	Charophyte Zone / Markers	Present - Trias	
	W Europe Calc. Algae horizons	e. Cret.	
	W Periadriatic Calc. Algae horizons	e. Cret.	
Plants (spores, pollen, flora)		15 columns	
Triassic spores and pollen	Pollen / Spores (Germanic/Alpine) -- Zone / Subzone / Datum	Triassic	Kürschner, W.M., and Herngreen, G.F.W., 2010. Triassic palynology of central and northwestern Europe: a review of palynofloral diversity patterns and biostratigraphic subdivisions. In: Lucas, S.G. (editor), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 263-283; and P.A. Hochuli (in Hardenbol et al., SEPM charts, 1998)
	Pollen / Spores (Arctic)	Triassic	From SEPM chart (1998; converted to GTS2012)
Carboniferous spores, pollen, flora	Flora Macro Zone (Carbon.)	Carboniferous	GTS2004 diagrams (Davydov et al., 2004)
	Flora Micro Zone (Carbon.)	Carboniferous	GTS2004 diagrams (Davydov et al., 2004)
Devonian spores, pollen, flora	Macroplants Zone	Devonian	Devonian zonations and relative age-calibrations (relaive to conodont "master" scale) are based on Thomas Becker's detailed chart (2010; delivered to Gradstein and Ogg); partly used in GTS2012 Devonian chapter. See http://www.devoniantimes.org/who/pages/archaeopteris.html and other pages at Devonian Times
	Western Europe Miospore Zone name / Abbreviation	Devonian	
	Eastern Europe Miospore Abbreviation / EE zone	Devonian	
	Australian Spore Zones / Subzones / Southeast Standard	Devonian	Australian: relationships to conodonts scheme taken from Young (in Young & Laurie, 1996) Price et al. 1985; Young in Young & Laurie 1996. Southeast Standard: Partridge 2006 & Backhouse, assorted). NOTE: Needs revision. Use detailed versions in Australian Datapack (TSCreator website)
	Australian spore zones (Southeast Std.)	Devonian	Southeast Standard: Partridge 2006 & Backhouse, assorted)
Silurian spores	Spore Zone (Silurian)	Silurian	
Vertebrates (Land and Marine)			
Fish and Reptiles (Silurian-Cretaceous)	**8 columns**		
Silurian Fish Zone		Silurian	
Devonian Fish			Devonian zonations and relative age-calibrations (relaive to conodont "master" scale) are based on Thomas Becker's detailed chart (2010; delivered to Gradstein and Ogg); partly used in GTS2012 Devonian chapter.
	Shark Zones	Devonian	SEE ALSO: http://www.devoniantimes.org/who/pages/sharks.html and other pages on Sharks at Devonian Times
	Armored Fish (Placoderm) Zones	Devonian	SEE ALSO: http://www.devoniantimes.org/who/pages/placoderm.html and other pages on Fish (Ray-fin, Lobe-fin) at Devonian Times
	Acanthodian Zones	Devonian	Acanthodians were among the earliest known vertebrates with jaws. Their new adaptation allowed them to nibble flesh off prey instead of waiting for morsels of food to float by. [FROM: http://animal.discovery.com/prehistoric/acanthodian/]; SEE ALSO: http://www.devoniantimes.org/who/pages/acanthodians.html and other pages on Acanthodians at Devonian Times
	Australian Early Fish -- Phoebondont Assemblages / Turinid Assemblages	Devonian	
	Other Devonian Vertebrate Zones	Devonian	SEE ALSO: http://www.devoniantimes.org/who/pages/densignathus.html and other pages on Tetrapods at Devonian Times

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
Amphibians-Reptiles (Carboniferous-Cretaceous)		Carb-Cret	Lucas, S.G., Sullivan, R.M., and Spielmann, J.A., 2012. Cretaceous vergtebrate biochronology, North American Western Interior. J. Strat., 36: 436-461.; Lucas, S.G., 2009. Global Jurassic tetrapod biochronology. Volumina Jurassic 6: 99-108"; Lucas, S.G., 2010d. The Triassic timescale based on nonmarine tetrapod biostratigraphy and biochronology. In: Lucas, S.G. (editor), The Triassic Timescale. The Geological Society, London, Special Publication, 334: 17-39. AND Perm-Carb from Lucas publications. SEE ALSO: http://www.devoniantimes.org/who/pages/densignathus.html and other pages on Tetrapods at Devonian Times
	Land Vertebrate Zones (faunachrons)	Carb-Cret	
	Vertebrate Datum	Carb-Cret	
Mammals	12 columns		Woodburne (2004); and J. Hooker (GTS2004 and GTS2012 diagrams)
North American Mammals	NALMA (Zones) / Subzones	Present - mid-Cret.	
	N.Amer. zonal and selected markers	Present - mid-Cret.	
	Plio-Pleist datums	Present - Pliocene	
	Other N.Amer. Events	Present - mid-Cret.	
Europe Mammals	ELMA zones	Cenozoic	
	MN-MP zones	Cenozoic	
	Other European mammal zones	Cenozoic	
	Europe Paleogene events	Paleogene	
Asian Mammals	ALMA zones / Subzones	Paleogene	
South America Mammals	SALMA zones	Cenozoic	
Hominid Evolution		6 columns	Main sources = Primate Fossil Record (Cambridge Univ Press; 2002); Tattersall & Schwartz (Evolution of Genus Homo; Ann. Rev. Earth & Planet. Sci., 2009); Australian Museum website; NOVA Human evolution website; Smithsonian website. NOTE: **Humanoid datapack** at TSC download page has images and active links.
	Tool intervals -- Paleo-Neolithic / Tool cultures / Europe tool cultures	Quaternary	Tattersall & Schwartz (2009)
	Main Homo and Australopithecus species ranges	6 Ma	Tattersall & Schwartz (2009); Primate Fossil Record (Cambridge Univ Press; 2002); Australian Museum website; NOVA Human evolution website; Smithsonian website
	Primate species ranges	50 Ma	Primate Fossil Record (Cambridge Univ Press; 2002); Australian Museum website; NOVA Human evolution website; Smithsonian website
	Primate Evolution Major Events	80 Ma	Tattersall & Schwartz (2009); Primate Fossil Record (Cambridge Univ Press; 2002)
Sequences, Sea-Level and Stable Isotopes			
Sequences, Onlap and Sea-Level Curves	33 columns total		
Phanerozoic Composites	10 columns		
Phanerozoic Sequence Synthesis	Sequences (SEPM Global or Tethyan; Haq and Schutter, 2008)	Present - Cambrian	Ceno-Mesozoic = Hardenbol, J., Jacquin, T., Vail, P.R., et al. (SEPM charts, 1998), Paleozoic = Haq and Schutter (Science, 2008) with Seq-stage-nomenclature by ExxonMobil group (Chengjie Liu et al., Jan'08. who also modified some of the previous SEPM nomenclature for Ceno-Mesozoic). CRET (2015) = Revised from: Haq, B.U., 2014. Cretaceous eustasy revisited. Global and Planetary Change, 113: 44-58.
	Age-Name of Paleozoic Seq by Haq-Schutter'08	Perm.-Camb.	Haq, B.U., and Schutter, S.R., 2008. A chronology of Paleozoic sea-level changes. Science (3 Oct 2008), 322: 64-68.

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
	Phanerozoic T-R Cycles (SEPM98; GTS12)	Present - Cambrian	CENOZOIC-MESOZOIC = Hardenbol, J., Jacquin, T., Vail, P.R., et al. (SEPM charts. 1998); Cretaceous revised from: Haq, B.U., 2014. Cretaceous eustasy revisited. Global and Planetary Change, 113: 44-58. Paleozoic = versions used in GTS2012 charts
	Major Mesozoic-Cenozoic T-R Trends (SEPM98)	present - Triassic	CENOZOIC-MESOZOIC = Hardenbol, J., Jacquin, T., Vail, P.R., et al. (SEPM charts. 1998); Cretaceous revised from: Haq, B.U., 2014. Cretaceous eustasy revisited. Global and Planetary Change, 113: 44-58
	Arabian Plate sequences (Simmons et al., 2007)	Present - Cambrian	Simmons et al. (GeoArabia, 2007); recalibrated by NEFTEX to GTS2012 (data set provided to J.Ogg, Feb 2013)
Schematic Coastal Onlap (Phanerozoic synthetic)	Coastal Onlap (synthetic)	Present - Cambrian	Coastal Onlap (SEPM-Haq'08 synthetic) -- Ceno-Mesozoic = Hardenbol, J., Jacquin, T., Vail, P.R., et al. (SEPM charts. 1998) with Tethyan SBs, Paleozoic = Haq and Schutter (Science, 2008). SB Falls set as Minor SB = 20m, Medium = 45m, Major = 80m relative to long-term envelope (in turn, Ceno & Jur = SEPM'98; CRET = Revised from: Haq, B.U., 2014. Cretaceous eustasy revisited. Global and Planetary Change, 113: 44-58.Tri = Haq'05 GeoArabia; Paleozoic = Haq and Schutter'08 Science)
	Coastal Onlap segmented (synthetic)	Present - Cambrian	
Phanerozoic Sea-level Synthesis (meters relative to present)	Short-Term Phanerozoic	Present - Cambrian	CENOZOIC-MESOZOIC = Hardenbol, J., et al. (SEPM charts. 1998), but CRETACEOUS = revised from Haq, B.U., 2014. Cretaceous eustasy revisited. Global and Planetary Change, 113: 44-58; PALEOZOIC = Haq and Schutter (Science, 2008); amplitudes of SEPM'98 Triassic sequences are offset from long-term Triassic curve by Haq and Al-Qahtani (2005) following advice of Bilal Haq (pers. comm. to J.Ogg, April, 2006), and base of their Triassic (Haq and Al-Qahtani, 2005) was used to adjust the Paleozoic (Haq and Schutter, 2008).
	Mean Sea Level (intermediate term; SEPM-Haq'08 synthetic)	Present - Cambrian	Computed as mid-point of Coastal-onlaps. See above for method.
	Long-Term Phanerozoic (SEPM98-Haq'08)	Present - Cambrian	CENOZOIC-MESOZOIC = Hardenbol, J., et al. (SEPM charts. 1998); but CRETACEOUS = revised from Haq, B.U., 2014. Cretaceous eustasy revisited. Global and Planetary Change, 113: 44-58; PALEOZOIC = Haq and Schutter (Science, 2008); amplitudes of SEPM'98 Triassic sequences are offset from long-term Triassic curve by Haq and Al-Qahtani (2005) following advice of Bilal Haq (pers. comm. to J.Ogg, April, 2006), and base of their Triassic (Haq and Al-Qahtani, 2005) was used to adjust the Paleozoic (Haq and Schutter, 2008).
Period-level and alternate versions	23 columns		
High-Res Plio-Pleist Sea Level		Plio-Pleist.	Miller et al. (Science, 2005) based on conversion of oxygen-isotope data. They have similar detail extending back to 9 Ma, and a generalized curve back to 170 Ma, but the time scales in their table are Berggren et al (1995) and Gradstein et al (1994), which significantly diverge from GTS2004 below 5.32 myr, therefore this older curve is omitted until conversions are available.
Boreal Jurassic sequences (SEPM98)	Sequences / Cycles	Jurassic	Hardenbol, J., Jacquin, T., Vail, P.R., et al. (SEPM charts, 1998)
Paleozoic Sloss Sequences	Mega-Sequence / Super-Sequence	Perm.-Camb.	Haq, B.U., and Schutter, S.R., 2008. A chronology of Paleozoic sea-level changes. Science (3 Oct 2008), 322: 64-68.
Perm-Carb Sequences			
Major Perm-Carb sea-level trends	Major North American Pennsylvanian glacials [Heckel, 2013]	Carb	Heckel, 2013
	Perm-Carb-Devon Main T-R episodes (Ross-Ross'95)	Perm-Carb-Devon	Permian = Ross-Ross'95; lowermost Permian = Wardlaw (unpubl.); Upper Carb = Heckel, 2006; Heckel et al., 2007; Lower-Middle Carb = Ross-Ross'87/88; Devonian = Johnson et al. (1985)
Medium and High-resolution cycles	Donets Basin 400-kyr cycle (Penn-earliest Perm)	Penn-Perm	Schmitz-Davydov'12 drew saw-tooth sequences, with SB schematically as 1/16th (1/4th of 100kyr cycle) below MFS.
	Mid-Continent 400kyr or medium Devon-Carb-Perm Sequences (Heckel, Ross)	Perm-Carb-Devon	Permian = Ross-Ross'95; lowermost Permian = Wardlaw (unpubl.); Upper Carb = Heckel, 2006 and 2015; Heckel et al., 2007; Lower-Middle Carb = Ross-Ross'87/88; Devonian = Johnson et al. (1985)
	High-Resolution Carb-Perm Sequences (Heckel, Ross)	Perm-Carb	Permian = Ross-Ross'95; lowermost Permian = Wardlaw (unpubl.); Upper Carb = Heckel, 2006 and 2015; Heckel et al., 2007; Lower-Middle Carb = Ross-Ross'87/88; Devonian = Johnson et al. (1985)
Devonian (Becker, GTS2012)	Schematic Devonian Sea-level Curve (Endpoint 0 to 3)	Devonian	Devonian curves and relative age-calibrations (relaive to conodont "master" scale) are based on Thomas Becker's detailed GTS2012 charts

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
	T-R Event name (Devon)	Devonian	
	Devonian Sequence Lowstands / T-R Cycles (Johnson '85)	Devonian	
Silurian-Ordovician	7 columns		
	Silurian-Ordovician Sea Level - Curve, Intervals	Silur.-Ordov.	Johnson, M.E., 2006. Relationship of Silurian sea-level fluctuations to oceanic episodes and events. GFF (journal formerly called Geologiska Föreningens i Stockholm Förhandlingar), 128: 115-121. AND Nielsen, A.T., 2004. Ordovician sea level changes: A Baltoscandia perspective. In: The Great Ordovician Biodiversification Event (edited by Webby, B.D., Paris, F., Droser, M.L., and Percival, I.), Columbia University Press, N.Y., p. 84-93.
	Silurian Oceanic episodes (Jeppsson'06)	Silurian	Jeppsson (1998) as shown in Johnson (2006)
	Ordovician Sealevel Events (Baltoscandia)		Nielsen, A.T., 2004. Ordovician sea level changes: A Baltoscandia perspective. In: The Great Ordovician Biodiversification Event (edited by Webby, B.D., Paris, F., Droser, M.L., and Percival, I.), Columbia University Press, N.Y., p. 84-93.
	Silurian schematic Sealevel (Loydell '98)	Silurian	Loydell (1998) as drawn and calibrated to graptolite zones by Mike Melchin (Aug'11 for GTS2012 charts)
	Late Ordovician Sequences (Central USA; Holland '08)	Lt. Ordov.	Steven Holland (3 Mar'08; stratum@uga.edu ; to J.Ogg). See www.uga.edu/strata/ordoss and www.uga.edu/strata/cincy/strata/strata.html for details and references
	Ordovician-Silurian T-R Cycles (GTS04)	Silur.-Ordov.	PALEOZOIC = GTS2004 diagrams
Stable Isotopes (O-18, C-13, Sr)	19 columns		
Oxygen-18 curves, Temperatures, and events	*per-mil PDF*		
	Plio-Pleist Marine Oxygen-18 composite	Pleist - Pliocene	Lisiecki, L. E., and M. E. Raymo (2005). *[scale = +2.5 to +5.2 per-mil PDB]*
	Cenozoic-Campanian Marine Oxygen-18 Composite	Present - latest Cret.	Derived from Cramer (2009) -- See Saltzman and Thomas (GTS2012 Carbon-isotope chapter); but only every 10th item from 9-point averaging of Benthic foraminifer compilation (29000 data points in original) is shown here; NOTE: Cramer had two sets -- original and "adjusted" (which removed many of the original)
	Marine Isotope Stages -- Warm MIS / Cold MIS	Pleist - Pliocene	***(Needs 20 cm/myr !!).*** Numbering, including Pliocene extension, from Crowhurst (2002) -- see above curve for relatively placement to their O-18 curve. Warm MIS (odd numbers), and Cold MIS (even numbers) listed in seoparate columns to avoid over-crowding.
	Miocene-Paleocene Oxy-18 **events**	Miocene - Paleocene	Miocene-Oligocene event definitions by Miller et al. (1991) and additional calibrations by Pekar et al (2002); Eocene-Paleocene events after Zachos et al. (2008) and summary by Westerhold et al. (2008) and Westerhold and Rohl (2008, in press); click on events for more details and calibration references.
Paleozoic-Mesozoic Oxygen-18 and Tropical sea-surface temperature	Oxy-18 carbonate	Ordov-Cretaceous	Different sources for Cret-Jur; then Veizer-Prokoph 2015 for Cambrian-Triassic; but using Oxygen-to-Temp conversion from Veizer-Prokoph 2015; and overlay of TEX86
	Adjusted Tropical SST	Ordov-Cretaceous	Different sources; but using Oxygen-to-Temp conversion from Veizer-Prokoph 2015. LATE CRET has an overlay of TEX86 temperature estimates (much higher). TRIASSIC = Veizer-Prokoph 2015 have this 25C as 20C for end-Rhaetian cooling after empiracl compensation for Phanerozoic ocean Oxy-18 trends => 5C less for their smoothing (4C used here).
Ordov-Silur-Devon and Triassic conodont Oxy-18 and tropical temp	Oxy-18 conodont apatite	Ordov-Silur-Devon; Triassic	TRIASSIC = Measured from smoothed curve in Figure in Trotter et al., EPSL 2015. Lower values = Warmer. Temp calibration (using Sun et al.; but which Trotter had shifted by -1) => set 17.5 as 36C;18.5 as 32C; etc. DEVONIAN = Joachimski EPSL2009 - Fig.4 averaged curve; SILURIAN = Trotter et al. (2016) for Silurian (3pt average of Baltica plus Annicosti, calibrated to conodont zones); ORDOV = Trotter et al. (2008) with Temp conversion = =41-4.2*(C9-15.3) based on Fig.3 in Trotter et al (2008) and also used in Joachimski et al. EPSL2009. BUT, see comments from Puceat et al. (2010); Veizer and Prokoph (201);, etc
	Implied Tropical temperature	Ordov-Silur-Devon; Triassic	

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
Cryogenian-Ediacaran Glaciations		Cryogenian-Ediacaran	Sturtian, Marangoan "Snowball Earth" episodes; plus mid-Ediacaran Gaskier's glaciation -- Rooney, A.D., Strauss,, J.V., Brandon, A.D., and Macdonald, F.A., 2015. A Cryogenian chronology: Two long-lasting synchronous Neoproterozoic glaciations. Geology, 43: 459-462.
Precambrian Oxygen & Banded Iron Fm.		late Archean-early Proterozoic	Revised from Van Kranendonk, GTS2012
Carbon-13 curves and events	*per-mil PDF*		*[scale = +5 to -0.3 per-mil PDB]*
	Phanerozoic-Proterozoic Carbon-13 Composite	Present - Proterozoic	CENOZOIC (0-70 Ma) = Derived from Cramer (2009) -- See Saltzman and Thomas (GTS2012 Carbon-isotope chapter); but only every 10th item from 9-point averaging of Benthic foraminifer compilation (29000 data points in original) is shown here; NOTE: Cramer had two sets -- original and "adjusted" (which removed many of the original)); LATE CRET (70-100 Ma) = Composite English Chalk by Jarvis et al. (2006) plus Camp-Maastr boundary from Voight et al. (2010); EARLY CRET (100-145 Ma) = Gale et al. (2011; Cret. Res.), Herrle et al. (2004. EPSL), Renard et al. (2005) and Follmi et al (2006. Paleoceanography) and Martinez et al. (2015); JURASSIC (145-200 Ma) = mainly Katz et al. 2005 (in Muttoni et al., 2014) enhanced by Glowniak and Wierzbowski (2007) for mid-Oxf, Pellanard et al. (2014) for Callov-Oxf boundary; Jenkyns (2004) for Bathonian-Aalenian, Kemp et al. (2005)and Bodin et al. (2010) for early Toarcian. TRIASSIC = Data from Suppl. to Muttoni et al. (2014) for upper Ladinian through uppermost Rhaetian, which had sudden jump upward to Jurassic of Katz et al., 2005 (used here, pending Jurassic chart scaling). BUT -- THEY IGNORE MOST PREVIOUS STUDIES; ONLY USE THEIR SINGLE-SECTION SETS. Early Triassic-lowermost Ladinian from Sun et al (2012) as cycle-adjusted by Mingsong Li. NO data for upper Anisian. Carboniferous = Saltzman, Geology 2003; Gzelian through Permian = Buggisch et al., PPP 2015. Devon = Average of the Max and Min envelope of Becker in GTS2012. Ordov = Bergström et al., 2009. Lethaia; Latest Ordov and early Silurian = Melchin et al (2014) with Hirnantian enhanced from Bergström et al (2014); rest of Silurian = Cramer, 2011; but fit to be consistent with base-Devon Klonk excursion of Becker (2012). CAMBRIAN = Zhu et al. (2006; provided by Loren Babcock, then rescaled by Peng-Babcock for Concise GTS in Dec07
	Devonian C-13 range	Devonian	From Becker (GTS2012) -- Minimum and Maximums of envelope
Carbon-13 and Anoxic Events	Carbon Cycle Events (Cret; Early Paleozoic)	Cret-Jur; Ordov-Silur	LATE CRETACEOUS (69-100 Ma) = Composite English Chalk by Jarvis et al. (2006); DEVON = Becker (GTS2012);
	Anoxic and Biotic Episodes (Cret-Jur; Early Paleozoic) - Cret-Jur / Early Paleozoic	Cret-Jur; Devonian	"JURASSIC (145-200 Ma) = mainly Jenkyns et al. (2002) enhanced by Glowniak and Wierzbowski (2007) for mid-Oxf, Kemp et al. (2005) for early Toarcian, and Palfy et al (2001) for Tri-Jur boundary; Devonian from Becker (GTS2012)
	Cambrian C-13 events	Cambrian	by Loren Babcock (originally derived from Zhu et al. (2006), then enhanced and rescaled by Peng-Babcock for GTS2012. Most names seem to relate to China, therefore tied to their China zones where possible.
***Strontium** 87/86 ratio*	*[scale = 0.7068 to 0.7093]*	present-Cambrian	John McArthur (2004, Lowess version 4, supporting compilation for GTS2004) [NOTE: He rescaled graphics for GTS2012; but didn't provide a table, therefore, for now, used re-scaling of the GTS2004 curves based only on GTS2004-GTS2012 age conversions, with no new data). HOWEVER: Devonian is from Becker (2012); and part of Silurian is from Cramer (2011; as indicated by Melchin in GTS2012).
Global Reconstructions (images		1 column	
	Versions by Ron Blakey		Late Precambrian to Recent globes by Ron Blakey [*https://deeptimemaps.com/global-series-thumbnails/*] , based on Chris Scotese's reconstructions [at *http://www.scotese.com*]
Quaternary (high-resolution)		19 columns	
Quaternary Regional Stages			P. Gibbard (2004, and references therein; pers. commun. to J.Ogg, 2006; 2010)
	Italian marine Stages / Substages	Pleistocene	
	North America Stages / Substages	Pleistocene	

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
	NW Europe Stages / Substages	Pleistocene	
	British Stages / Substages	Pleistocene	
	Russian Plain Stages / Substages	Pleistocene	
	New Zealand stages	Pleistocene	
Chinese Loess			
	Loess Sequence	Pleistocene	An Zhisheng et al. (1990) [measured from their diagram]. "S" = soil levels onto loess; "L" = Loess pulses.
	Magnetic Susc.	Present - Pliocene	An Zhisheng et al. (1990) *[measured from their diagram]. Magnetic susceptibility (SI units) = 0 to 230*
Antarctic Ice Cores			
	delta-Deuterium	Present - mid-Pleist (740 kyr)	Jouzel et al. (2004). Accessed from NCDC Paleoclimatology Program. *[scale = -450 to -360 per-mil]*
	CO2	Present - mid-Pleist (650 kyr)	0-11 ka = Taylor Dome (Indermuhle et al, 1999a); 11-27 ka = Taylor Dome (Smith et al, 1999); 27-60 kyr = Taylor Dome (Indermuhle et al, 1999b). 64-417 kyr = Vostok (Barnola et al., 2003); 417-649 kyr = Dome C (Siegenthaler, 2005). Accessed from NCDC Paleoclimatology Program, and spliced together. *[scale = 180 to 1300 ppmv]*
Milankovitch curves		0 to 3 Ma	Analyseries 2.0 output using: Laskar et al (2004)
	Insolation 65N	Pleistocene	[W/m2] function of time and true longitude (season). From time = 0 to 2500 kyr BP. With starting season = 0 deg. from vernal point. With ending season = 180 degrees. With latitude = 65 degrees (north>0, south<0). using the Laskar 2004 solution. And with solar constant = 1365 W/m2. *[scale = 335 to 410 Watts/m2]*
	Eccentricity	Pleistocene	Laskar et al (2004) *[scale = 0 to 0.06, where 0.0 = circular; Present = 0.17]*
	Obliquity	Pleistocene	Laskar et al (2004) *[scale = 21.5 to 25 degrees, Present = 23.45 degrees]*
	Precession	Pleistocene	Laskar et al (2004) *[scale = -0.06 to +0.06; Present = +0.01]*
Impacts, Volcanism, Tectonics			
Carbonate Trends	5 columns	present-Cambrian	Markello, J.R.; Koepnick, R.B.; Waite, L.E.; and Collins, J.F., 2006, The Carbonate Analogs Through Time (CATT) Hypothesis and the Global Atlas of Carbonate Fields- A Systematic and Predictive look at Phanerozoic Carbonate Systems, in Lukasik, J. and Simo, T. eds., Controls on Carbonate Platform and Reef Development, SEPM Special Publication.
	Carb Platform Reefs		
	Carb Platform Organisms		
	Carb Platform - Platform Types		
	Carb Platform - Carbonate builders		
	Major Reef builders		
Hydrocarbon System overviews	6 columns	present-Cambrian	Mainly from Lowell Waite (author) and Roger Gilcrease (compiler), 2002. Phanerozoic Cycles and Events (NV PXD Global Stratigraphic Chart 02.DSF), March 27, 2002 (printed by Pioneer Natural Resources; permission provided by L. Waite); with additional items from Markello et al. (2006)
	Icehouse / Greenhouse		after Fisher, 1981 (from Waite, 2002)
	Anoxic Intervals		Markllo et al. (2006)
	Major Source Rocks		Markllo et al. (2006)
	Global Source Rocks		With % of world's total generated (Waite, 2002)
	Reservoir Intervals		With % of world's trapped reserves (Waite, 2002)
	Major Evaporite Seals		Major evaporite packages (seal facies) (Waite, 2002)
Impacts	14 main columns:		*Meteor Impacts [dashed => estimated; arrow UP => younger than this level; DOWN => older]. With URL links for details on every event, Includes a column for impact-icon (if downloaded)*
	Global effects (>50 km crater)	Past 2 billion years	Mainly from Earth Impact Database, 2008. [http://www.unb.ca/passc/ImpactDatabase/]; plus other publications

Category			
Group and sub-group	**Subsets**	**Age span**	**Sources (selected major ones)**
	Regional Impacts (<50 km crater) -- 6 pairs of columns by region	Past 2 billion years	Pairs of columns (5-50 km, and <5 km) for each region -- Europe, Russia-Asian, Australian, African, North American, South American
	Recent impacts	Past 1 Ma	
Large Igneous Provinces (LIPs)	9 columns		
	Super LIPs; Major LIPs	Past 3 billion years	Mainly from Large Igneous Provinces Commission (2008). All events have URL links to their maps and summaries; plus "LIP of the Month" as appropriate.
	Regional LIPs of smaller extent - 7 columns by continent	Past 3 billion years	Columns for each region -- Asia, Europe to Urals, Africa, N.America, S.America, India and Indian Ocean, Australia-Antarctica
Passive Margins	13 columns		
	Modern margins -- 6 columns, by ocean basin	present-Jurassic	Mainly from Bradley (2008) Passive margins through earth history. Earth-Science Reviews, 91: 1–26.
	Past margins - 7 columns, by continent	Past 3 billion years	
Precambrian Crust Formation	2 columns		
	Crust Formation curve / events	Archean-Proterozoic	Modified from Van Kranendonk, GTS2012