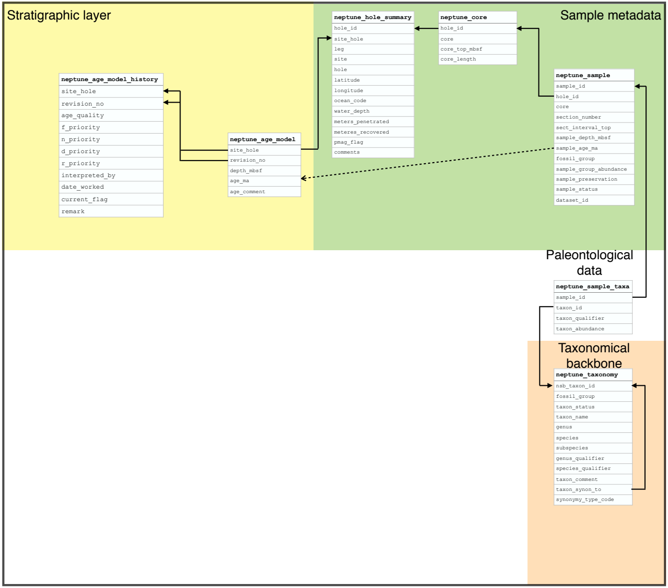
Neptune Sandbox Berlin

Johan Renaudie & David Lazarus
Museum für Naturkunde, Berlin
2022-02-10

The Neptune Database

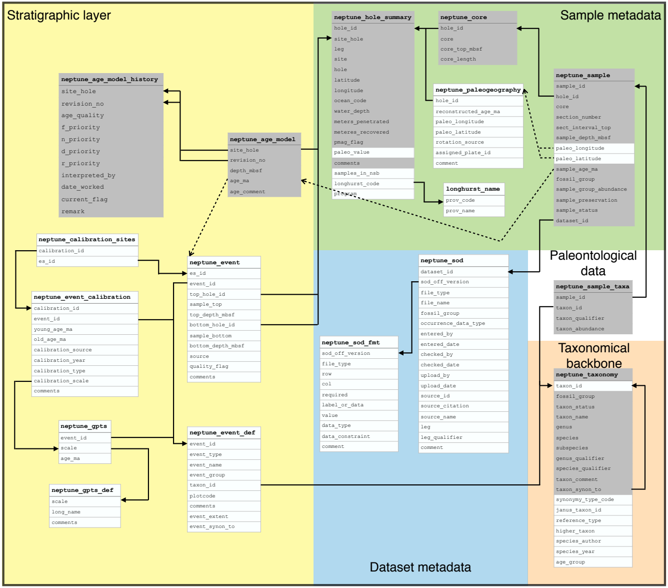
- Started at ETH in Zurich in 1990 as a database of microfossils based on published DSDP and ODP deep-sea drilling data, for paleobiology.
- Put online and updated from 2001 to 2006 as part of NSF-funded Chronos project. Unstable and data damage after project ended late 2000s.
- Salvaged and reopened since 2010 as NSB (Neptune Sandbox Berlin) at the MfN in Berlin, with help of Pat Diver and small grant from CEES Oslo.
- 2014–2015, ESF-funded effort to update it and expand its stratigraphic capabilities for use in paleoceanography.
- Linked to Mikrotax system since 2015.
- Currently run by 2 people (JR, DBL) on voluntary basis.

NSB Structure

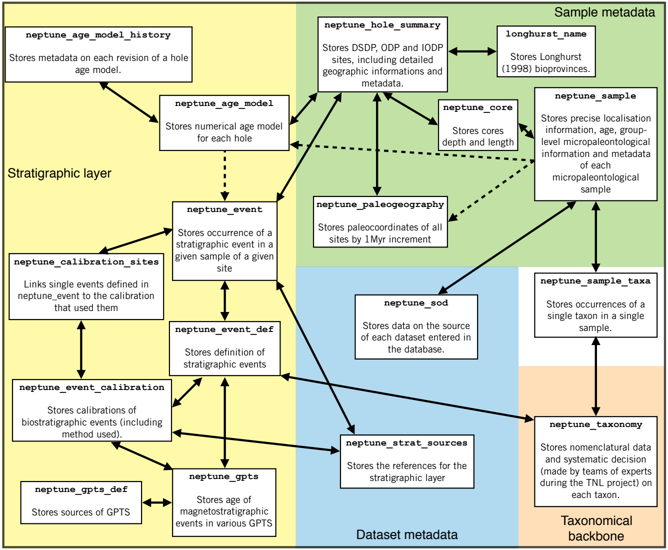


Neptune prior to NSB

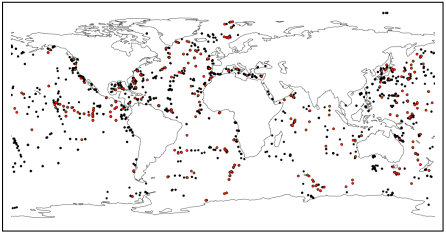
NSB Structure



NSB Structure



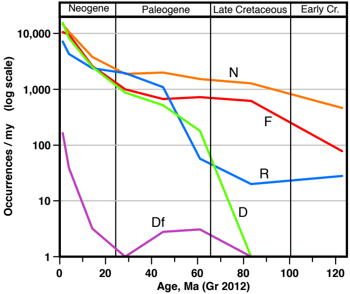
NSB Content



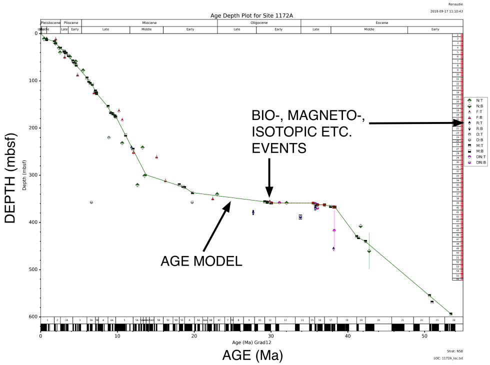
768 057 occurrences.
502 deep-sea drilling holes.
Mostly Cenozoic, but significant Cretaceous.
More carbonate than siliceous fossil data so far.

18 859 taxa names
for 5 microfossil groups
(R, D, PF, N, DN).

Synonymy resolved using TNL: international effort from IODP Paleontology Coordination Group.



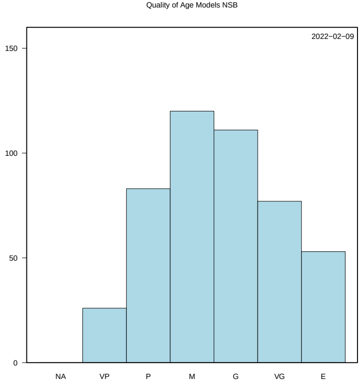
NSB Content



Continuous age vs depth functions (age models) for each section

28 774 stratigraphic events (including 5 130 calibrations for them)

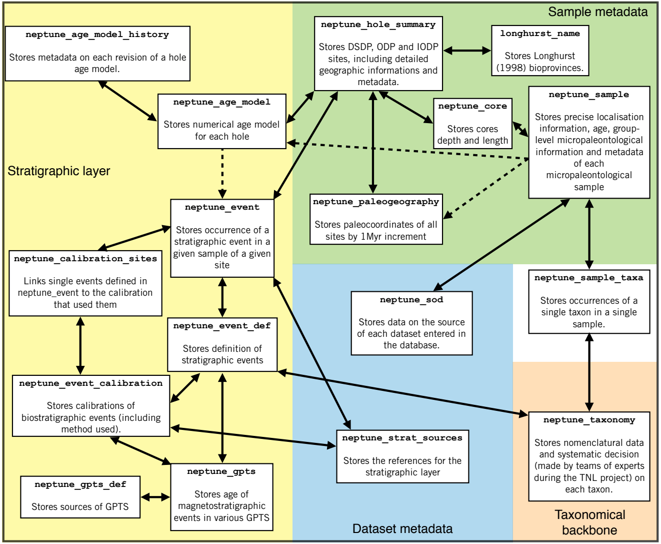
Age models for 470 DSDP, ODP or IODP holes.



Age model quality vary but most above average.

Website option to ignore poor age models set by default.

Age model library



Age model library

neptune_event_def

event_id	event_type	event_name	event_group	taxon_id	plotcode	comments	event_extent	event_synon_to
695	TOP	Turborotalia pomeroli	F	[NULL]	tTURBpome	[NULL]	global	[NULL]
696	BOT	Cribrohantkenina inflata	F	[NULL]	bCRIBinfl	[NULL]	global	[NULL]
697	TOP	Acarinina spp.	F	[NULL]	tACARspp	[NULL]	global	[NULL]
698	TOP	Acarinina collactea	F	[NULL]	tACARcoll	[NULL]	global	[NULL]
699	TOP	Subbotina linaperta	F	[NULL]	tSUBBlina	[NULL]	global	[NULL]
700	TOP	C1n	M	[NULL]	tC1n	Brunhes	global	[NULL]
701	BOT	C1n	M	[NULL]	bC1n	Brunhes	global	[NULL]
702	TOP	C1r.1n	M	[NULL]	tC1r.1n	Jaramillo	global	[NULL]
703	BOT	C1r.1n	M	[NULL]	bC1r.1n	Jaramillo	global	[NULL]

Age model library

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695	TOP	Turborotalia pomeroli	F	[NULL]	tTURBpome	[NULL]	global	[NULL]
696	BOT	Cribrohantkenina inflata	F	[NULL]	bCRIBinfl	[NULL]	global	[NULL]
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698	TOP	Acarinina collactea	F	[NULL]	tACARcoll	[NULL]	global	[NULL]
699	TOP	Subbotina linaperta	F	[NULL]	tSUBBlina	[NULL]	global	[NULL]
700	TOP	C1n	M	[NULL]	tC1n	Brunhes	global	[NULL]
701	BOT	C1n	M	[NULL]	bC1n	Brunhes	global	[NULL]
702	TOP	C1r.1n	M	[NULL]	tC1r.1n	Jaramillo	global	[NULL]
703	BOT	C1r.1n	M	[NULL]	bC1r.1n	Jaramillo	global	[NULL]

neptune_event_calibration

calibration_id	event_id	calibration_source	calibration_year	calibration_type	calibration_scale	young_age_ma	old_age_ma	comments	source_id
194	1093	Wade et al.	2011	M	CK95	38.00	[NULL]	[NULL]	864
195	1094	Wade et al.	2011	M	CK95	40.00	[NULL]	[NULL]	864
196	1095	Wade et al.	2011	M	CK95	27.50	[NULL]	[NULL]	864
197	1096	Wade et al.	2011	M	CK95	28.40	[NULL]	[NULL]	864
251	638	Cody et al.	2008	M	Grad04	3.93	4.19	CONOP Average	658
253	640	Cody et al.	2008	M	Grad04	4.3	4.64	CONOP Average	658
250	637	Cody et al.	2008	M	Grad04	4.58	4.75	CONOP Average	658
256	643	Cody et al.	2008	M	Grad04	4.58	4.74	CONOP Average	658
257	644	Cody et al.	2008	M	Grad04	4.61	4.7	CONOP Average	658
254	641	Cody et al.	2008	M	Grad04	4.3	4.57	CONOP Average	658

Age model library

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695	TOP	Turborotalia pomeroli	F	[NULL]	tTURBpome	[NULL]	global	[NULL]
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700	TOP	C1n	M	[NULL]	tC1n	Brunhes	global	[NULL]
701	BOT	C1n	M	[NULL]	bC1n	Brunhes	global	[NULL]
702	TOP	C1r.1n	M	[NULL]	tC1r.1n	Jaramillo	global	[NULL]
703	BOT	C1r.1n	M	[NULL]	bC1r.1n	Jaramillo	global	[NULL]

neptune_event_calibration

calibration_id	event_id	calibration_source	calibration_year	calibration_type	calibration_scale	young_age_ma	old_age_ma	comments	source_id
194	1093	Wade et al.	2011	M	CK95	38.00	[NULL]	[NULL]	864
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196	1095	Wade et al.	2011	M	CK95	27.50	[NULL]	[NULL]	864
197	1096	Wade et al.	2011	M	CK95	28.40	[NULL]	[NULL]	864
251	638	Cody et al.	2008	M	Grad04	3.93	4.19	CONOP Average	658
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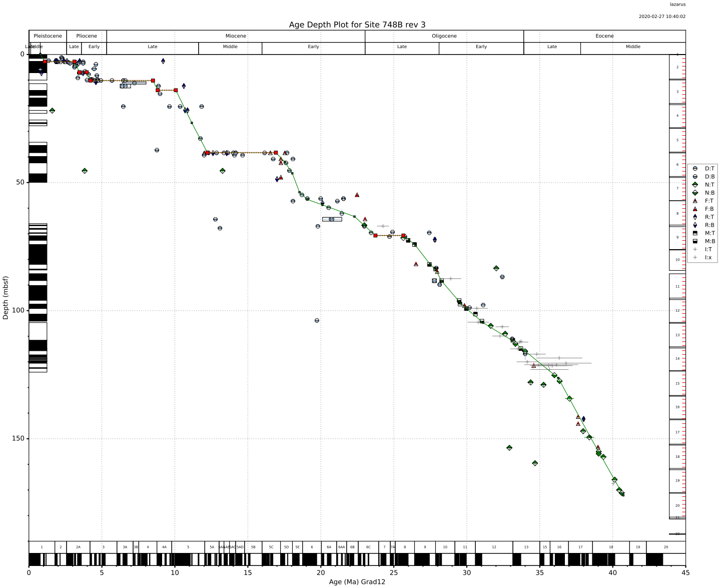
257	644	Cody et al.	2008	M	Grad04	4.61	4.7	CONOP Average	658
254	641	Cody et al.	2008	M	Grad04	4.3	4.57	CONOP Average	658

neptune_event

es_id	event_id	top_hole_id	sample_top	top_depth_mbsf	bottom_hole_id	sample_bottom	bottom_depth_mbsf	source	source_id
24736	1080	111_677A	16-CC	148.59	111_677A	17-CC	151.57	Houghton 1989	701
21733	111	111_677A	19-CC	172.47	111_677A	20-CC	180.67	Houghton 1989	701
23159	1076	111_677A	12-3,95	105.15	111_677A	12-CC	110.84	Houghton 1989	701
24170	93	111_677A	6-3,10	47.30	111_677A	6-6,78	52.48	Houghton 1989	701
18415	934	111_677A	24-3,65	215.35	111_677A	24-CC	221.05	Houghton 1989	701
12596	1085	111_677A	16-CC	148.59	111_677A	17-CC	151.57	Jenkins & Houghton 1989	705
21650	940	111_677A	20-CC	180.67	111_677A	21-CC	185.57	Houghton 1989	701
11933	9	111_677A	10-2,150	85.20	111_677A	10-3,130	86.50	Jenkins & Houghton 1989	705
22195	1071	111_677A	7-3,45	57.15	111_677A	7-6,84	62.04	Houghton 1989	701
21852	933	111_677A	19-CC	172.47	111_677A	20-CC	180.67	Houghton 1989	701
19891	106	111_677A	29-CC	265.26	111_677A	30-CC	275.48	Houghton 1989	701

Age model library



Age model library

neptune_age_model

site_hole	revision_no	age_ma	depth_mbsf	age_comment
762C	1	34.085972	168.182	[NULL]
762C	1	37.340460	263.864	[NULL]
762C	1	40.438657	277.727	[NULL]
762C	1	43.397971	277.727	[NULL]
762C	1	47.254786	330.475	[NULL]
762C	1	52.613917	369.525	[NULL]
762C	1	57.097708	420.455	[NULL]
762C	1	62.548715	519.045	[NULL]
762C	1	63.420985	519.045	[NULL]
762C	1	65.778689	553.273	[NULL]
762C	1	69.666593	603.458	[NULL]
762C	1	75.366248	616.292	[NULL]
762C	1	85.599852	782.273	[NULL]
762C	1	95.659265	806.676	[NULL]
762C	1	104.539295	825.143	[NULL]
762C	1	111.684952	825.143	[NULL]
762C	1	122.542580	841.651	[NULL]
762C	1	144.282300	841.651	[NULL]

Age model library

neptune_age_model

site_hole	revision_no	age_ma	depth_mbsf	age_comment
762C	1	34.085972	168.182	[NULL]
762C	1	37.340460	263.864	[NULL]
762C	1	40.438657	277.727	[NULL]
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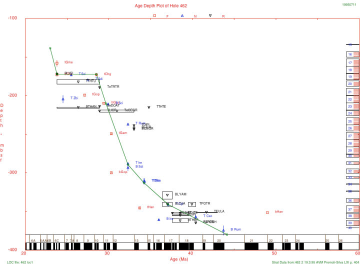
762C	1	111.684952	825.143	[NULL]
762C	1	122.542580	841.651	[NULL]
762C	1	144.282300	841.651	[NULL]

neptune_age_model_history

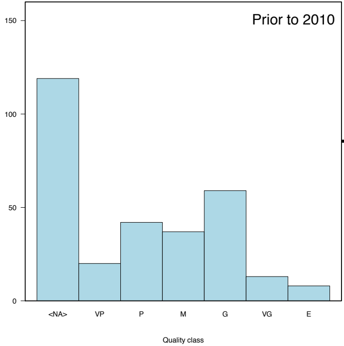
site_hole	revision_no	age_quality	interpreted_by	date_worked	current_flag	remark
1337A	0	VG	Renaudie	2015-04-13	N	Qest by dbl
1337A	1	VG	lazarus	2017-03-08	N	Qest by dbl 8.3.17. Minor shifts of loc to better match fuller set of data added to NSB after rev0 loc by Renaudie
1337A	2	E	lazarus	2021-12-21	Y	Qest dbl. Orbitally tuned upper 2/3, near constant sed rate tuned section supports loc w. only bstrat in lower part
1337B	0	E	lazarus	2021-12-30	Y	Qest dbl. Orbitally tuned. plot labeled Rev2 to match 1337A
1337D	0	E	lazarus	2021-12-30	Y	Qest dbl. Orbitally tuned.
1338A	0	G	Renaudie	2015-04-13	N	Qest by dbl 6.2.17. Excellent model now avail: Backman et al. 2016 IODP Leg SR vol online. JR (2015): uses IR magneto; M disagrees wi
1338A	1	N/A	lazarus	2022-01-30	Y	[NULL]
1338B	0	G	Renaudie	2015-04-13	N	Qest by dbl 6.2.17. Excellent model now avail: Backman et al. 2016 IODP Leg SR vol online. JR (2015): uses IR magneto; M disagrees w
1338B	1	G	lazarus	2017-04-06	N	Qest by dbl 6.4.17. Also in comparison to 1338A. Pmag coverage spotty, some scatter. Loc could be moved ca 5 to max 1 my at some ir
1338B	2	N/A	lazarus	2022-01-30	Y	[NULL]

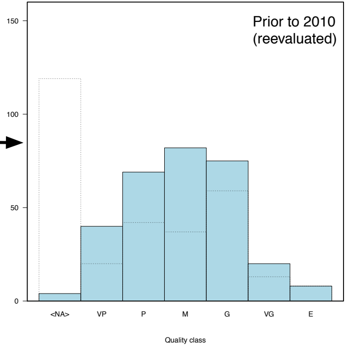
Quality Control

Age model assessment



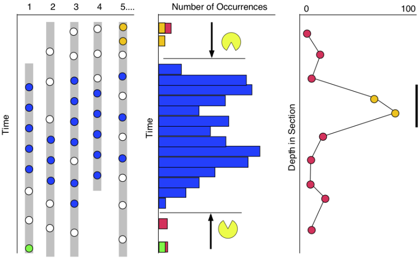
- New quality assessment of old Chronos-era age models



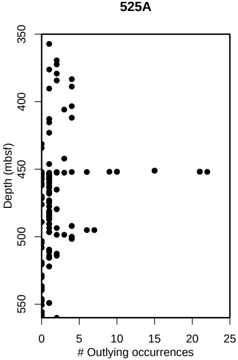


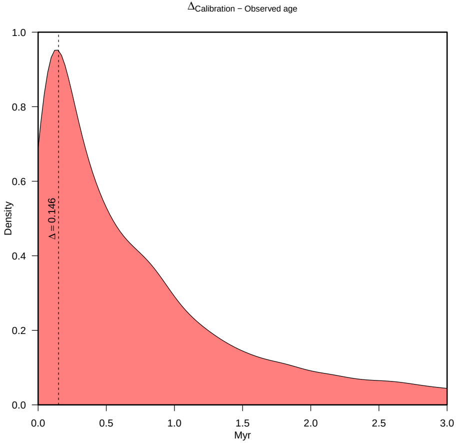
Quality Control

Pacman

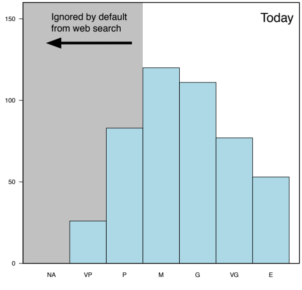


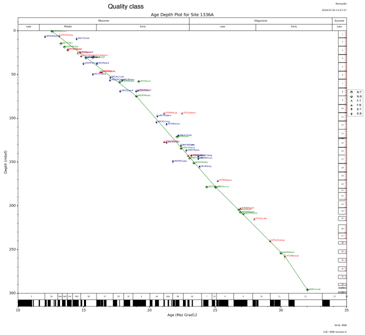
- New quality assessment of old Chronos-era age models
- Outlier detection using e. g. PacMan analysis (Lazarus et al. 2012)





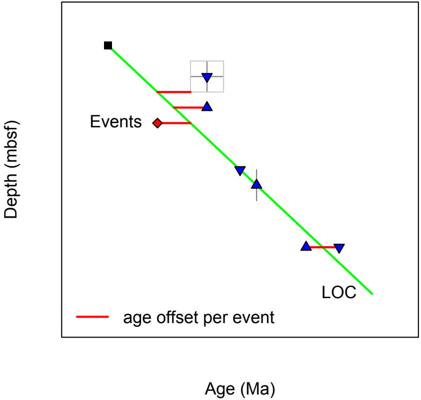
Quality Control

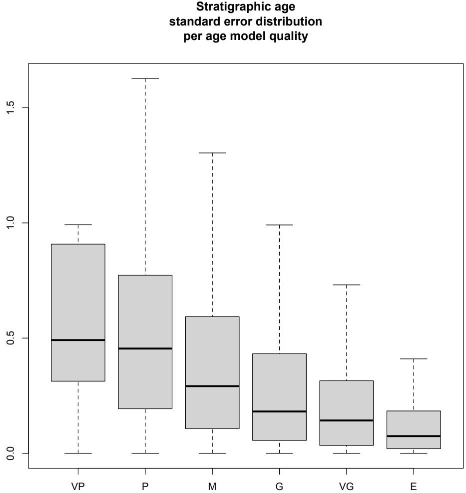




- New quality assessment of old Chronos-era age models
- Outlier detection using e. g. PacMan analysis (Lazarus et al. 2012)
- Selected undated holes containing the larger amount of samples
- Re-did main offenders by using modern calibrations and newly published statigraphic events (including astrochronology)
- Added possibility to filter out datasets with poor age models on the web portal
- $>$ 300 new/revised age models since 2014; including $>$100 since 2020.

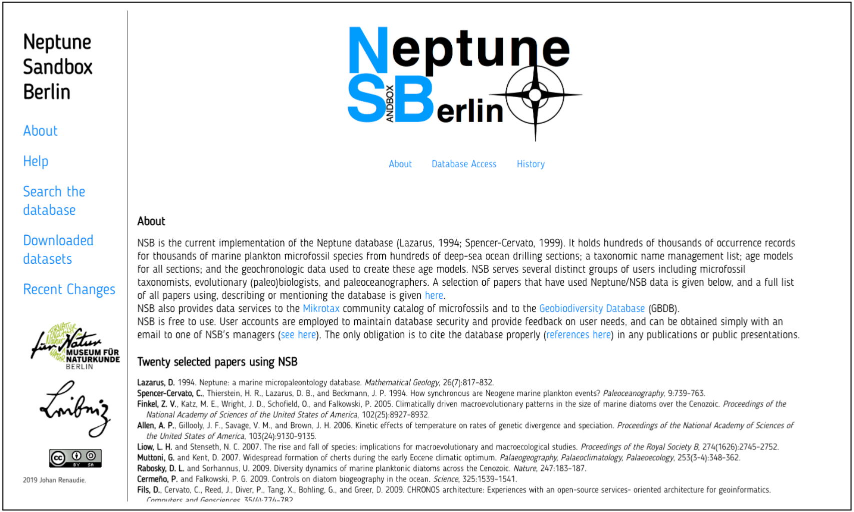
Error estimates on age models





Age model quality estimate qualitative but match quantitative estimates: **VP**: LOC poorly constrained; **P**: median error ca. $\pm$ 0.45Myr; **M**: ca. $\pm$ 0.30Myr; **G**: ca. $\pm$ 0.20Myr; **VG**: ca. $\pm$ 0.15Myr; **E**: ca. $\pm$ 0.075Myr.

Web portal: nsb.mfn-berlin.de



Neptune Sandbox Berlin

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2019 Johan Renaudie.

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About

NSB is the current implementation of the Neptune database (Lazarus, 1994; Spencer-Cervato, 1999). It holds hundreds of thousands of occurrence records for thousands of marine plankton microfossil species from hundreds of deep-sea ocean drilling sections; a taxonomic name management list; age models for all sections; and the geochronologic data used to create these age models. NSB serves several distinct groups of users including microfossil taxonomists, evolutionary (paleo)biologists, and paleoceanographers. A selection of papers that have used Neptune/NSB data is given below, and a full list of all papers using, describing or mentioning the database is given here.

NSB also provides data services to the Mikrotax community catalog of microfossils and to the Geobiodiversity Database (GBDB).

NSB is free to use. User accounts are employed to maintain database security and provide feedback on user needs, and can be obtained simply with an email to one of NSB's managers (see here). The only obligation is to cite the database properly (references here) in any publications or public presentations.

Twenty selected papers using NSB

Lazarus, D. 1994. Neptune: a marine micropaleontology database. *Mathematical Geology*, 26(7):817-832.

Spencer-Cervato, C., Thierstein, H. R., Lazarus, D. B., and Beckmann, J. P. 1994. How synchronous are Neogene marine plankton events? *Paleoceanography*, 9:739-763.

Finkel, Z. V., Katz, M. E., Wright, J. D., Schofield, O., and Falkowski, P. 2005. Climatically driven macroevolutionary patterns in the size of marine diatoms over the Cenozoic. *Proceedings of the National Academy of Sciences of the United States of America*, 102(25):8927-8932.

Allen, A. P., Gillooly, J. F., Savage, V. M., and Brown, J. H. 2006. Kinetic effects of temperature on rates of genetic divergence and speciation. *Proceedings of the National Academy of Sciences of the United States of America*, 103(24):9130-9135.

Liow, L. H. and Stenseth, N. C. 2007. The rise and fall of species: implications for macroevolutionary and macroecological studies. *Proceedings of the Royal Society B*, 274(1626):2745-2752.

Muttoni, G. and Kent, D. 2007. Widespread formation of cherts during the early Eocene climatic optimum. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 253(3-4):348-362.

Rabosky, D. L. and Sorhannus, U. 2009. Diversity dynamics of marine planktonic diatoms across the Cenozoic. *Nature*, 247:183-187.

Cermeño, P. and Falkowski, P. G. 2009. Controls on diatom biogeography in the ocean. *Science*, 325:1539-1541.

Fils, D., Cervato, C., Reed, J., Diver, P., Tang, X., Bohling, G., and Greer, D. 2009. CHRONOS architecture: Experiences with an open-source services- oriented architecture for geoinformatics. *Computers and Geosciences*, 35(4):774-782.

Web portal: nsb.mfn-berlin.de

Age models

Neptune Sandbox Berlin

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Search an age model

Hole 1338A

Scale Gradstein et al. 2012

You are currently logged in as Renaudie. Log Out Search

Revision 0

Interpreted by	*Renaudie*	Date	*April 13, 2015*
Age Quality	*G*	Currently used in NSB	*Y*
Remarks	*Qest by dbl 6.2.17. Excellent model now avail: Backman et al. 2016 IODP Leg SR vol online. JR (2015): uses IR magneto; M disagrees with biostrat between 200 and 300 mbsf*		

Hole	Age (Ma)	Depth (mbsf)	Comment
1338A	0.000000	0.000	None
1338A	0.782725	8.276	None
1338A	1.109405	11.971	None
1338A	1.762765	21.207	None
1338A	2.579465	31.368	None
1338A	3.118487	37.833	None
1338A	3.330829	40.142	None
1338A	3.608507	43.837	None
1338A	4.180197	51.688	None
1338A	4.376205	54.459	None
1338A	5.029564	66.929	None

Web portal: nsb.mfn-berlin.de

Event calibrations

Neptune Sandbox Berlin

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Search an event calibration

Event BOT Scale Gradstein et al. 2012

You are currently logged in as Renaudie. Log Out Search

Event ID	Calib. ID	Type	Event Name	Group	Age min	Age max	Geographical Extent	Source	Calibration Type	Original Scale	Comments
1073	1210	BOT	Emiliania huxleyi	N	0.3		global	Berggren et al. 1985	M	Berg85	ODP Technical Note 24
1073	174	BOT	Emiliania huxleyi	N	0.29		global	Backman et al. 2012	O	Grad04	

All ages given here on Gradstein et al. 2012 scale.

This event has been found in the following sites:

Event ID	TOP				BOTTOM				Source event	Comment	
	Hole	Sample	Depth (mbsf)	Age (*)	Hole	Sample	Depth (mbsf)	Age (*)			
1073	101_626C	5-1,40	38.90		101_626C	5-CC	48.01		626C_fn_bstrat95		
1073	104_642B	2-6,85	13.15		104_642B	3-2,87	16.67		Donnally 1989		
1073	104_643A	1-2,50	2.00	0.278	104_643A	1-3,50	3.50	0.31	Donally 1989		
1073	104_644A	4-1,50	26.20		104_644A	4-2,50	27.70		644A_mfnr_bstrat95		
1073	105_646A	2-5,102	12.02	0.184	105_646A	2-6,104	13.54	0.207	Baldauf et al 1989		
1073	105_646B		12.03	0.182	105_646B		13.55	0.2	Baldauf et al 1989		
1073	105_647A	1-6,130	8.80	0.275	105_647A	1-7,14	9.14	0.285	647A_mfn_bstrat95		
1073	107_651A	8-CC	64.42		107_651A	9-1,69	69.49		651A_mn_bstrat95		
1073	107_653A	3-2,60	15.30		107_653A	3-2,120	15.90		Rio et al. 1990		Used for calibration of the event (see calibration No 174).
1073	107_653A		15.60		107_653A		15.60		Glaçon et al 1990		
1073	107_655A	1-2,20	1.70		107_655A	1-2,120	2.70		Müller 1990		
1073	108_657A		0.90		108_657A		3.30		657A_fn_bstrat95		
1073	108_658A		34.20	0.275	108_658A		43.70	0.318	Manivit 1989		
1073	108_658A		34.20	0.275	108_658A		43.70	0.318	658A_mfn_bstrat95		
1073	108_659A	1-5,130	7.30	0.241	108_659A	2-1,30	8.10	0.27	Manivit 1989		

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Web portal: nsb.mfn-berlin.de

Search for events in sections

Neptune Sandbox Berlin

About

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Search for stratigraphic events

Hole: 320-1333A

Scale: Gradstein et al. 2012

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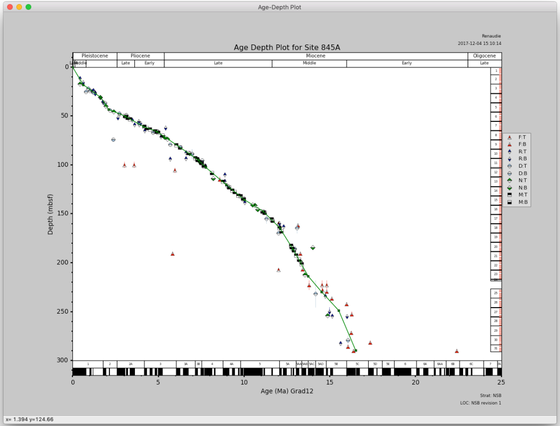
	Type	Event Name	Sample (Top)	Sample (Bottom)	Depth mbsf (Top)	Depth mbsf (Bottom)	Age min	Age max	Source event	Source calibration	Comment
M	TOP	C6An.1n	320_1333A-1-1,55	320_1333A-1-1,65	0.55	0.65	20.04		Expedition 320/321 Scientists, 2010	Gradstein et al. 2012	
M	BOT	C6An.1n	320_1333A-1-1,110	320_1333A-1-1,115	1.10	1.15	20.21		Expedition 320/321 Scientists, 2010	Gradstein et al. 2012	
M	TOP	C6An.2n	320_1333A-1-2,50	320_1333A-1-2,60	2.00	2.10	20.44		Expedition 320/321 Scientists, 2010	Gradstein et al. 2012	
R	BOT	Stichocorys delmontensis	320_1333A-1-2,104	320_1333A-1-4,104	2.54	5.54	20.6		Expedition 320/321 Scientists, 2010	Kamikuri et al. 2012	Used for age model revision 0
R	BOT	Stichocorys delmontensis	320_1333A-	320_1333B-	2.54	7.48	20.6		Kamikuri et al.	Kamikuri et al.	Used for

NSB_ADP_wx

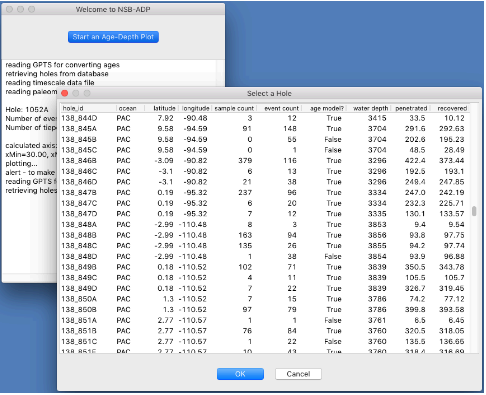
Currently available for Mac OSX 10.12 and higher, or as a python script, at `http://gihub.com/plannapus/nsb_adp_wx/releases`.

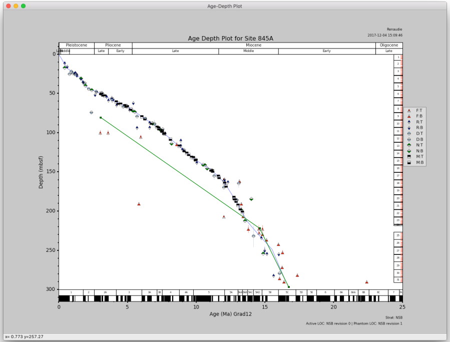


Modernisation of Age-Depth plot software (Lazarus, 1992; Bohling, 2005)

NSB_ADP_wx

Allows users to create an age model, to explore NSB age model and biostratigraphic events library, to modify an existing age model, compare alternative ones, etc.





Future of NSB and associated software stack

- Triton integration
- Ability to work with mcd in addition to mbsf
- API for stratigraphic data
- Ability to store paleomagnetic raw data to allow new interpretations and error quantification
- `NSB_ADP_shiny`? Web-based age-depth plot maker with direct connection to DB would increase its accessibility

Additional informations.

Access to the Database:
Website: `http://nsb.mfn-berlin.de`
Username: guest
Password: arm_aber_sexy

For direct PostgreSQL connection:
Host: 212.201.100.111
Port: 5432
Database name: nsb

NSB_ADP_wx: `http://github.com/plannapus/nsb_adp_wx/releases`

Renaudie, J., Lazarus, D.B., Diver, P. (2020) NSB (Neptune Sandbox Berlin): an expanded and improved database of marine planktonic microfossil data and deep-sea stratigraphy. *Palaeontologia Electronica*, 23(1):a11.

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