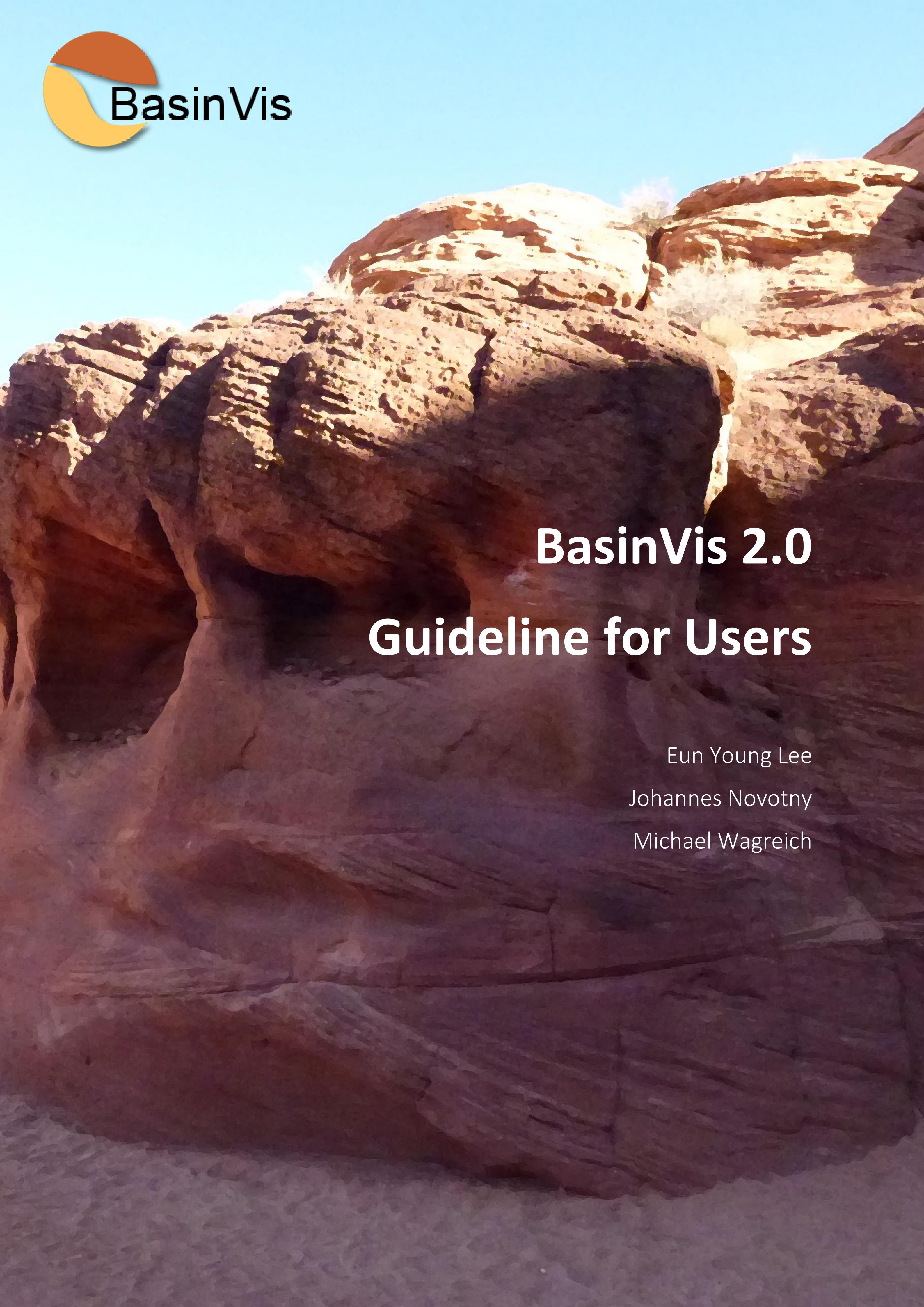

BasinVis 2.0

Guideline for Users

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Johannes Novotny

Michael Wagreich

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This document introduces you to the user interface of BasinVis 2.0.

BasinVis 2.0 is an open-source software implemented entirely in MATLAB® version 9.3 (R2017b) and requires the 'Symbolic Math' and 'Curve Fitting' toolboxes (Math, Statistics, and Optimization package). It can be operated under Microsoft Windows (XP or higher), Mac OS X (10.7.4 þ or higher), and recent Linux distributions (e.g., Ubuntu 18.04 LTS or higher).

For detailed descriptions of the functionality of BasinVis versions 1.0 and 2.0, please check the publications;

Lee, E.Y., Novotny, J., Wagreich, M., 2020. Compaction trend estimation and applications to sedimentary basin reconstruction (BasinVis 2.0). Applied Computing & Geosciences 5, 100015. https://doi.org/10.1016/j.acags.2019.100015

Lee, E.Y., Novotny, J., Wagreich, M., 2016. BasinVis 1.0: A MATLAB®-based program for sedimentary basin subsidence analysis and visualization. Computers & Geosciences 91, 119–127. http://dx.doi.org/10.1016/j.cageo.2016.03.013

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BasinVis 2.0 Guideline for Users

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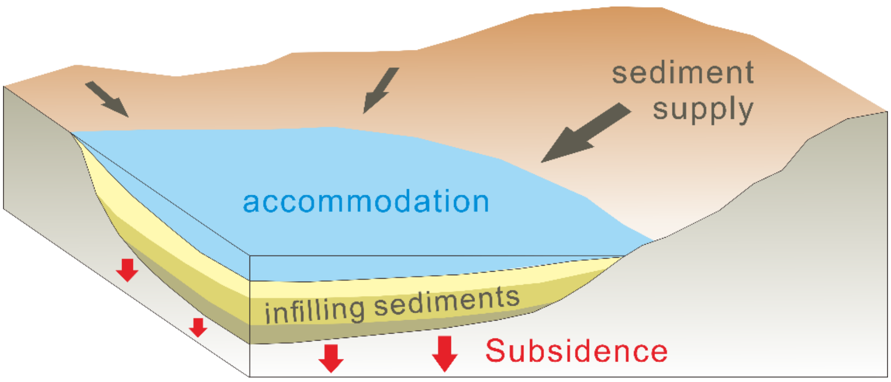


from Lee et al. (2020)

TABLE OF CONTENTS

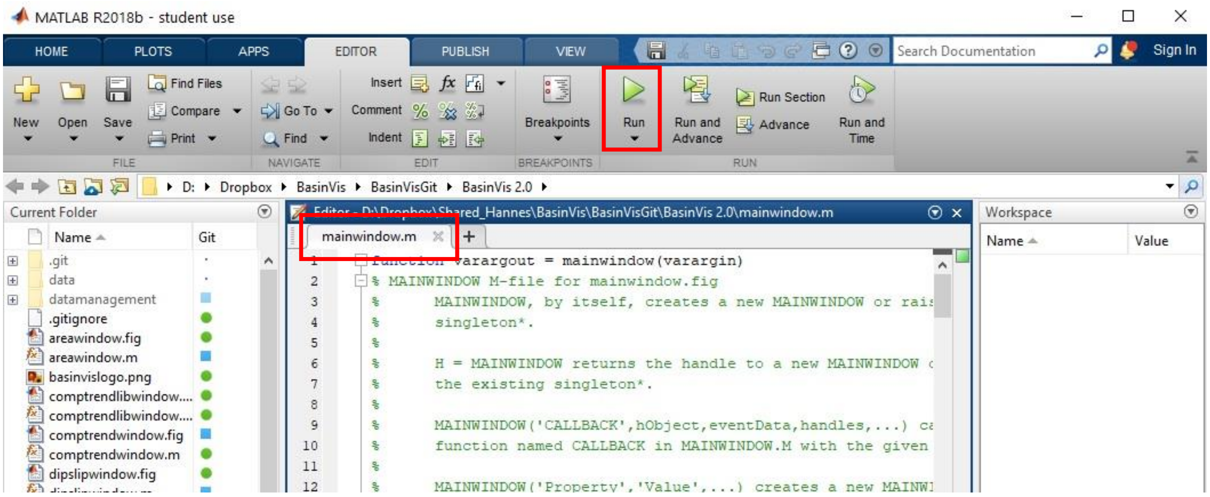
INSTALLATION

- download BasinVis 2.0 at

  https://geologist-lee.com/basinvis-2_0/

  https://github.com/jonovotny/BasinVis/tree/2.0-beta

- extract the Zip file in a directory of your choice.
- open MATLAB and change the current folder to the BasinVis directory.
- execute "mainwindow" in the command window.



As practical example, the following files are provided:

"Example_SVB project.mat", containing a complete BasinVis example project

"Example_SVB_well data.xlsx",
containing the well data used in the example project in MS Excel format

"Example_Porosity-Depth_U1459_Houtman.xlsx",
containing porosity-depth data in MS Excel format

MAIN WINDOW

The main window acts as central hub to all functions and process stages of BasinVis 2.0. Function buttons are arranged to follow the order of the workflow and are enabled as soon as all required data for the individual operations have been entered and saved.

BasinVis 2.0 main window consists of four stages;

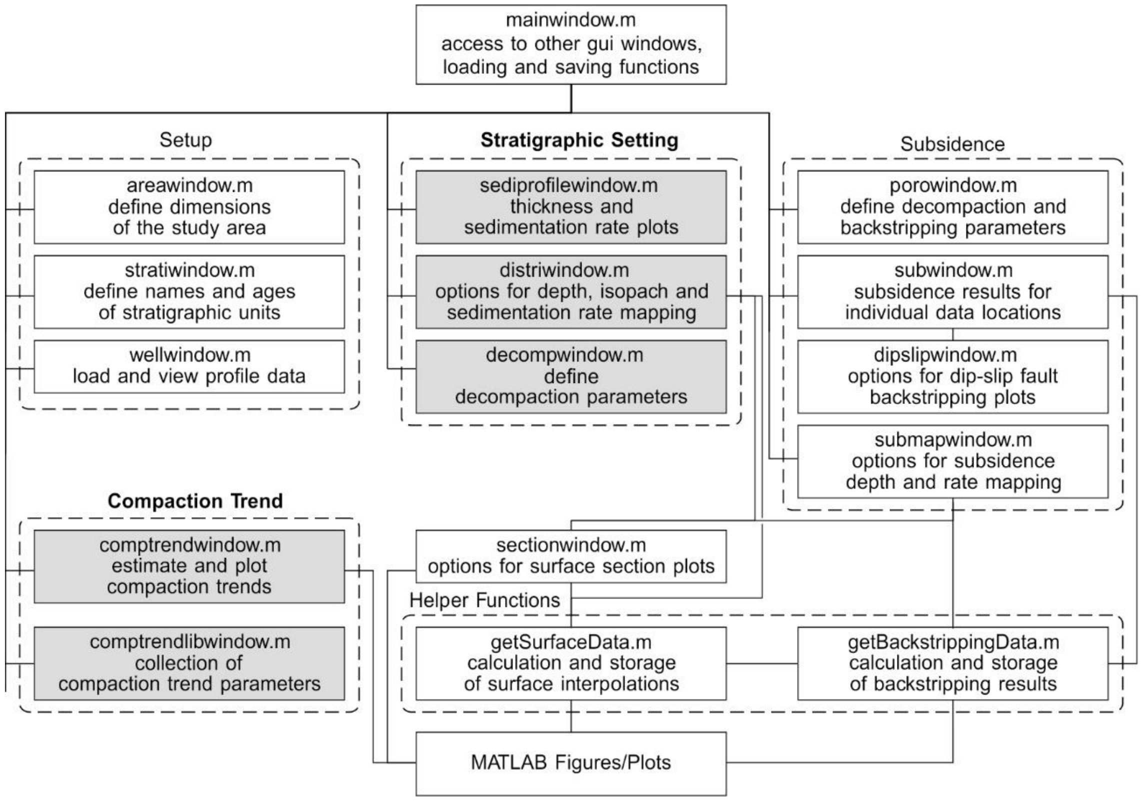
SETUP
STRATIGRAPHIC SETTING
SUBSIDENCE
COMPACTION TREND

Each stage includes several windows of distinct functions. In a new project, only the "Study Area" button is enabled.

For practice, open a MATLAB Data file "Example_SVB project.mat".

WORKFLOW CHART

Workflow chart of BasinVis 2.0 with main script files and their high-level functions. New or improved scripts of BasinVis 2.0 are grey-colored.



from Lee et al. (2020)

DATASET

To use BasinVis 2.0 completely, you need to have the following data available. Some individual operations can be accessed with part of the data.

Parameter	Symbol	Description
Study area	X, Y, Z	a size of mapping and modeling area
Well location	x, y	x, y coordinators in the study area
Depth	z_1, z_2, …	Top depth of each stratigraphic unit
Geologic age	Ma	Geologic age of each stratigraphic unit
Initial porosity	ϕ_0	Initial porosity (%) derived from compaction trend
Coefficient	c	compaction coefficient derived from compaction trend
Density	ρ_s	Average density of sediment grain (kg/m^3)
	ρ_m	Average density of mantle (3.3 kg/m^3 input)
	ρ_w	Average density of water (1.0 kg/m^3 input)
Waterdepth	W_d	Paleo-waterdepth
Sealevel	Δ_{SL}	Paleo-sealevel

Well location is relative to the study area. See an attached excel file "Example_SVB_well data.xlsx" for an example of well locations and depths of stratigraphic units.

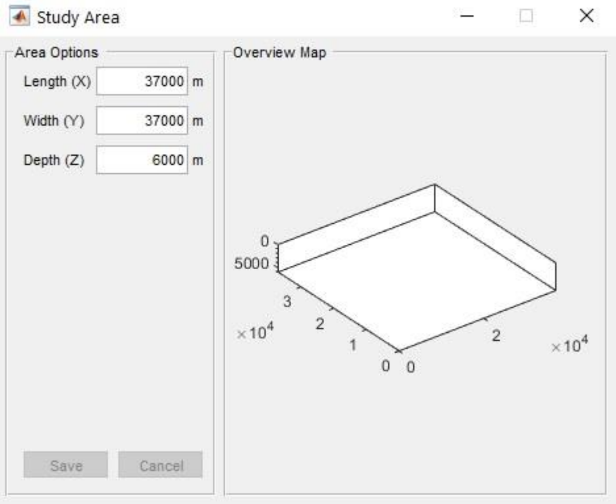
Initial porosity and compaction coefficient are based on a porosity-depth dataset, which can be estimated using functions in the "Compaction Trend" stage of BasinVis 2.0 (see *Trend Estimation and Trend Library*).

Densities of mantle and water are applied as 3300 kg/m^3 and 1000 kg/m^3 input BasinVis 2.0. You can change them at Line 71 in *datamanagement/getBackstrippingData.m* and Line 169 in *subwindow.m*.

If variations of waterdepth and sealevel are not applicable for your study area or on purpose, the parameters can be input 0.

SETUP

Study Area

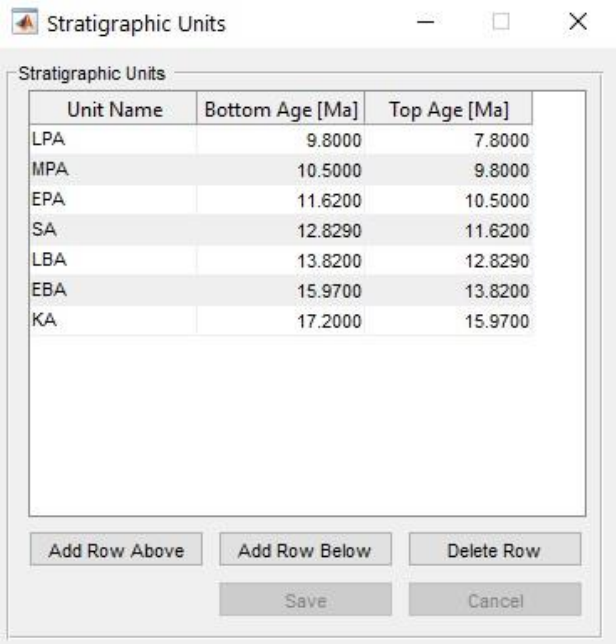


Access via the “Study Area” button in the Main Window.

Enter the dimensions of the study area you want to visualize, and press save.

The provided area will be the reference frame for your project throughout the rest of the application (e.g. x-y coordinate frame of your well locations, surface plots, etc.).

Stratigraphic Units



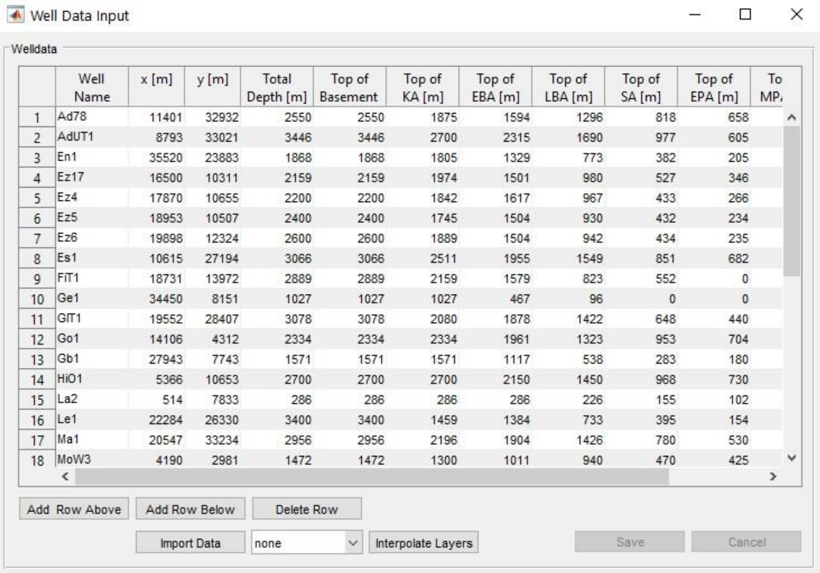
Accessed via the “Stratigraphic Units” button in the Main Window after the study area has been saved.

Enter the Unit Names with bottom and top ages for all stratigraphic units you want to use in your project. Add them by age in ascending order with the youngest unit on top, and press save.

Attention! Please make sure that the information in this table is complete and correct before continuing to subsequent analysis stages. Due to restrictions with the MATLAB data structures, additional lines for units cannot be added after the well data has been loaded or manually entered.

Well Data Input

Accessed via the “Well Data Input” button in the Main Window after the stratigraphic units have been saved.



Well Data Input

Welldata

	Well Name	x [m]	y [m]	Total Depth [m]	Top of Basement	Top of KA [m]	Top of EBA [m]	Top of LBA [m]	Top of SA [m]	Top of EPA [m]	To MP,
1	Ad78	11401	32932	2550	2550	1875	1594	1296	818	658	
2	AdUT1	8793	33021	3446	3446	2700	2315	1690	977	605	
3	En1	35520	23883	1868	1868	1805	1329	773	382	205	
4	Ez17	16500	10311	2159	2159	1974	1501	980	527	346	
5	Ez4	17870	10655	2200	2200	1842	1617	967	433	266	
6	Ez5	18953	10507	2400	2400	1745	1504	930	432	234	
7	Ez6	19898	12324	2600	2600	1889	1504	942	434	235	
8	Es1	10615	27194	3066	3066	2511	1955	1549	851	682	
9	FiT1	18731	13972	2889	2889	2159	1579	823	552	0	
10	Ge1	34450	8151	1027	1027	1027	467	96	0	0	
11	GIT1	19552	28407	3078	3078	2080	1878	1422	648	440	
12	Go1	14106	4312	2334	2334	2334	1961	1323	953	704	
13	Gb1	27943	7743	1571	1571	1571	1117	538	283	180	
14	HiO1	5366	10653	2700	2700	2700	2150	1450	968	730	
15	La2	514	7833	286	286	286	286	226	155	102	
16	Le1	22284	26330	3400	3400	1459	1384	733	395	154	
17	Ma1	20547	33234	2956	2956	2196	1904	1426	780	530	
18	MoW3	4190	2981	1472	1472	1300	1011	940	470	425	

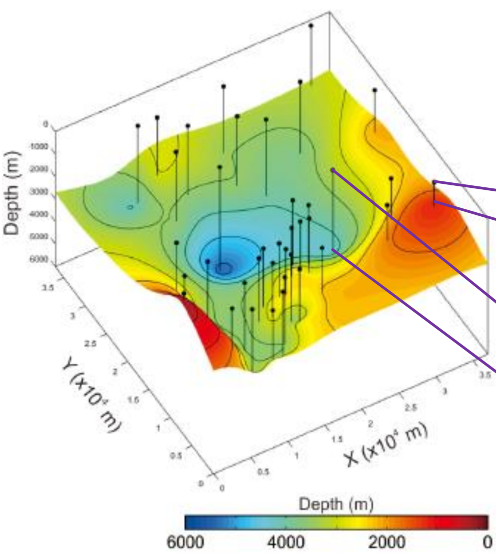
Add Row Above | Add Row Below | Delete Row

Import Data | none | Interpolate Layers | Save | Cancel

Enter your well data locations within the study area and the depths (meters) of stratigraphic units, and save them. You can import data from an excel file if it follows the same structure as the table.

An excel file “Example_SVB_well data.xlsx” is provided for practice.

Attention! If a unit does not exist at a given profile location, it has to be reported at the same depth as its overlying layer. In practice, not every profile reaches the basement layer and in some cases not every boundary between sedimentary layers is reported with a depth value (e.g. *Lee and Wagreich, 2016*). To accommodate for these cases, we allow empty depth fields. By selecting a surface interpolation method and pushing the “Interpolate Layers” button, the empty layer depth data will be filled in based on the surface interpolation at the given the well location.



Example >

Study area: X 37000 m, Y 37000 m, Z 6000 m

x, y = 34450, 8151

z = 1027 m (Top depth of basement)

x, y = 25135, 15620

z = 3625 m (Top depth of basement)

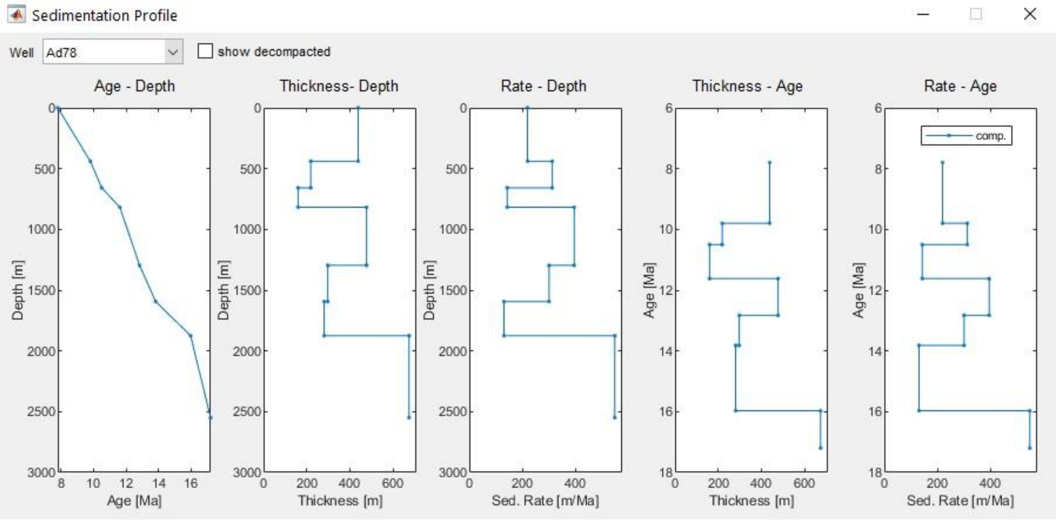
from Lee and Wagreich (2018)

STRATIGRAPHIC SETTING

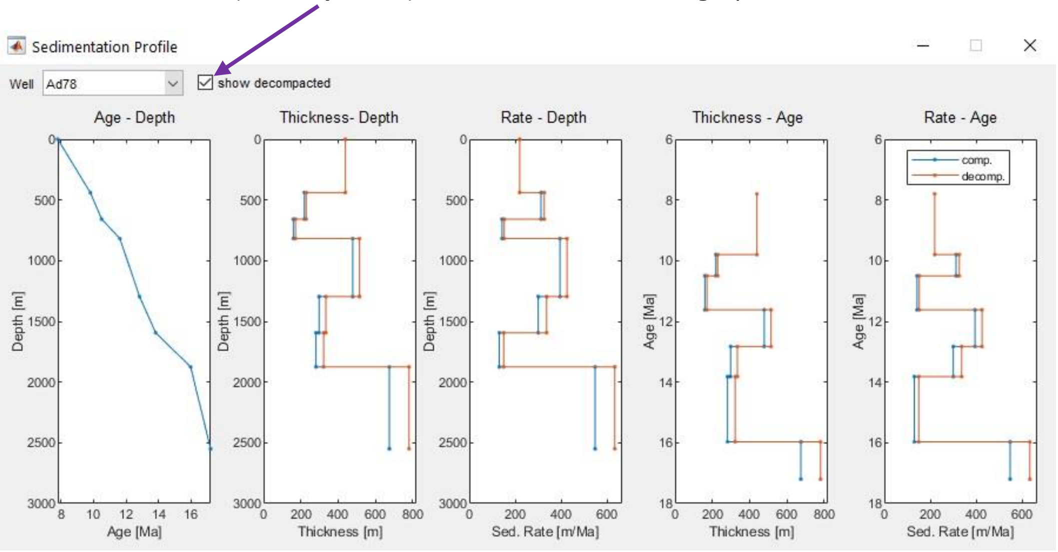
Sedimentation Profile

Accessed via the “Sedimentation Profile” button in the Main Window after the well data have been saved. Plots of Age-Depth, Thickness-Depth, Sedimentation Rate-Depth, Thickness-Age, Sedimentation Rate-Age are presented of each well. Wells can be selected in the dropdown menu in the top left corner.

Plots with present (**compacted**) thickness of each stratigraphic unit >



Plots with restored (**decompacted**) thickness of each stratigraphic unit >



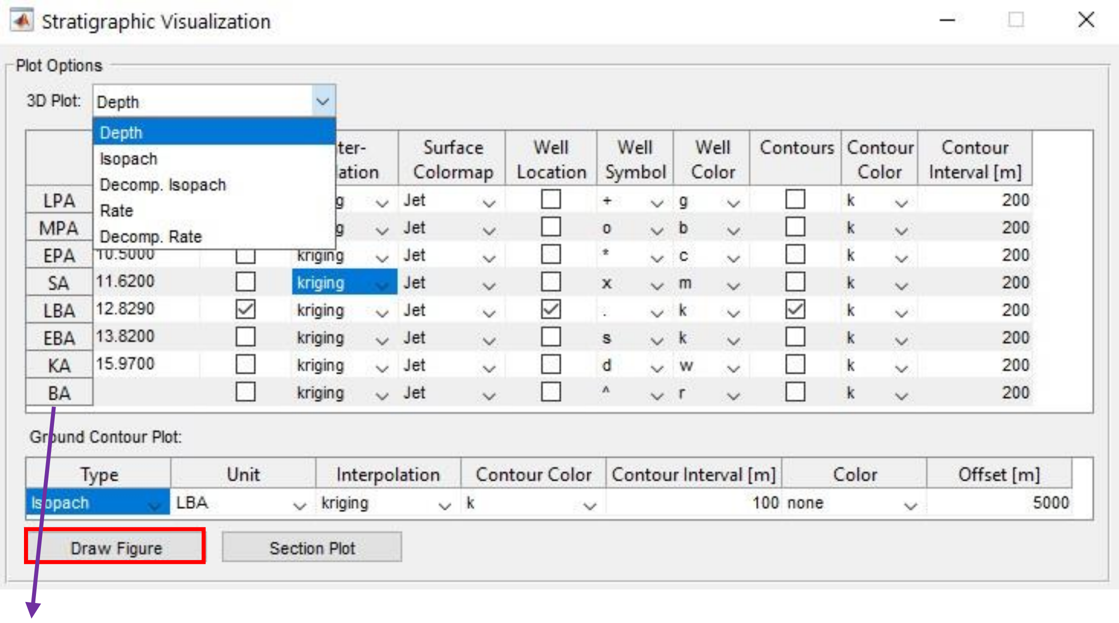
Attention! The thickness decompaction is activated by providing the compaction trend parameters at “Decompaction Parameters” (see *Decompaction Parameters*).

Stratigraphic Visualization

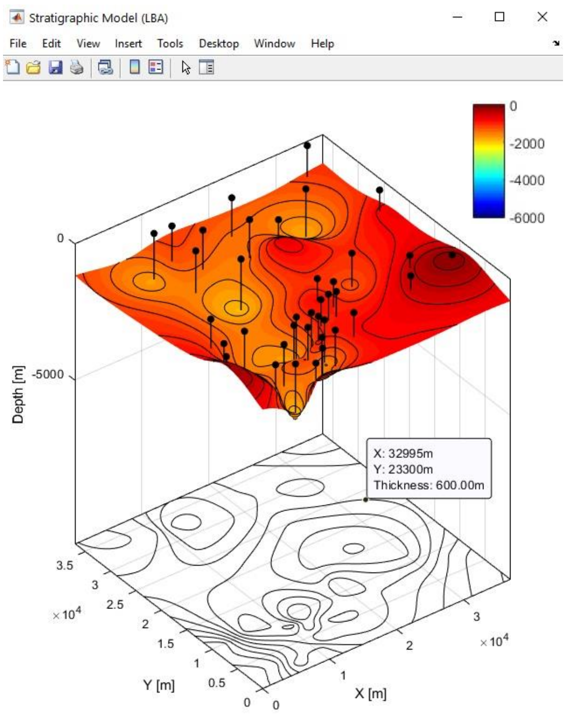
Accessed via the “Stratigraphic Visualization” button in the Main Window after the well data have been saved. This window offers a variety of options to generate plots based on the well data;

Depth, Isopach, Decompacted Isopach, Sedimentation Rate, Decompacted Sedimentation Rate.

Attention! Isopach and sedimentation rate based on decompacted thickness are activated by providing the compaction trend parameters at “Decompaction Parameters” (see *Decompaction Parameters*).



“BA” unit means Basement (bottom depth of the lowermost stratigraphic unit).



The **3D plot** table offers options for 3D surface and contour plots of depth, isopach, or sedimentation rate models for stratigraphic units. These options include settings for interpolation type (linear, natural, cubic, TPS, kriging), surface colormap (based on the standard Matlab Colormaps), well indicators (with symbol and color), and 3D contours (color and interval).

The **ground contour plot** is an optional 2D plot below the 3D surface plot that can be used to show additional information of depth, isopach, or sedimentation rate. You can use Matlab’s datatip function to determine contour values of the ground contour plot within plot windows.

All visualizations are generated in standard MATLAB plot windows, giving users access to advanced plot options to customize visualization results. Visualizations can be exported to the wide range of image formats supported by MATLAB.

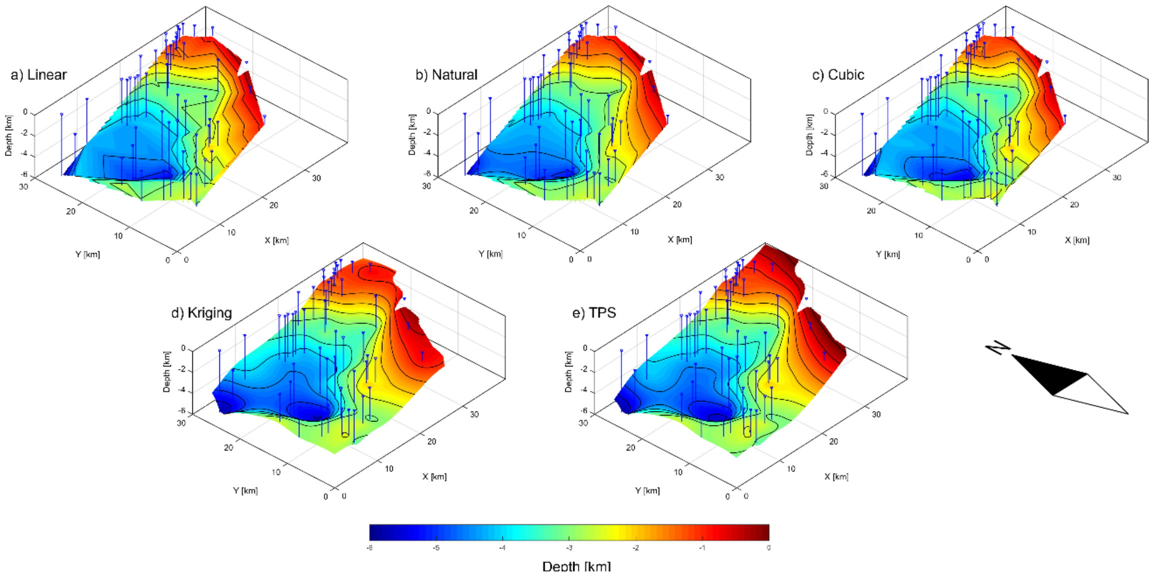
Attention! By default, layer depth maps are interpolated directly from the depth values at well locations. However, layer depth surfaces generated in that way may intersect each other in areas with insufficient depth data.

Interpolation methods >

Five commonly used interpolation methods in geosciences and related fields (e.g. *Li and Heap, 2008*) are provided for 2D and 3D visualization; Linear, Natural, Cubic Spline, Thin-Plate Spline (TPS) and Ordinary Kriging.

Example >

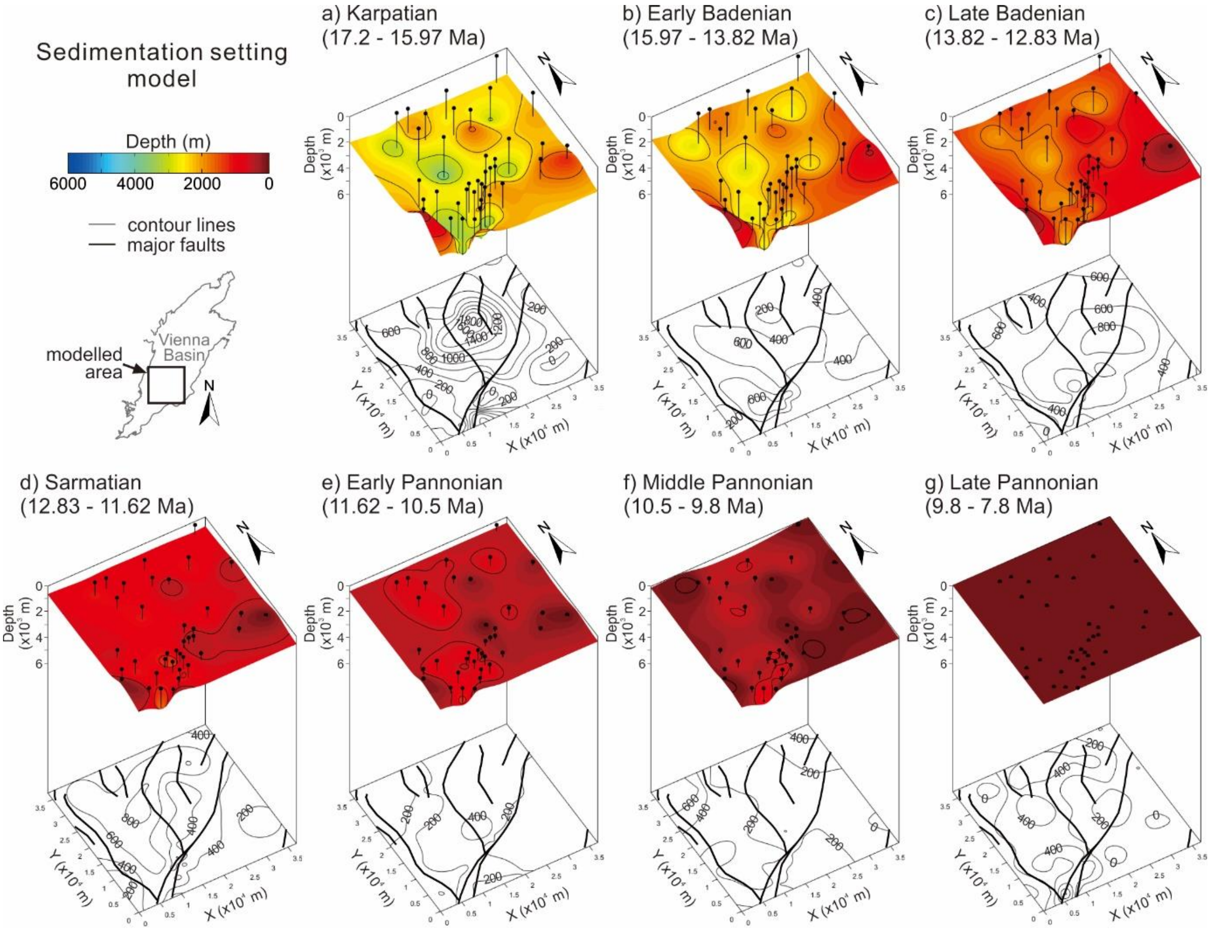
Pre-Neogene basement depth models of the central Vienna Basin, with five interpolation methods.



from Lee et al. (2016)

Example >

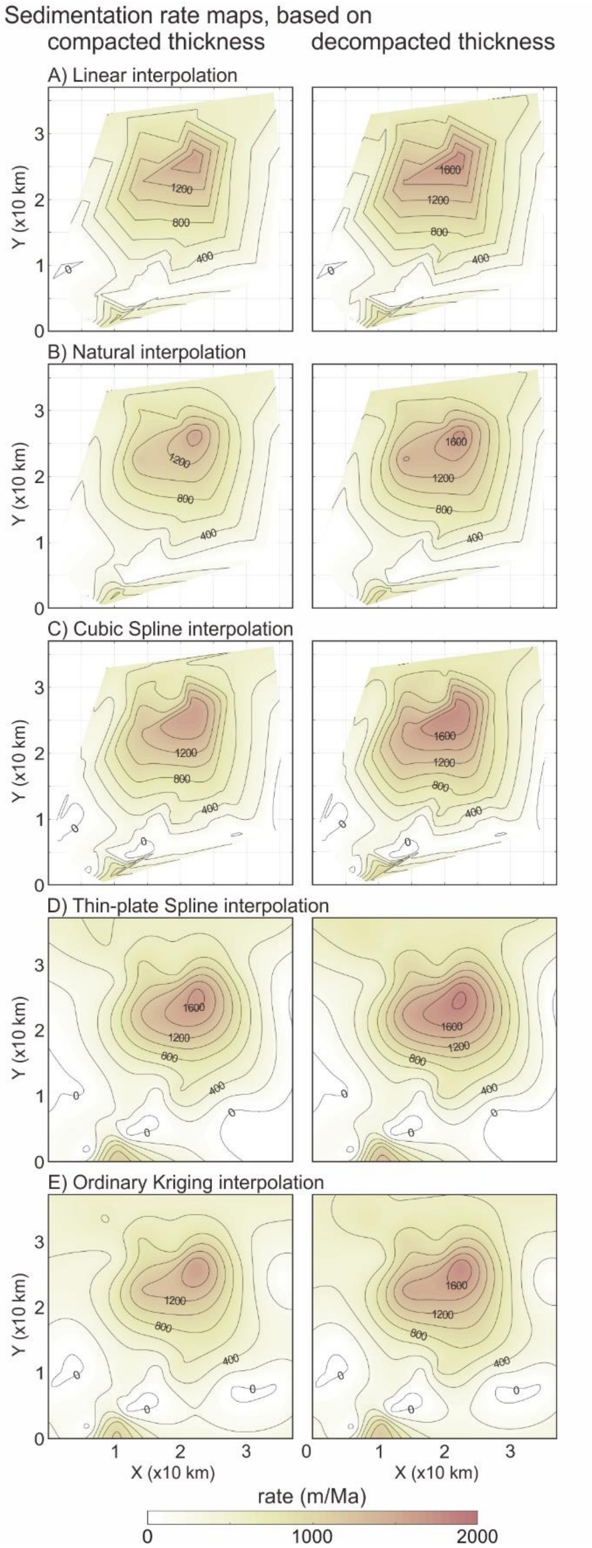
Sedimentation setting model of the southern Vienna Basin. 3D sediment distribution surface (above) and 2D sediment thickness isopach (below) of each time stage. Ordinary Kriging interpolation is applied. Contour numbers and fault locations on the ground plot were added manually.



from Lee and Wagreich (2018)

Example >

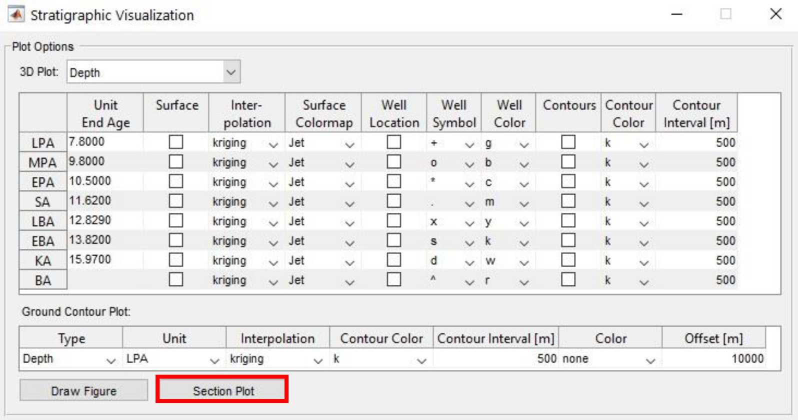
Sedimentation rate maps of the Karpatian unit in the southern Vienna Basin, based on compacted and decompacted thickness. Five interpolation methods are applied.



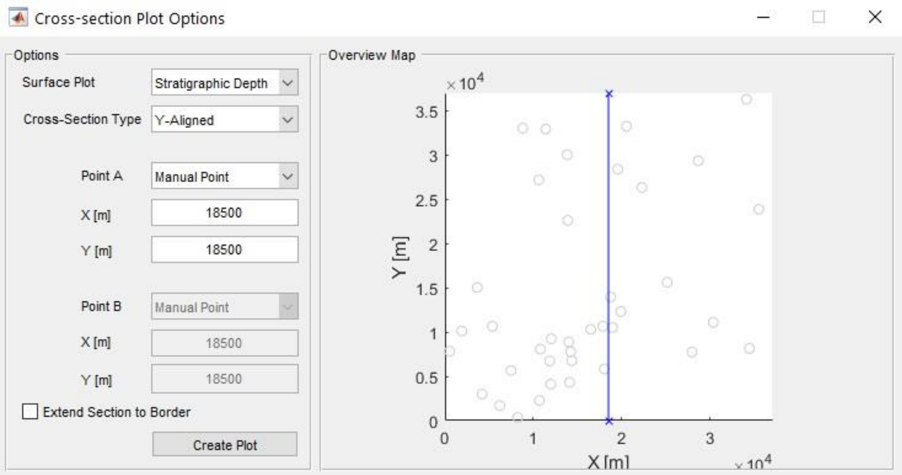
from Lee et al. (2020)

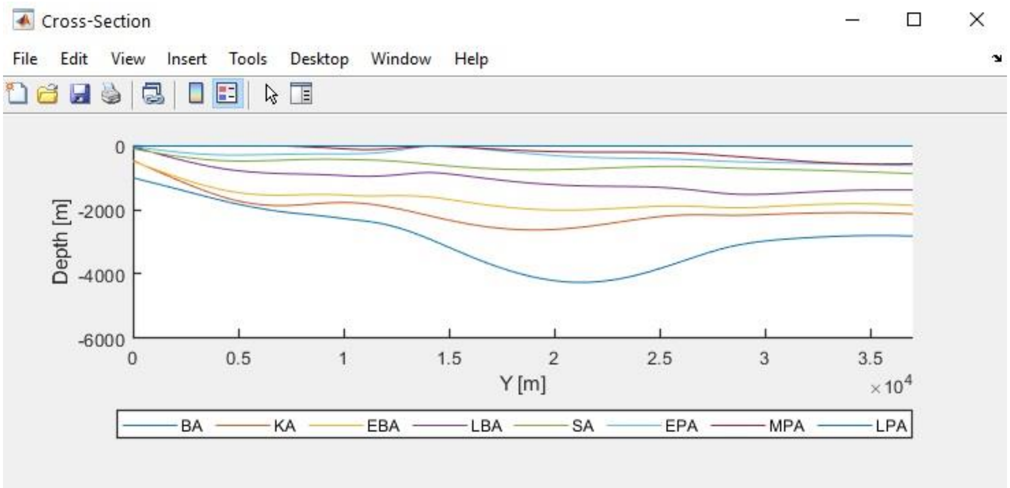
Cross-section Plot

Accessed via the “Section Plot” button in the “Stratigraphic Visualization” window.



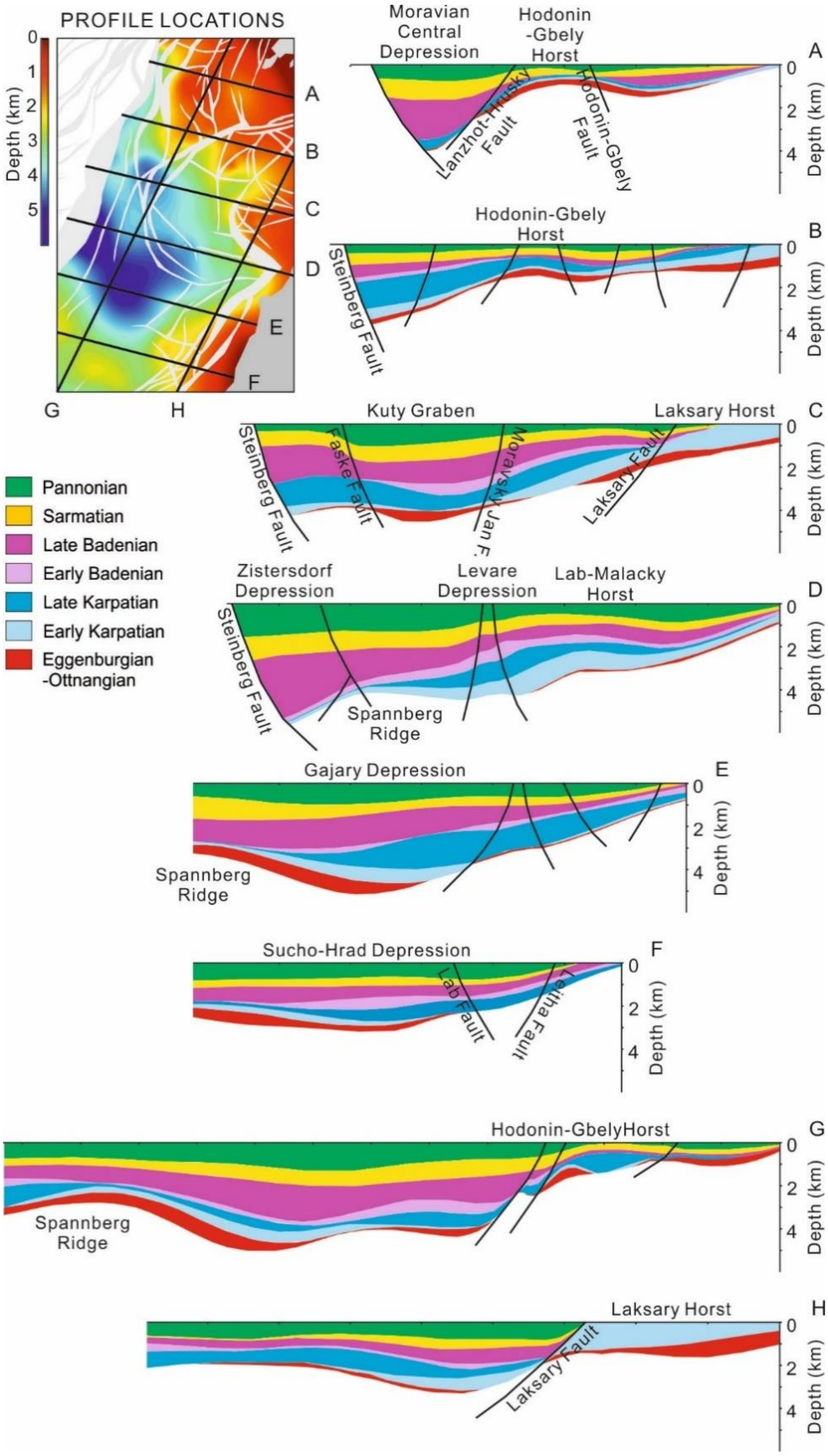
This window allows you to create 2D Section plots through the interpolation results for all stratigraphic units. The location of a section can be defined as an axis-aligned line (parallel to the x or y-axis) by selecting a single point on the study area or as an arbitrary line between a point pair.





Example >

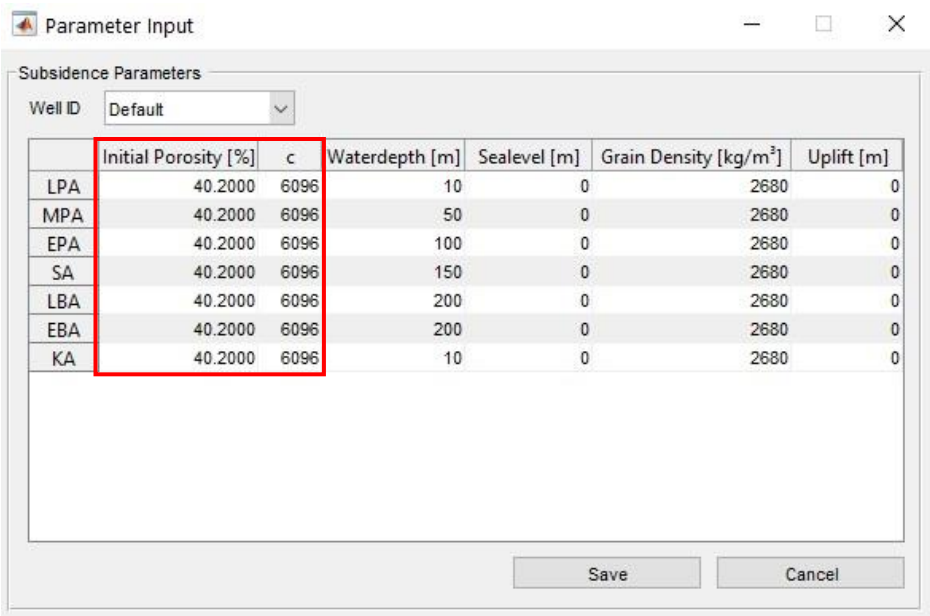
Cross-sections of the central and northern Vienna Basin. Stratigraphic unit colors and faults are added manually.



from Lee and Wagreich (2016)

Decompaction Parameters

Accessed via the “Parameter Input” button in the Main Window after the well data have been saved.



	Initial Porosity [%]	c	Waterdepth [m]	Sealevel [m]	Grain Density [kg/m³]	Uplift [m]
LPA	40.2000	6096	10	0	2680	0
MPA	40.2000	6096	50	0	2680	0
EPA	40.2000	6096	100	0	2680	0
SA	40.2000	6096	150	0	2680	0
LBA	40.2000	6096	200	0	2680	0
EBA	40.2000	6096	200	0	2680	0
KA	40.2000	6096	10	0	2680	0

Enter parameters to decompact the thickness of each stratigraphic unit; Initial porosity (%), compaction coefficient (c), and save them.

Initially, every well uses the parameters entered under the Well ID “Default”. Parameters can be saved individually for every well by selecting them in the Well ID dropdown menu.

Attention! The initial porosity and compaction coefficient (c) are based on a single-term exponential curve of the compaction trend (see *Trend Estimation*);

$$\phi = \phi_0 \exp(-y/c)$$

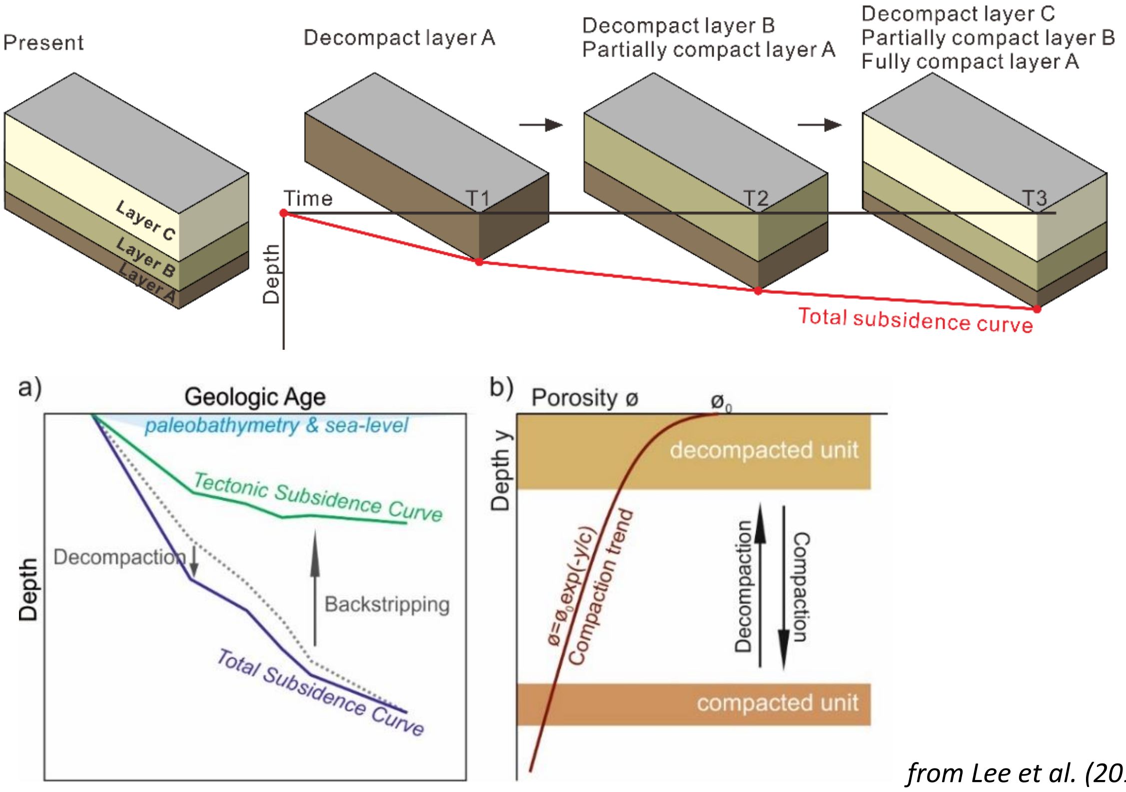
where ϕ: porosity (%) at depth y (m), ϕ_0: initial porosity (%), c: compaction coefficient.

If you do not have initial porosity and coefficient data for your study area, we recommend accessing the “Trend Library” in the Main Window (see *Trend Library*).

SUBSIDENCE

Total Subsidence calculation >

To evaluate total subsidence, it is necessary to restore the thickness of each compacted layer over geologic time using appropriate porosity-depth trends (compaction trend) of a sedimentary basin. Therefore, it is crucial to understand the relationship between porosity and burial depth and derive an appropriate trend equation.



from Lee et al. (2019)

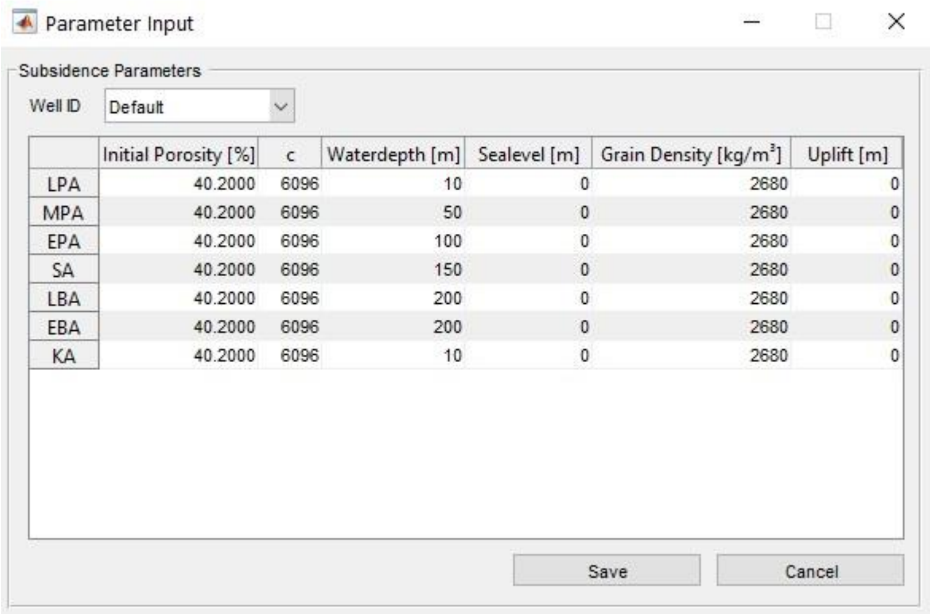
Tectonic Subsidence calculation >

Incorporating the various effects results in the Airy-isostasy compensated 1D tectonic subsidence (Z) at any geologic time t in the past (*Bond and Kominz, 1984; Sclater and Christie, 1980; Steckler and Watts, 1978; Watts and Steckler, 1979*),

$$Z(t) = S(t)\left(\frac{\rho_m - \rho_s}{\rho_m - \rho_w}\right) + W_d(t) - \Delta_{SL}(t)\left(\frac{\rho_m}{\rho_m - \rho_w}\right)$$

where $S(t)$: sediment layer thickness at any time t evaluated by decompaction, ρ_w, ρ_m and ρ_s: densities of water, mantle, and mean sediment, $W_d(t)$: paleo-bathymetry at any time t, $\Delta_{SL}(t)$: sea-level change at any time t. When we calculate this equation for many different sedimentary layers infilling a sedimentary basin, it is necessary to repeat the calculation for each subsequent time in basin evolution.

Subsidence Parameters



	Initial Porosity [%]	c	Waterdepth [m]	Sealevel [m]	Grain Density [kg/m³]	Uplift [m]
LPA	40.2000	6096	10	0	2680	0
MPA	40.2000	6096	50	0	2680	0
EPA	40.2000	6096	100	0	2680	0
SA	40.2000	6096	150	0	2680	0
LBA	40.2000	6096	200	0	2680	0
EBA	40.2000	6096	200	0	2680	0
KA	40.2000	6096	10	0	2680	0

Enter parameters for decompaction and subsidence analysis, and save them; Initial porosity (%), compaction coefficient (c), waterdepth (m), sealevel (m), grain density (kg/m^3), uplift (m).

Initially, every well uses the parameters entered under the Well ID “Default”. Parameters can be saved individually for every well by selecting them in the Well ID dropdown menu.

Example parameters >

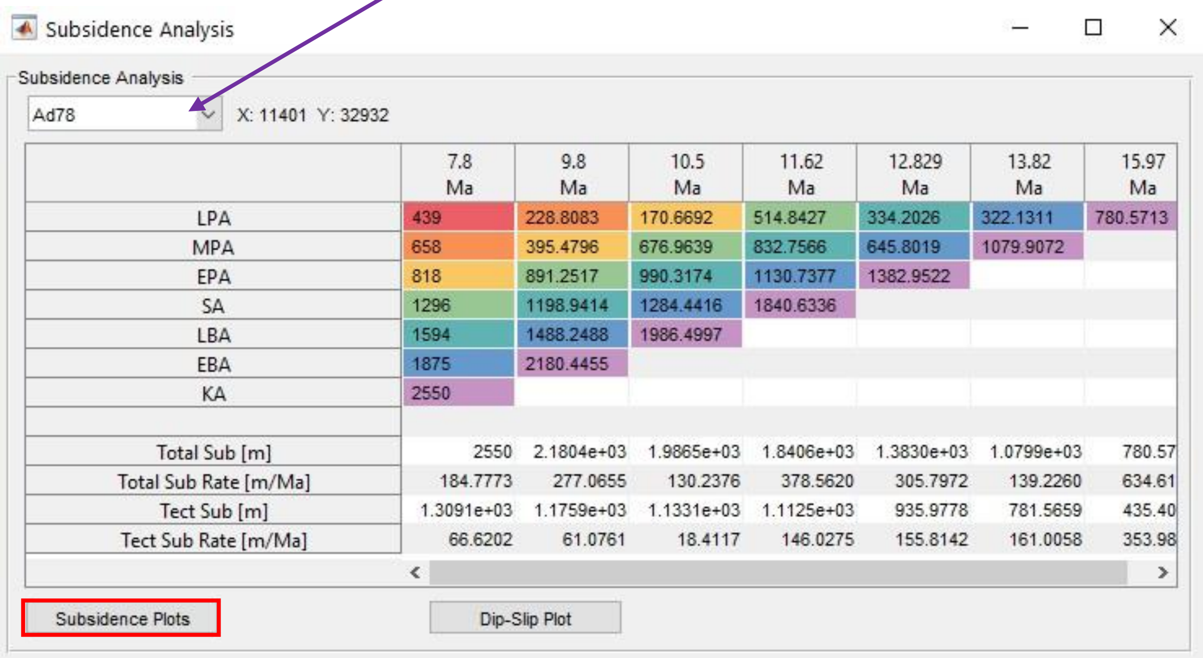
Lithology	Initial porosity (%)	Coefficient (c)	Grain density (kg/m^3)
sand	49	3704	2650
shale	63	1961	2720
shaley sand	56	2564	2680
chalk	70	1408	2710

from Sclater and Christie (1980)

Subsidence Analysis

Accessed via the “Subsidence Analysis” button in the Main Window after the subsidence parameters have been saved.

This window shows the numeric decompaction and backstripping results at a single well location. Wells can be selected in the dropdown menu in the top left corner.



	7.8 Ma	9.8 Ma	10.5 Ma	11.62 Ma	12.829 Ma	13.82 Ma	15.97 Ma
LPA	439	228.8083	170.6692	514.8427	334.2026	322.1311	780.5713
MPA	658	395.4796	676.9639	832.7566	645.8019	1079.9072	
EPA	818	891.2517	990.3174	1130.7377	1382.9522		
SA	1296	1198.9414	1284.4416	1840.6336			
LBA	1594	1488.2488	1986.4997				
EBA	1875	2180.4455					
KA	2550						
Total Sub [m]	2550	2.1804e+03	1.9865e+03	1.8406e+03	1.3830e+03	1.0799e+03	780.57
Total Sub Rate [m/Ma]	184.7773	277.0655	130.2376	378.5620	305.7972	139.2260	634.61
Tect Sub [m]	1.3091e+03	1.1759e+03	1.1331e+03	1.1125e+03	935.9778	781.5659	435.40
Tect Sub Rate [m/Ma]	66.6202	61.0761	18.4117	146.0275	155.8142	161.0058	353.98

The numerical results show subsidence depth and rate of Total Subsidence (Basement Subsidence) and Tectonic Subsidence of a selected well.

Total Sub: Total subsidence depth (m)

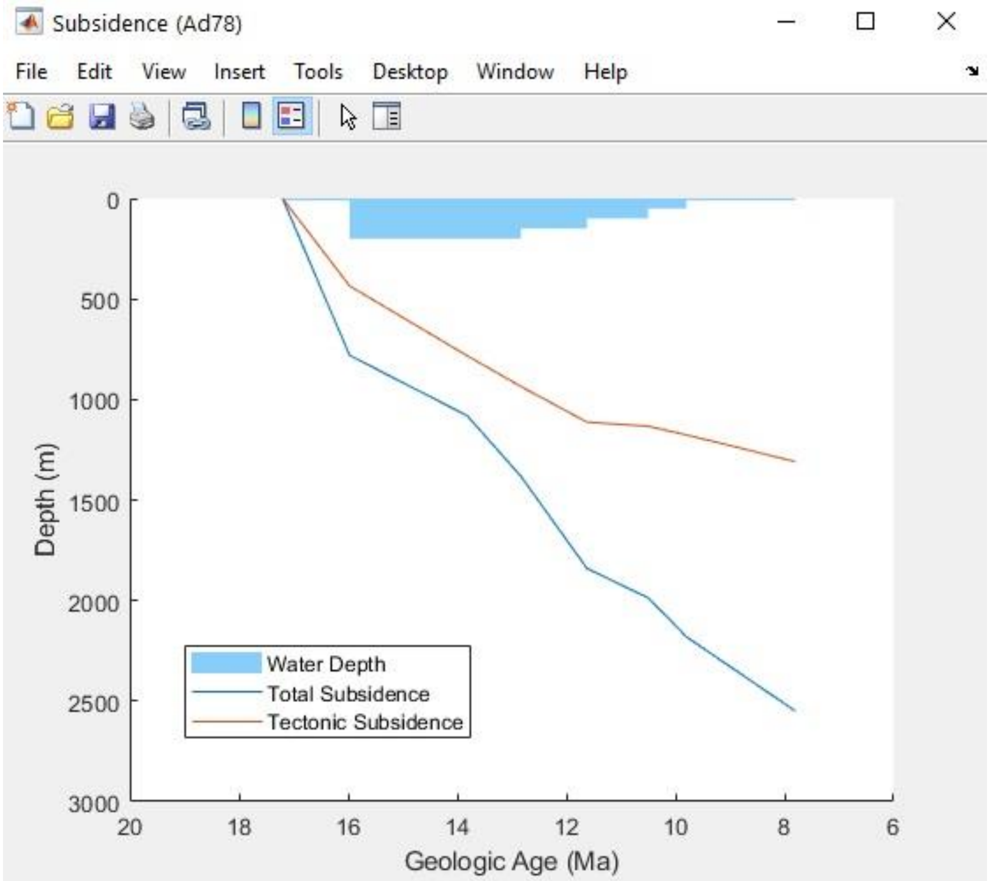
Total Sub Rate: Total subsidence rate (m/Ma)

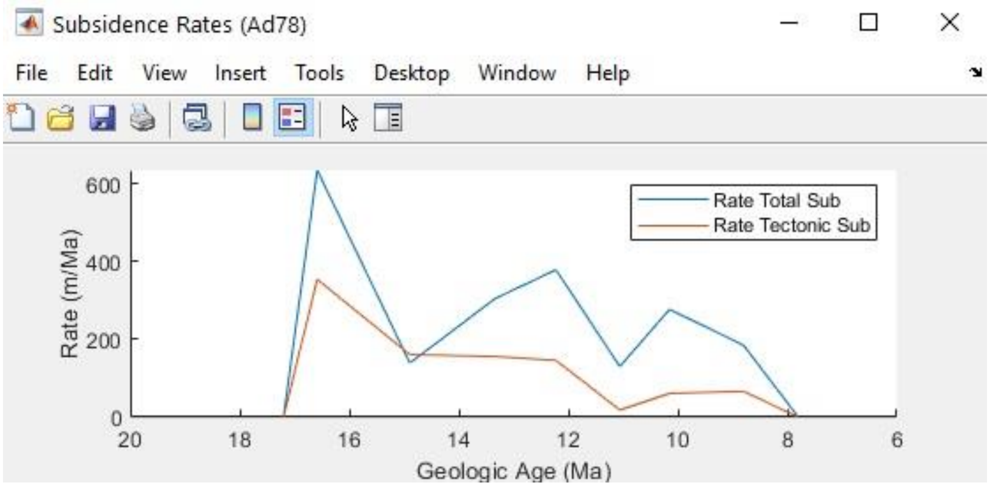
Tect Sub: Tectonic subsidence depth (m)

Tect Sub Rate: Tectonic subsidence rate (m/Ma)

The “Subsidence Plots” button allow you to generate 2D plot representations of depth and rate of Total Subsidence and Tectonic Subsidence.

Paleo-waterdepth is indicated by the blue bars on top of the plot.



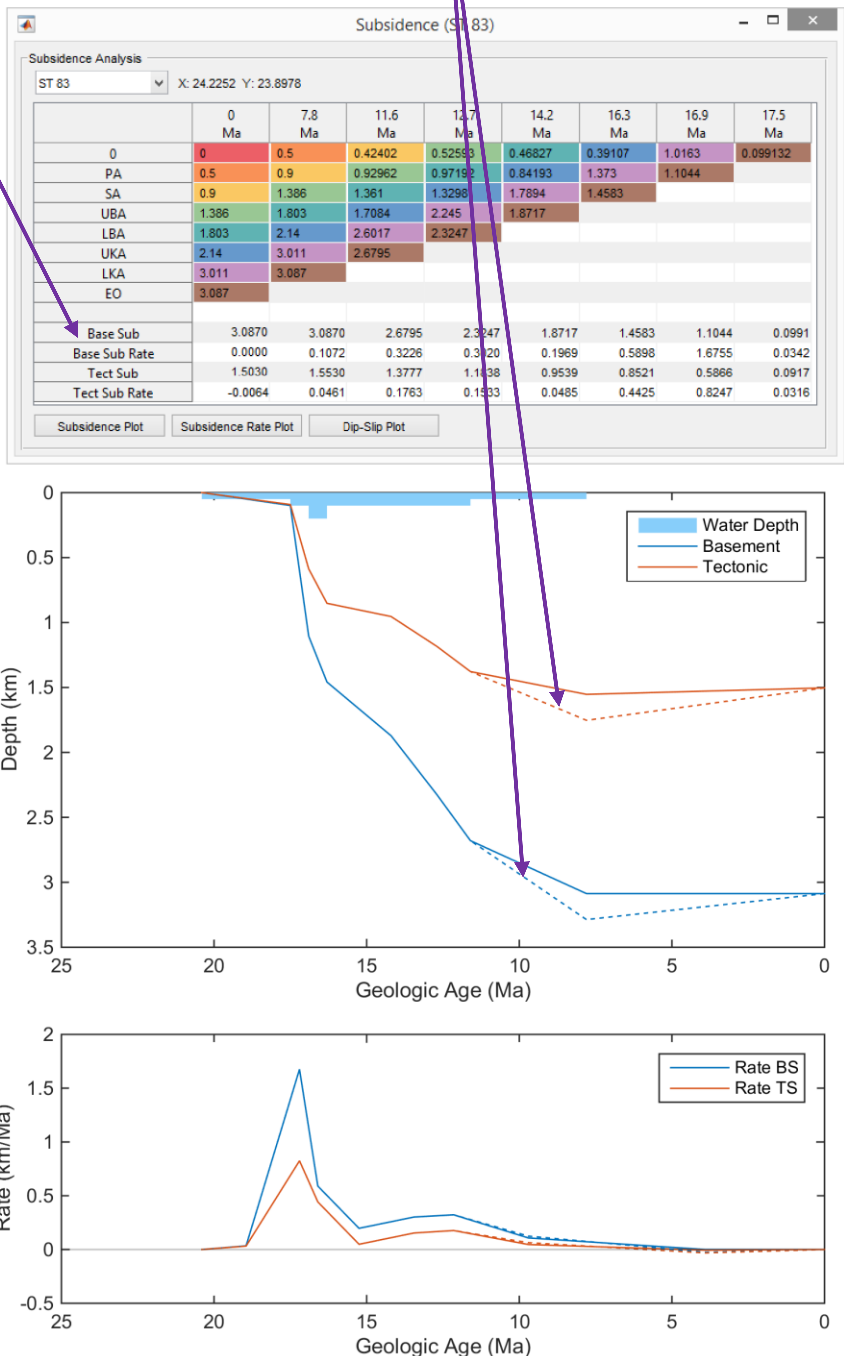


BasinVis

Example>

The correction for uplift is visualized by the dotted line plots.

Total Sub of BasinVis version 2.0 corresponds to Base Sub of BasinVis version 1.0.

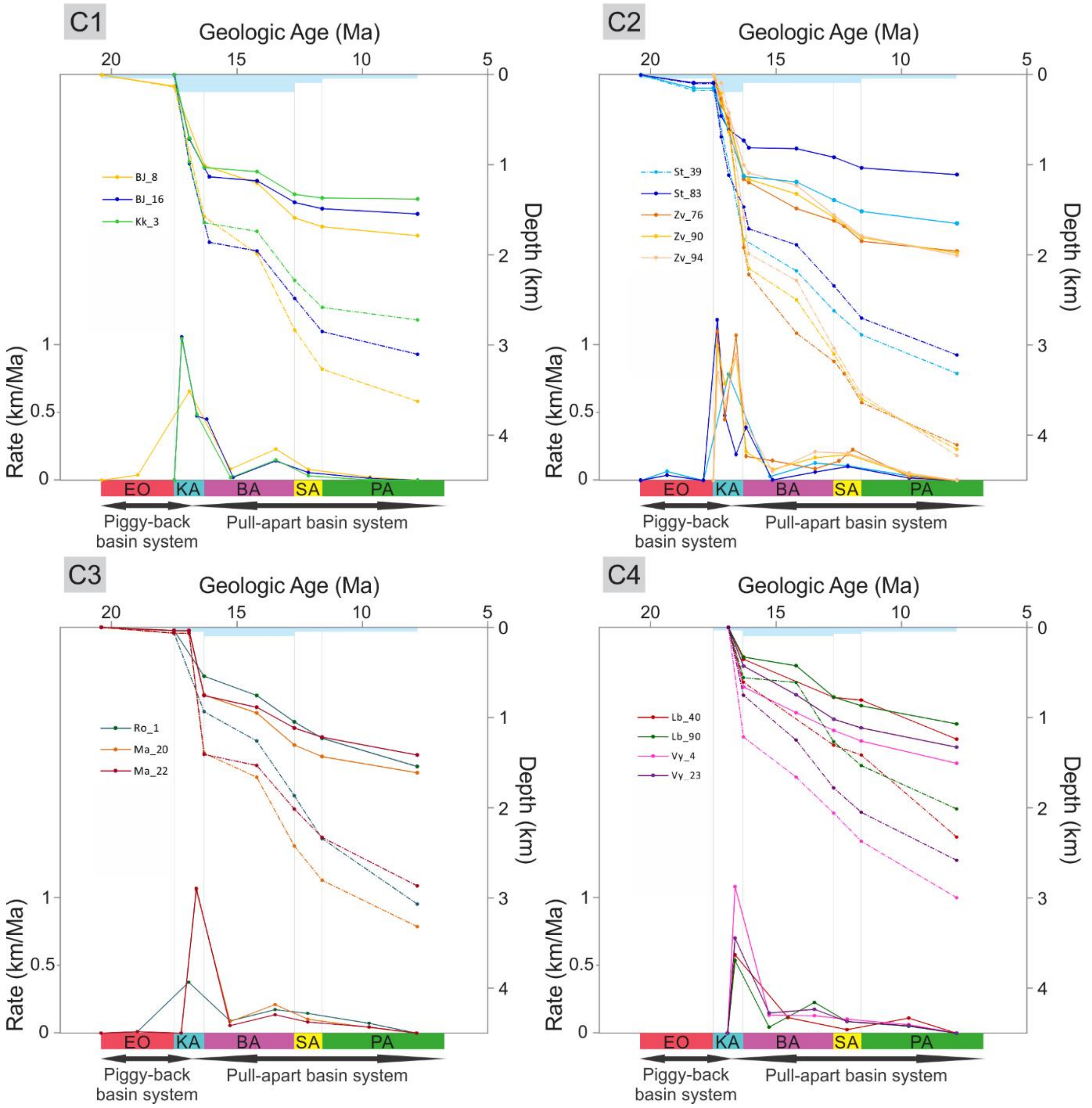


	0 Ma	7.8 Ma	11.6 Ma	12.7 Ma	14.2 Ma	16.3 Ma	16.9 Ma	17.5 Ma
0	0	0.5	0.42402	0.525[illegible]3	0.46827	0.39107	1.0163	0.099132
PA	0.5	0.9	0.92962	0.971[illegible]2	0.84193	1.373	1.1044	
SA	0.9	1.386	1.361	1.3298	1.7894	1.4583		
UBA	1.386	1.803	1.7084	2.245	1.8717			
LBA	1.803	2.14	2.6017	2.3247				
UKA	2.14	3.011	2.6795					
LKA	3.011	3.087						
EO	3.087							
Base Sub	3.0870	3.0870	2.6795	2.3[illegible]47	1.8717	1.4583	1.1044	0.0991
Base Sub Rate	0.0000	0.1072	0.3226	0.3[illegible]20	0.1969	0.5898	1.6755	0.0342
Tect Sub	1.5030	1.5530	1.3777	1.1[illegible]38	0.9539	0.8521	0.5866	0.0917
Tect Sub Rate	-0.0064	0.0461	0.1763	0.1[illegible]33	0.0485	0.4425	0.8247	0.0316

from Lee et al. (2016)

Example >

Subsidence curves of the central Vienna Basin.

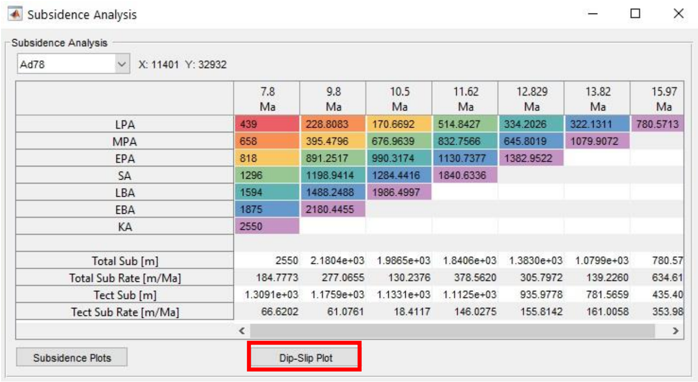


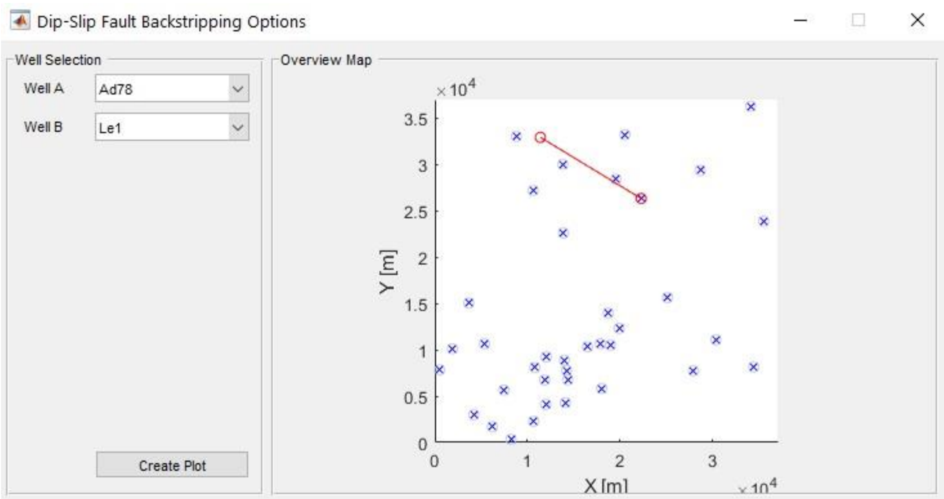
from Lee and Wagreich (2017)

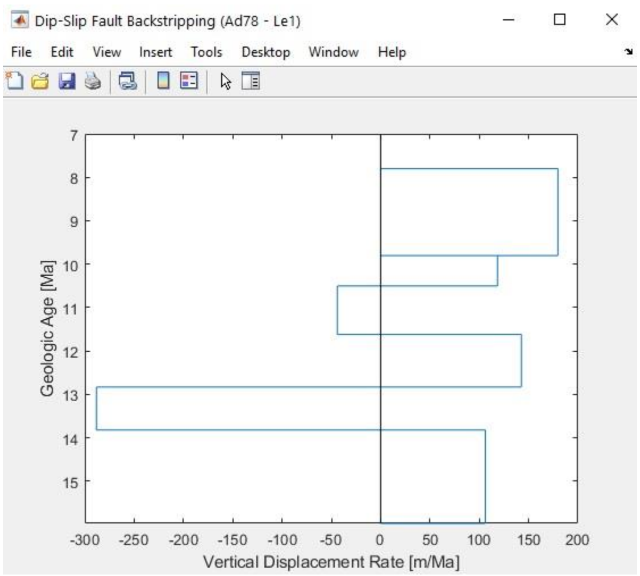
Dip-Slip Plot

Accessed via the "Dip-Slip Plot" button in the "Subsidence Analysis" window.

Guided by a preview map, users select a pair of well locations eligible for dip-slip fault backstripping and can generate step plots of the vertical fault displacement rates (m/Ma) between them.



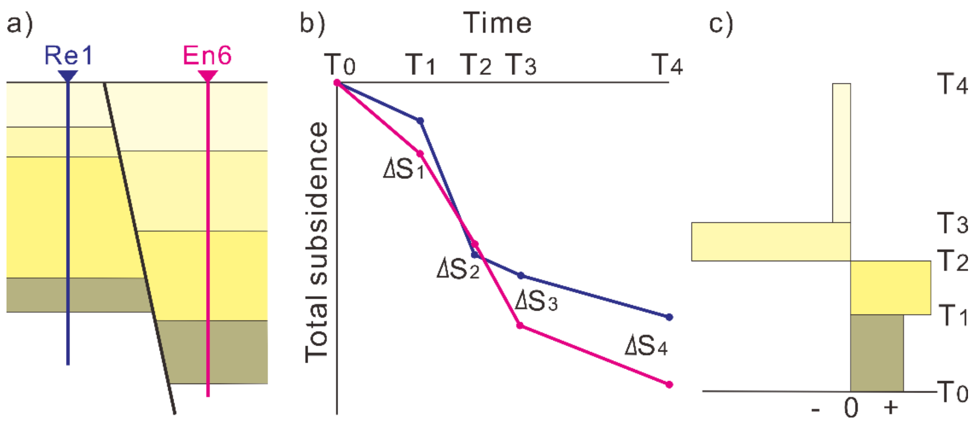




Dip-Slip Fault Backstripping calculation >

Total subsidence curves can be used to analyze vertical fault displacement through time for a syn-sedimentary fault, which is called as the dip-slip fault backstripping (*ten Veen and Kleinspehn, 2000; ten Veen and Postma, 1999; Wagreich and Schmid, 2002*). This analysis starts the evaluation of total subsidence curves from two stratigraphic profiles from the footwall and hanging wall blocks of a syn-sedimentary fault. The difference (ΔS_t) in vertical position of two subsidence points at a given time t records segments of similar or differential dip-slip activity. The dip-slip values are calculated by substracting ΔS_{i-1} from ΔS_i divided by the duration of the stratigraphic interval. The results are presented in step plots of the slip rate and time, and the values indicate the sense of dip-slip for relative block movements (*Wagreich and Schmid, 2002*).

Process of dip-slip fault backstripping analysis;
a) Two wells on the footwall and the hanging wall of a syn-sedimentary normal fault.
b) Total subsidence curves of the two wells and their difference ΔS_t.
c) Step plot of the apparent dip-slip rates and stratigraphic time along the fault.

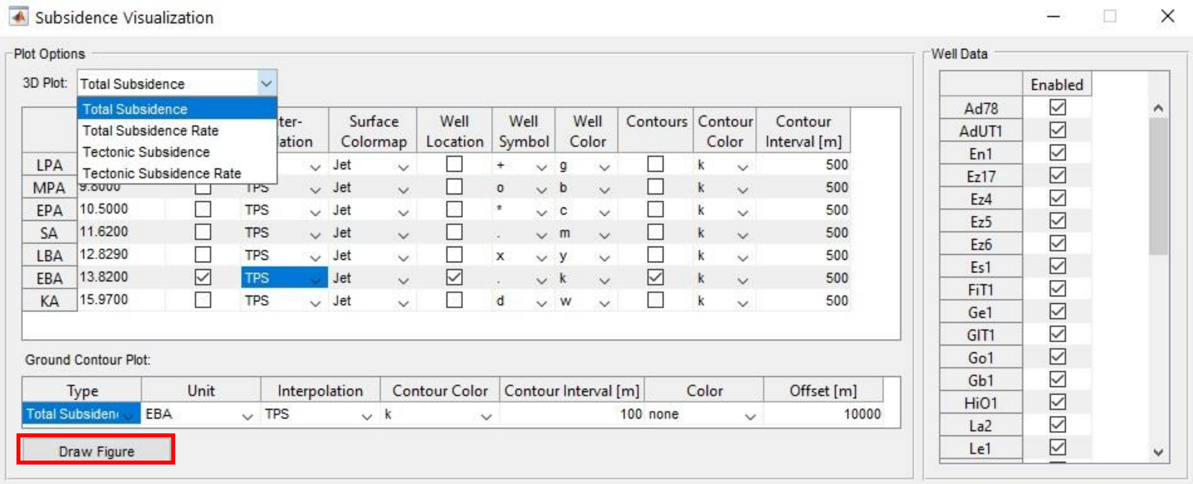


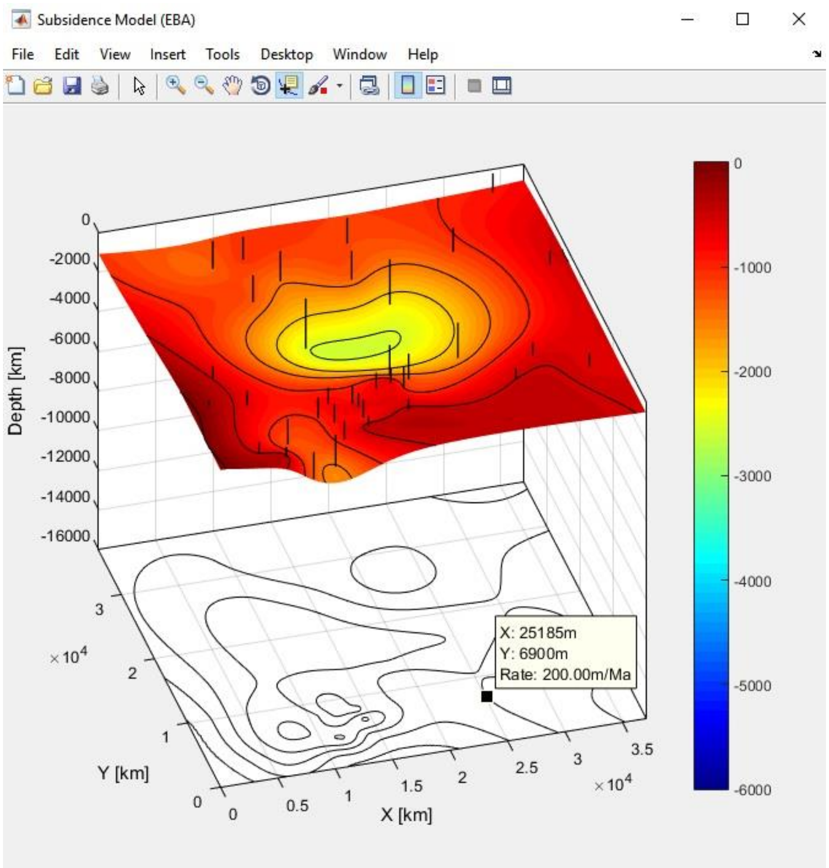
from Lee et al. (2019)

Subsidence Visualization

Accessed via the “Subsidence Visualization” button in the Main Window after the subsidence parameters have been saved. Only wells that reached the basin floor are considered for subsidence visualization. Subsidence depth and rate of wells are interpolated for each time stage.

This window offers plot options similar to those available in the “Stratigraphic Visualization” window. Individual wells can be excluded from the interpolation using the “Well Data” table on the right side of the window.

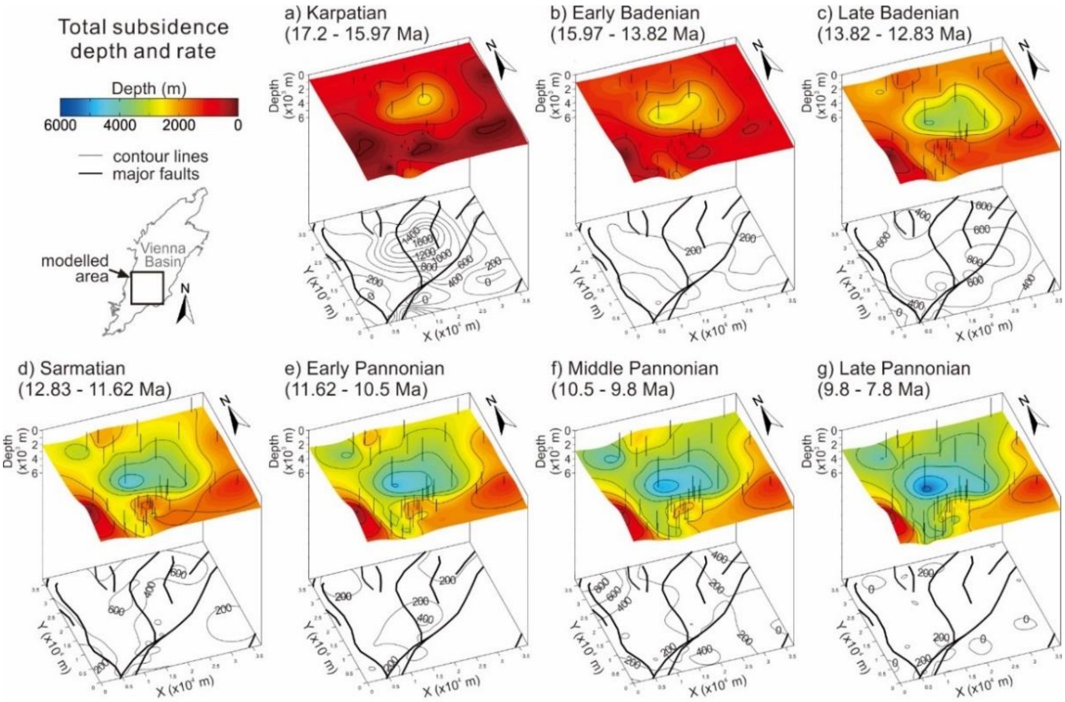


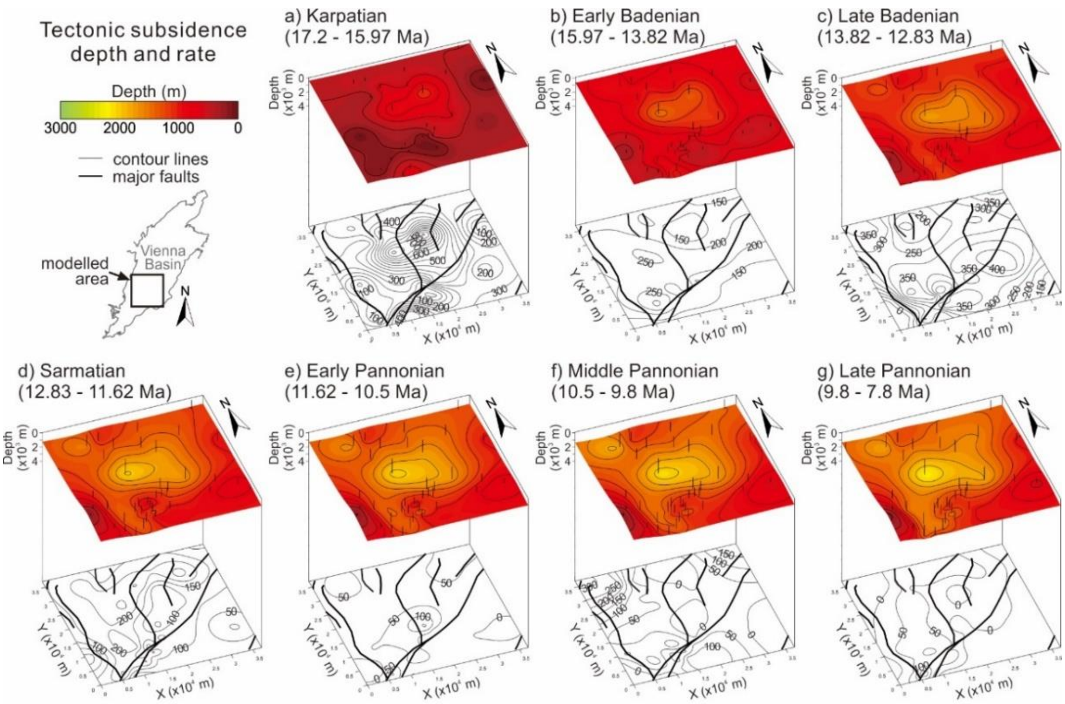


All visualizations are generated in standard MATLAB plot windows, giving users access to advanced plot options to customize visualization results. Visualizations can be exported to the wide range of image formats supported by MATLAB.

Example >

Total and tectonic subsidence visualization of the southern Vienna Basin. Contour numbers and fault locations on the ground plot are added manually.

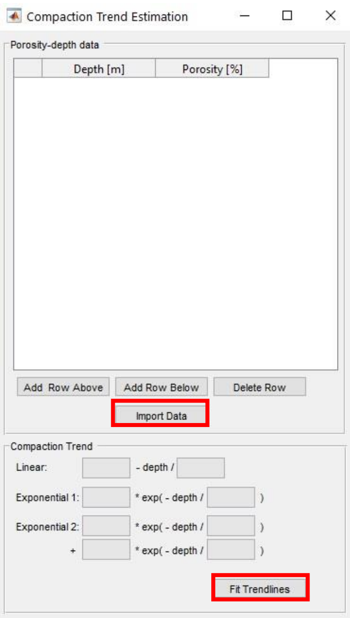




from Lee and Wagreich (2018)

COMPACTION TREND

Trend Estimation



Accessed via the “Trend Estimation” button in the Main Window.

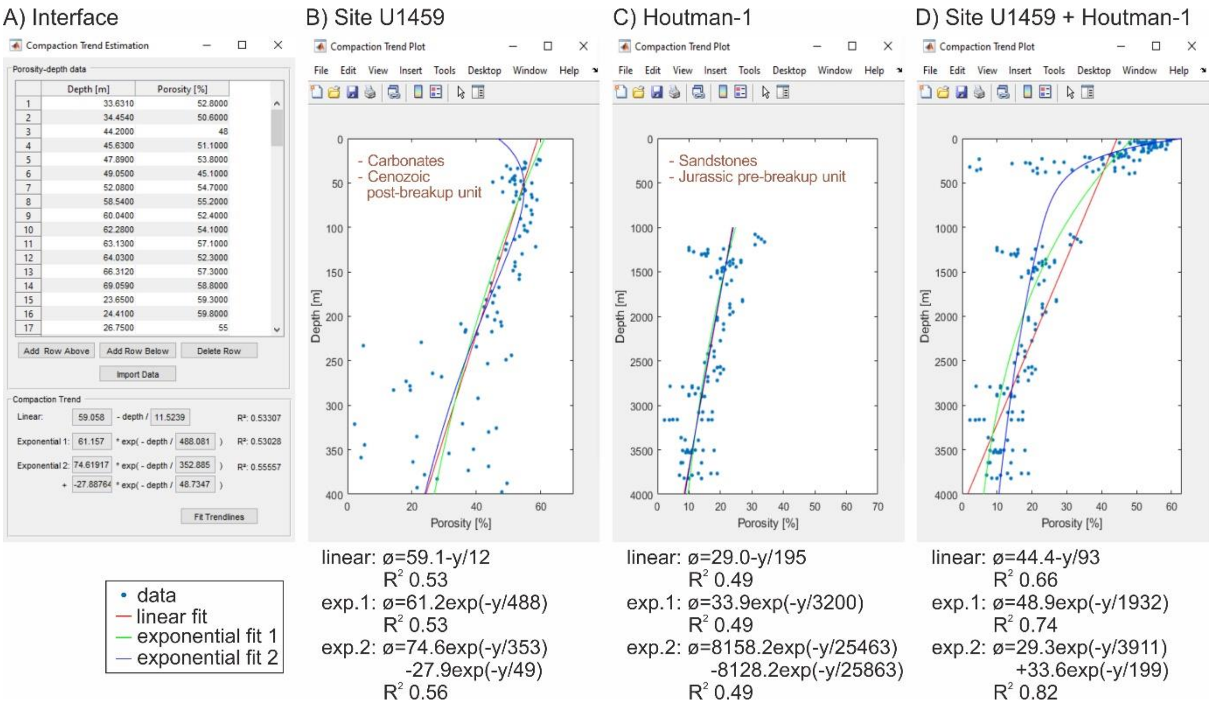
Enter depth (m) and porosity (%) data. You can import data from an excel file, if it follows the same structure as the table.

An excel file “Example_Porosity-Depth_U1459_Houtman.xlsx” is provided for exercise.

Click “Fit Trendlines” to show estimated equations and lines with data points.

Example >

Compaction trends of IODP Site U1459 and well Houtman-1 in the Perth Basin.



from Lee et al. (2020)

Compaction trend estimation >

In BasinVis 2.0, the compaction trend is estimated by three functions with determination coefficient (R^2), based on porosity-depth data.

a single-term exponential curve,

$$\phi = \phi_0 \exp(-y/c)$$

a linear function,

$$\phi = \phi_0 - y/c$$

where ϕ: porosity (%) at depth y (m), ϕ_0: initial porosity (%) when the layer places near the surface during deposition, c: compaction coefficient.

a two-term exponential equation,

$$\phi = \phi_1 \exp(-y/c_1) + \phi_2 \exp(-y/c_2)$$

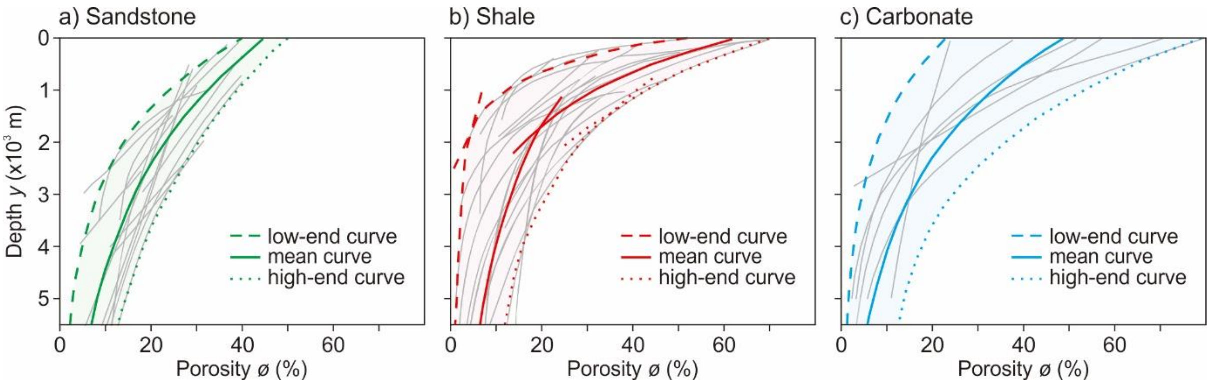
where ϕ: porosity (%) at depth y (m), ϕ_1+ϕ_2: initial porosity (%), c_1, c_2: compaction coefficients.

Compaction trends consisting of multiple piece-wise functions have also been suggested in several studies (e.g., a set of two exponential equations, a combination of one exponential and one linear equation).

from Lee et al. (2020)

Compilation of compaction trends and numerical analysis>

Compilation plots of published compaction trends (gray lines) of a) sandstone, b) shale, c) carbonate (*Giles, 1997*).

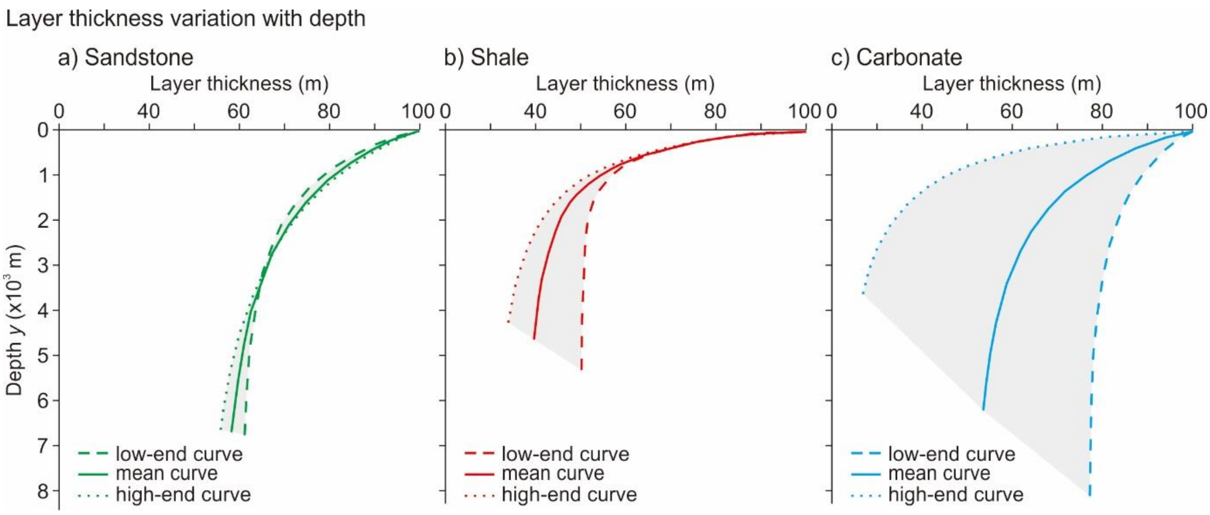


The compaction trend range of each lithology is defined by three sets of exponential curves; low-end curve (dashed line), mean curve (solid line), and high-end curve (dotted line).

Exponential curves estimated from compaction trend ranges of sandstone, shale, and carbonate.

Lithology	Curve type	Exponential equation
Sandstone	low-end	$\emptyset = 40\exp(-y/1909)$
	mean	$\emptyset = 44\exp(-y/2966)$
	high-end	$\emptyset = 49\exp(-y/4040)$
Shale	low-end	$\emptyset = 50\exp(-y/764)$ (0 to 2,040 m) $\emptyset = 6\exp(-y/3560)$ (2,040~ m)
	mean	$\emptyset = 62\exp(-y/1472)$ (0 to 1,680 m) $\emptyset = 33\exp(-y/3299)$ (1,680~ m)
	high-end	$\emptyset = 69\exp(-y/2000)$ (0 to 1,420 m) $\emptyset = 52\exp(-y/3343)$ (1,420~ m)
Carbonate	low-end	$\emptyset = 23\exp(-y/1846)$
	mean	$\emptyset = 49\exp(-y/2566)$
	high-end	$\emptyset = 78\exp(-y/2574)$

Plots of layer thickness variation with depth; a) sandstone, b) shale, c) carbonate. A total of 100 layers are accumulated and compacted following the exponential curves from the compaction trend range of each lithology. The layer thickness range with depth is presented using applied curves; low-end curve (dashed line), mean curve (solid line), and high-end curve (dotted line).



from Kim et al. (2018)

Trend Library

Compaction Trend Library

	Lithology	Initial Porosity [%]	Coefficient c	Reference
1	Sand	49.0	3704	Sclater and Christie (1980)
2	Sand	54.5	1639	Kominz et al. (2011)
3	Sand	43.0	2222	Zhao et al. (2015)
4	Sandstone	50.0	2415	He et al. (2017)
5	Coarse Sandstone	42.8	1629	Gallagher and Lambec (1989)
6	Fine Sandstone	43.3	1217	Gallagher and Lambec (1989)
7	Shaly Sand	56.0	2564	Sclater and Christie (1980)
8	Shaly Sand/Sandy Shale	39.7-41.4	3367-5780	Lee and Wagreich (2016)
9	Shale	63.0	1961	Sclater and Christie (1980)
10	Shale	50.4	619	Gallagher and Lambeck (1989)
11	Shale	71.0	1961	Hansen (1996)
12	Shale	69.0	847	Zhao et al. (2015)
13	Clay	77.5	1251	Kominz et al. (2011)
14	Mudstone	59.8	1992	He et al. (2017)
15	Mudstone	50.0	2500	Royden and Keen (1980)
16	Silt	75.5	1091	Kominz et al. (2011)
17	Siltstone	45.7	864	Gallagher and Lambeck (1989)
18	Chalk	70.0	1408	Sclater and Christie (1980)
19	Chalk	68.0	2128	Royden and Keen (1980)
20	Ooze and Chalk	68.6-70.2	1315-2222	Bassinot et al. (1993)
21	Carbonates	58.2	1667	Lee et al. (2019)
22	Carbonates	41.73	2498	Schmoker and Halley (1982)
23	Limestone	51.34	1929	Schmoker and Halley (1982)
24	Dolomite	30.36	4618	Schmoker and Halley (1982)
25	Dolomite	24.0	6250	Royden and Keen (1980)

REFERENCES

Bassinot, F.C., Marsters, J.C., Mayer, L.A., Wilkens, R.H., 1993. Variations of porosity in calcareous sediments from the Ontong Java Plateau. Proceedings of the Ocean Drilling Program. Scientific Results 130(39), 653–661.

Bond, G.C., Kominz, M.A., 1984. Construction of tectonic subsidence curves for the early Paleozoic miogeocline, southern Canadian Rocky Mountains: Implications for subsidence mechanisms, age of breakup, and crustal thinning. GSA Bulletin 95, 155–173. https://doi.org/10.1130/0016-7606(1984)95<155:COTSCF>2.0.CO;2

Gallagher, K., Lambeck, K., 1989. Subsidence, sedimentation and sea-level changes in the Eromanga Basin, Australia. Basin Research 2, 115–131. https://doi.org/10.1111/j.1365-2117.1989.tb00030.x

Giles, M.R., 1997. Diagenesis: A Quantitative Perspective. Implications for Basin Modelling and Rock Property Prediction. Kluwer Academic Publishers, Dordrecht, p. 526.

Hansen, S., 1996. A compaction trend for Cretaceous and Tertiary shales on the Norwegian shelf based on sonic transit times. Petroleum Geosciences 2, 159–166. https://doi.org/10.1144/petgeo.2.2.159

He, M., Zhong, G., Liu, X., Liu, L., Shen, X., Wu, Z., Huang, K., 2017. Rapid post-rift tectonic subsidence events in the Pearl River Mouth Basin, northern South China Sea margin. Journal of Asian Earth Sciences 147, 271–283. https://doi.org/10.1016/j.jseaes.2017.07.024

Kim, Y., Lee, C., Lee, E.Y., 2018. Numerical analysis of sedimentary compaction: Implications for porosity and layer thickness variation. Journal of the Geological Society of Korea 54, 631–640.

Kominz, A.M., Patterson, K., Odette, D., 2011. Lithology dependence of porosity in slope and deep marine sediments. Journal of Sedimentary Research 81, 730–742. https://doi.org/10.2110/jsr.2011.60

Lee, E.Y., Novotny, J., Wagreich, M., 2016. BasinVis 1.0: A MATLAB®-based program for sedimentary basin subsidence analysis and visualization. Computers & Geosciences 91, 119–127. http://dx.doi.org/10.1016/j.cageo.2016.03.013

Lee, E.Y., Novotny, J., Wagreich, M., 2019. Subsidence Analysis and Visualization for Sedimentary Basin Analysis and Modelling. SpringerBriefs in Petroleum Geoscience & Engineering. Springer, Cham. https://doi.org/10.1007/978-3-319-76424-5

Lee, E.Y., Novotny, J., Wagreich, M., 2020. Compaction trend estimation and applications to sedimentary basin reconstruction (BasinVis 2.0). Applied Computing and Geosciences 5, 100015. https://doi.org/10.1016/j.acags.2019.100015

Lee, E.Y., Wagreich, M., 2016. 3D visualization of the sedimentary fill and subsidence evolution in the northern and central Vienna Basin (Miocene). Austrian Journal of Earth Sciences 109, 241–251. https://doi.org/10.17738/ajes.2016.0018

Lee, E.Y., Wagreich, M., 2017. Polyphase tectonic subsidence evolution of the Vienna Basin inferred from quantitative subsidence analysis of the northern and central parts. International Journal of Earth Science

106, 687–705.
https://doi.org/10.1007/s00531-016-1329-9

Lee, E.Y., Wagreich, M., 2018. Basin modelling with a MATLAB-based program, BasinVis 2.0: A case study on the southern Vienna Basin, Austria. Journal of the Geological Society of Korea 54, 615–630.

Li, J., Heap, A., 2008. A Review of Spatial Interpolation Methods for Environmental Scientists. Record 2008/23. Geoscience Australia, Canberra, p. 137.

Royden, L., Keen, C.E., 1980. Rifting process and thermal evolution of the continental margin of Eastern Canada determined from subsidence curves. Earth and Planetary Science Letters 51, 343–361. https://doi.org/10.1016/0012-821X(80)90216-2

Sclater, J.G., Christie, P.A.F., 1980. Continental stretching: An explanation of the Post-Mid-Cretaceous subsidence of the central North Sea Basin. Journal of Geophysical Research 85(B7), 3711–3739. https://doi.org/10.1029/JB085iB07p03711

Schmoker, J.W., Halley, R.B., 1982. Carbonate porosity versus depth: A predictable relation for South Florida. AAPG Bulletin 66, 2561–2570. https://doi.org/10.1306/03B5AC73-16D1-11D7-8645000102C1865D

Steckler, M.S., Watts, A.B., 1978. Subsidence of the Atlantic-type continental margin off New York. Earth and Planetary Science Letters 41, 1–13. https://doi.org/10.1016/0012-821x(78)90036-5

ten Veen, J.H., Kleinspehn, K.L., 2000. Quantifying the timing and sense of fault dip slip: New application of biostratigraphy and geohistory analysis. Geology 28, 471–474. https://doi.org/10.1130/0091-7613(2000)28<471:QTTASO>2.0.CO;2

ten Veen, J.H., Postma, G., 1999. Roll-back controlled vertical movements of outer-arc basins of the Hellenic subduction zone (Crete, Greece). Basin Research 11, 243–266. https://doi.org/10.1046/j.1365-2117.1999.00098.x

Wagreich, M., Schmid, H.P., 2002. Backstripping dip-slip fault histories: apparent slip rates for the Miocene of the Vienna Basin. Terra Nova 14, 163–168. https://doi.org/10.1046/j.1365-3121.2002.00404.x

Watts, A.B., Steckler, M.S., 1979. Subsidence and eustasy at the continental margin of Eastern North America. AGU, Maurice Ewing Series 3, 218–234.

Zhao, Z., Sun, Z., Wang, Z., Sun, Z., Liu, J., Zhang, C., 2015. The high resolution sedimentary filling in Qiongdongnan Basin, Northern South China Sea. Marine Geology 361, 11–24. https://doi.org/10.1016/j.margeo.2015.01.002

BasinVis LICENSE

BasinVis uses the following Matlab function packages under BSD License:

Ordinary Kriging

http://www.mathworks.com/matlabcentral/fileexchange/29025-ordinary-kriging

variogramfit

http://www.mathworks.com/matlabcentral/fileexchange/25948-variogramfit

Experimental (Semi-) Variogram

http://www.mathworks.com/matlabcentral/fileexchange/20355-experimental--semi---variogram

fminsearchbnd, fminsearchcon

http://www.mathworks.com/matlabcentral/fileexchange/8277-fminsearchbnd--fminsearchcon