Documentation for ModVisc 0.01

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Content:

1. General information

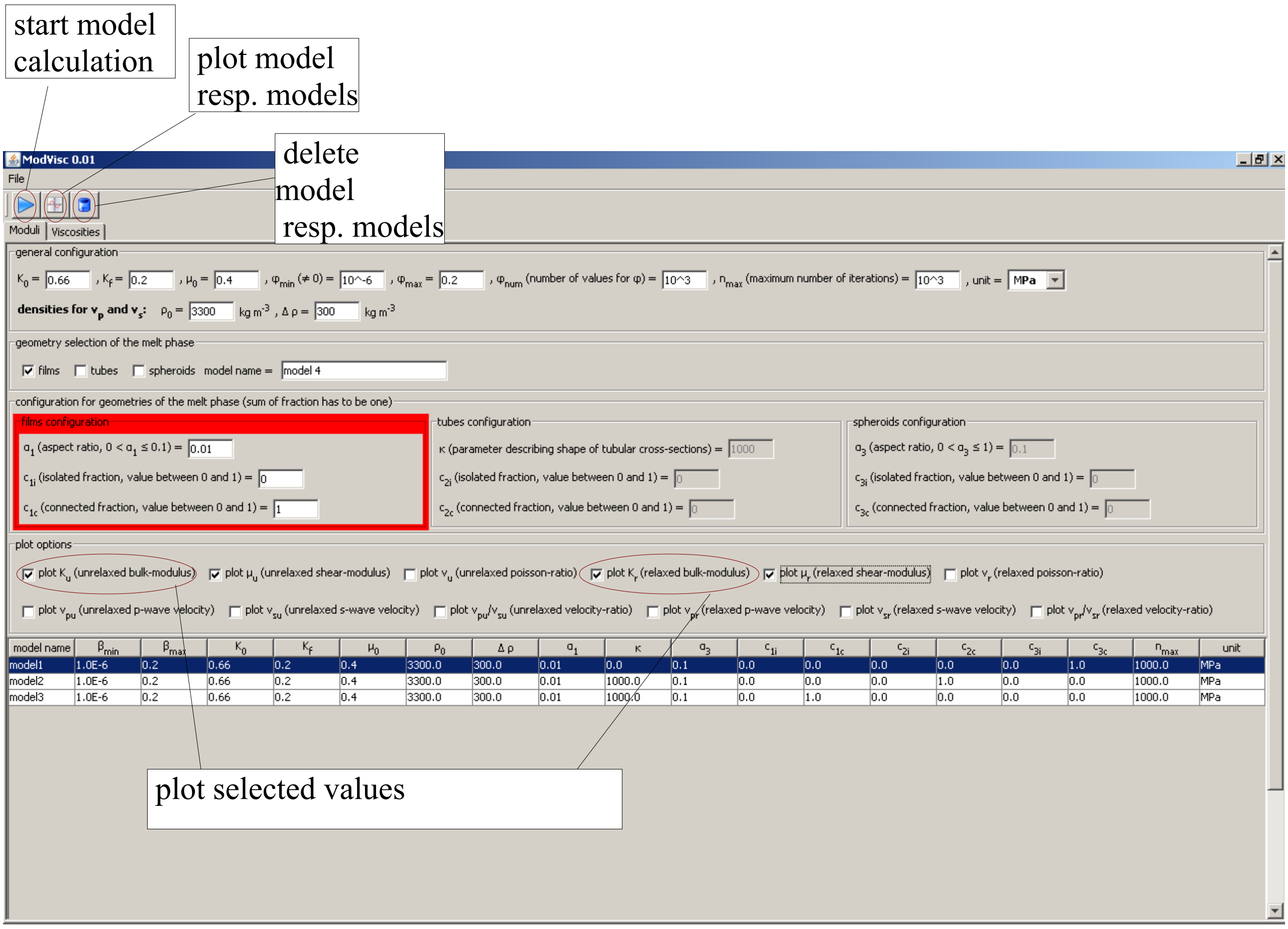

Figure 1: example for calculating and plotting elastic moduli or seismic velocities

In Fig. 1 you can see how to use ModVisc 0.01. It is possible to switch between the calculation of elastic moduli or effective viscosities. The handling is for both tabs the same.

2. Parameter description

2.1 Modulus

parameter name	description	default value
K_0	Intrinsic bulk-modulus of the matrix	0,66
K_f	Intrinsic bulk-modulus of the fluid	0,2
μ_0	Intrinsic shear-modulus of the matrix	0,4
φ_{min}	Minimum value for melt fraction (zero is not allowed)	10^{-6}
φ_{max}	Maximum value for melt fraction (has to be smaller or equal to one; one means 100% melt fraction)	0,2 (20%)
φ_{num}	Number of fraction values between φ_{min} and φ_{max}; realized with φ = logspace(log10(φ_{min}), log10(φ_{max}), φ_{num}); for detailed information please read matlab documentation about logspace	1000
n_{max}	Tells maximum number of iterations which are allowed for each fraction value φ	1000
unit	Unit for the moduli; free choose is not allowed because seismic velocities are also calculated	MPa
ρ_0	Intrinsic density of the matrix	3300 [kg m^{-3}]
$\Delta\rho$	Density difference between matrix and fluid; density for calculating the seismic velocities is given by $\rho = \rho0 - \Delta\rho\ \varphi$	300 [kg m^{-3}]
films	Check if you want to include film geometry	unchecked
tubes	Check if you want to include tube geometry	unchecked
spheroids	Check if you want to include spheroid geometry	checked
model name	This name appears in the model table and in the legend for the case of plotting	model 1
α_1	Aspect ratio of the oblate ellipsoidal films; should be << 1 otherwise there will occur relative errors for K and μ which increase linear with melt fraction; detailed information are given in 1)	0,01

c_{1i}	Relative fraction for isolated oblate ellipsoidal films; has to be a value between zero and one (zero means 0%, one means 100%); see *	0
c_{1c}	Relative fraction for connected oblate ellipsoidal films; has to be a value between zero and one (zero means 0%, one means 100%); see *	0
κ	Shape parameter for the cross section of the tubes; value interval reachs from zero to infinity (choose a really large value); for detailed information see 1) resp. 2)	0
c_{2i}	Relative fraction for isolated tubes; has to be a value between zero and one (zero means 0%, one means 100%); see *	0
c_{2c}	Relative fraction for connected tubes; has to be a value between zero and one (zero means 0%, one means 100%); see *	0
α_3	Aspect ratio of the oblate ellipsoidal spheroids; value has to be larger than zero and equal or smaller than 1 ($0<\alpha_3\leqslant 1$)	0,1
c_{3i}	Relative fraction for isolated oblate ellipsoidal spheroids; has to be a value between zero and one (zero means 0%, one means 100%); see *	0
c_{3c}	Relative fraction for connected oblate ellipsoidal spheroids; has to be a value between zero and one (zero means 0%, one means 100%); see *	1

* the sum of all c's has to be 1

2.2 Viscosities

parameter name	description	default value
η_{b0}	Effective bulk-viscosity of the matrix is set to infinity, because matrix is incompressible; for detailed information see [1]	∞
η_{bf}	Effective bulk-viscosity of the fluid is set to zero, because effective bulk viscosity relates the dilatational strain rate to the isotropic part of the viscous stress tensor and not to the pore fluid pressure; for detailed information see [1]	0
η_{s0}	Intrinsic dynamic shear-viscosity of the matrix	10^{18}
φ_{min}	Minimum value for melt fraction (zero is not allowed)	10^{-6}
φ_{max}	Maximum value for melt fraction (has to be smaller or equal to one; one means 100% melt fraction)	0,2 (20%)
φ_{num}	Number of fraction values between φ_{min} and φ_{max}; realized with φ = logspace(log10(φ_{min}), log10(φ_{max}), φ_{num}); for detailed information please read matlab documentation about logspace	1000
n_{max}	Tells maximum number of iterations which are allowed for each fraction value φ	1000
unit	Unit for the viscosities; is set to SI-unit and not changeable	Pa s
films	Check if you want to include film geometry	unchecked
tubes	Check if you want to include tube geometry	unchecked
spheroids	Check if you want to include spheroid geometry	checked
model name	This name appears in the model table and in the legend for the case of plotting	model 1
α_1	Aspect ratio of the oblate ellipsoidal films; should be << 1 otherwise there will occur relative errors for η_b and η_s which increase linear with melt fraction; detailed information are given in 1)	0,01
c_1	Relative fraction for oblate ellipsoidal films; has to be a value between zero and one (zero means 0%, one means 100%); see **	0

κ	Shape parameter for the cross section of the tubes; value interval reachs from zero to infinity (choose a really large value); for detailed information see 1) resp. 2)	0
c_2	Relative fraction for tubes; has to be a value between zero and one (zero means 0%, one means 100%); see **	0
α_3	Aspect ratio of the oblate ellipsoidal spheroids; value has to be larger than zero and equal or smaller than 1 ($0<\alpha_3\leqslant 1$)	0,1
c_3	Relative fraction for oblate ellipsoidal spheroids; has to be a value between zero and one (zero means 0%, one means 100%); see **	1

** $c_1 + c_2 + c_3 = 1$ has to be fulfilled

3. Plotting

You are able to plot the results of one or many models in one plotting window. Depending on whether you want to plot modulus or viscositiy models you can choose between different values to plot. All values are plotted against the total melt fraction φ.

3.1 <u>Modulus</u>

value	description
K_u	Unrelaxed bulk-modulus
K_r	Relaxed bulk-modulus
μ_u	Unrelaxed shear-modulus
μ_r	Relaxed shear-modulus
υ_u	Unrelaxed poisson-ratio
υ_r	Relaxed poisson-ratio
v_{pu}	Velocity of p-waves calculated with unrealxed moduli
v_{pr}	Velocity of p-waves calculated with realxed moduli
v_{su}	Velocity of s-waves calculated with unrealxed moduli
v_{sr}	Velocity of s-waves calculated with realxed moduli

v_{pu}/v_{su}	Ratio of the velocities calculated with unrelaxed moduli
v_{pr}/v_{sr}	Ratio of the velocities calculated with relaxed moduli

If you want to have for example K_u and K_r from one or from different models in one plot window you have to check these checkboxes and choose one model or by holding CTRL many models inside the model table. After that you have to press the plot button in the toolbar at the top of the program (see Fig. 1)

3.2 Viscosities

value	**description**
η_b	bulk-viscosity
η_s	shear-viscosity
υ	poisson-ratio

For the viscosities it is possible to plot bulk- and shear-viscosity in one plot window. There is even an option to plot only the important parts, because in some configurations the bulk- resp. shear-viscosity will rapidly decrease until the error boundary is reached. These values are not biased and maybe you don't want to plot them.

4. Saving

It is possible to save the calculated models as a text file (*.txt) or as a Matlab file (*.mat).

4.1 matlab data files

ModVisc saves the calculated models internally as a structure (struct). So even when you choose more than one model for saving there will be only one mat file. This mat file contains all models in the form of a struct (see "help struct" in matlab). To import your saved data in Matlab two alternatives. On the one hand you can do it interactive with File > Import Data and on the other hand you can do it in the command line with the command:

```
>>load 'path/filename'
```

When the saved data contains moduli models the variable name is "mod_models", when the saved data contains viscosity models the variable name is "visc_models". The following table should give you an overview which