**Excel-worksheets for model calculations**

You find worksheets for model calculations on the website. All worksheets have a similar format:

* In a green field you find the relevant equations.
* Input data (matrix and fluid properties) must be typed into yellow fields. Some recommended values are in a table. You can also use your own input parameters.
* Variables in the calculation area are in a grey field. Variables are, for example, porosity or aspect ratio. You can also modify the values of the variables.
* The white fields are calculation cells and results.
* The graphical presentation of the calculated data is at the lower end.

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| **Elastic-mechanical** |
| Bound models | **Voigt\_Reuss\_Hashin:** For a two-component layered model (solid, fluid) the elastic moduli (compressional modulus, shear modulus) are calculated as function of fluid volume fraction (porosity) based on the model of Voigt (upper bound) and Reuss (lower bound), and the Voigt-Reuss-Hill mean value. For the same two-component model, the Hashin-Shtrikman upper and lower bounds are calculated. |
| Inclusion isotropic | **Kuster\_Toksöz:** Calculation of normalized compressional and shear wave velocity for a two component material (solid, fluid) as function of porosity. Two models are used: Inclusions are spheres and inclusions are penny shaped cracks. Calculations for gas and water filled inclusion.**Budiansky:** Calculation of compressional and shear wave velocity as function of fracture parameter epsilon and porosity. For calculation, penny-shaped random distributed inclusions are assumed. Additional input parameter is the aspect ratio. |
| Inclusion anisotropic | **Hudson’s model**: Calculation of the components of the tensor of elasticity based on the assumption of a VTI medium (horizontal cracks). Additional input parameter is the aspect ratio. |
| Fluid replacement | **Gassmann:** The worksheet allows a fluid replacement based on Gassmann’s equation. Input: compressional and shear wave velocity measured for rock saturated with fluid 1, porosity, compressional modulus and density of fluid 1 and fluid 2. Output: compressional and shear wave velocity for the rock saturated with fluid 2.  |
| Structured model | There are five worksheets for different velocity influences:**Porosity:** Calculation of the porosity effect upon velocity with the quotient of pore aspect ratio to grain aspect ratio as parameter.**Pressure:** Calculation of pressure effect upon velocity controlled by parameters of the contact elasticity.**Tensor:** Calculation of the components of the “structure tensor” as function of structure angle and contact properties. Derivation of velocity ratios Vp/Vs and Thomson’s anisotropy parameters for the dry rock.**Velocity grids:** Grids are calculated with the equations from Table "Tensor". Two parameters are used as input (parameter, angle ).**Vp vs. strength:** Calculation of the relationship between velocity (in this case compressional wave velocity) and compressional strength.  |
| **Electrical-thermal**  |
| Layer\_bound models | **Electr.-Cond.:** Calculation of electrical conductivity of a 2-component material (solid, fluid) as function of porosity. The following equations are used: Voigt model (parallel, upper bound), Reuss model (series, lower bound), arithmetic mean, geometric mean, Krischer and Esdorn model with parameter a, generalized Lichtenecker-Rother model with parameter .**Permittivity:** same for permittivity**Therm.-Cond.:** same for thermal conductivity**Therm.-Cond. (10):** Worksheet for calculation of thermal conductivity of a material consisting of (maximum) 10 components. Input: volume fraction and conductivity of components. Calculation for following models: Voigt model (parallel, upper bound), Reuss model (series, lower bound), Krischer and Esdorn model with parameter a, generalized Lichtenecker-Rother model with parameter . |
| Inclusion models | There are three worksheets. All sheets are written for thermal conductivity. For calculation of permittivity write in the yellow input cells the matrix and fluid values for permittivity.For electrical conductivity write as matrix input parameter the matrix conductivity (including interparticle porosity) and for fluid conductivity the value for fracture filling fluid.**Spheres:** Calculation of thermal conductivity as function of volume fraction for a 2-component material under assumption ofspherical pores as inclusion in a solid host material,spherical grains as inclusion in a fluid host material.**Disk-random:** Calculation of thermal conductivity as function of volume fraction for a 2-component material under assumption of* spherical pores,
* disk shaped random oriented pores
* as inclusion in a solid host material.

**Ellipsoids-oriented:** Calculation of thermal conductivity as function of volume fraction for a 2-component material under assumption of ellipsoidic inclusions with orientation. Calculations deliver thermal conductivity for x-, y-axis and z-axis. Additional input parameter is aspect ratio. |