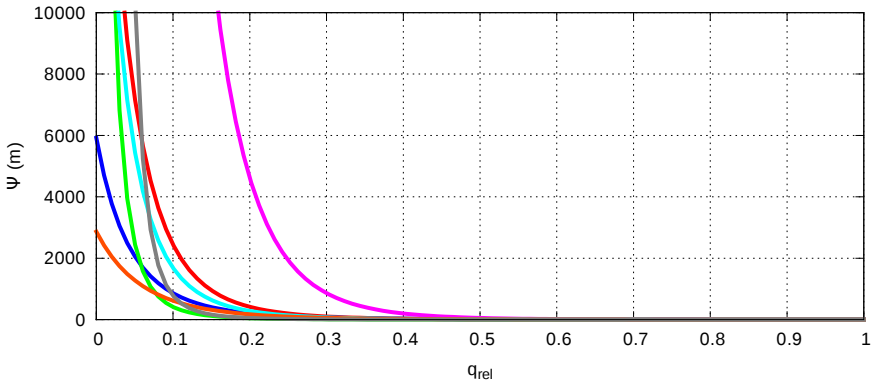


Hydraulic potential of soil  $\Psi(q_{rel}) = \Psi_g^* (q_{max}/q)^{**b}$

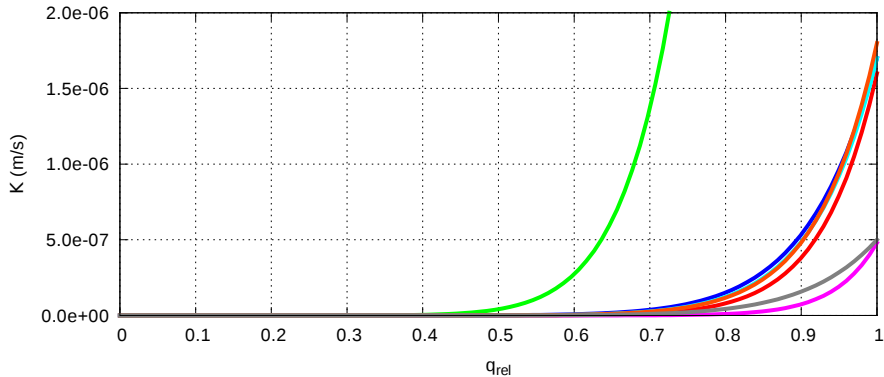


sandy clay loam  
silty loam  
sand

clay  
loam  
peat

rock

Hydraulic conductivity of soil  $K(q, f_{ice}) = K_g * ((q - f_{ice}q) / (q_{max} - f_{ice}q))^{2b+3}$ ,  $f_{ice}=0$

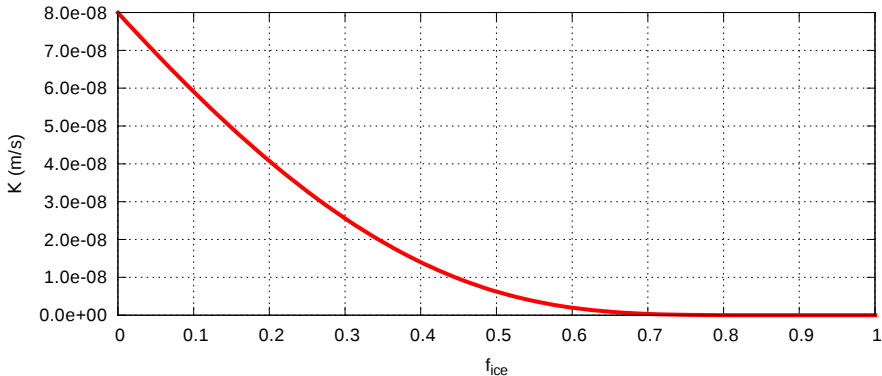


sandy clay loam  
silty loam  
sand

clay  
loam  
peat

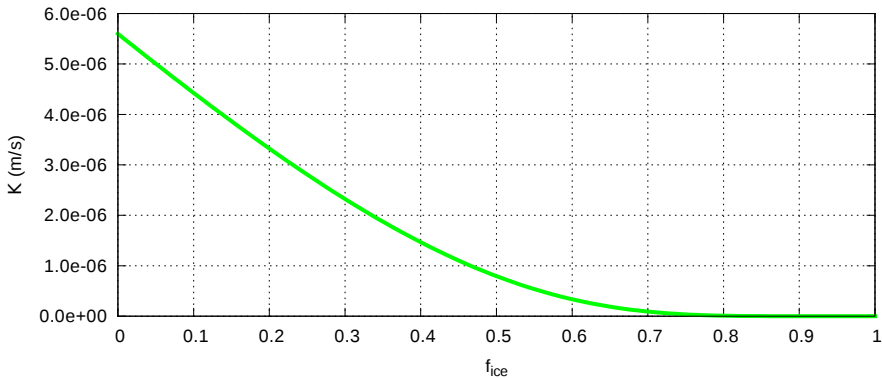
rock

Hydraulic conductivity of soil  $K(q, f_{ice}) = K_g * ((q - f_{ice}q) / (q_{max} - f_{ice}q))^{2b+3}$ , Sandy clay loam



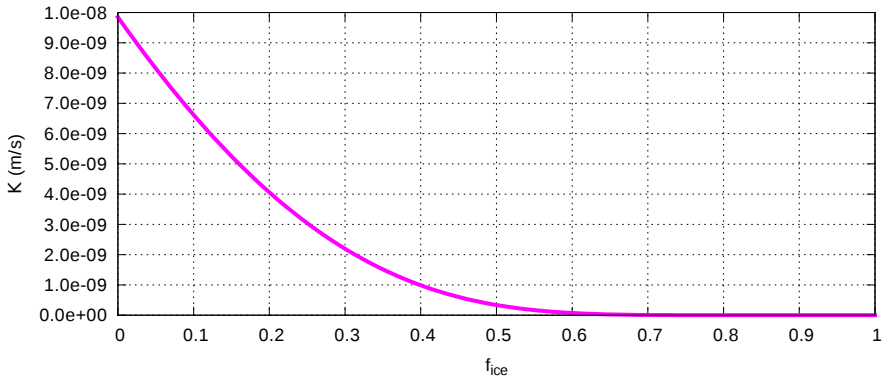
$q_{rel}=0.8$  —

Hydraulic conductivity of soil  $K(q, f_{ice}) = K_g * ((q - f_{ice}q) / (q_{max} - f_{ice}q))^{2b+3}$ , Sand



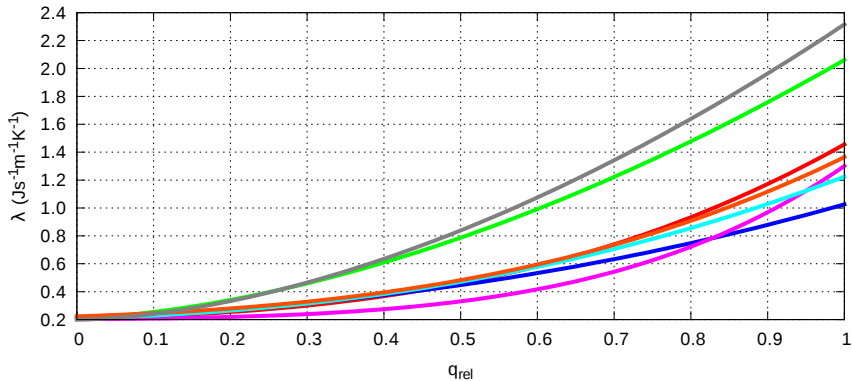
$q_{rel}=0.8$  —

Hydraulic conductivity of soil  $K(q, f_{ice}) = K_g * ((q - f_{ice} q) / (q_{max} - f_{ice} q))^{2b+3}$ , Clay



$q_{rel}=0.8$  —

Dynamic thermal conductivity of soil  $\lambda(\Psi)=0.2+300\exp(-6\lg(\Psi))$

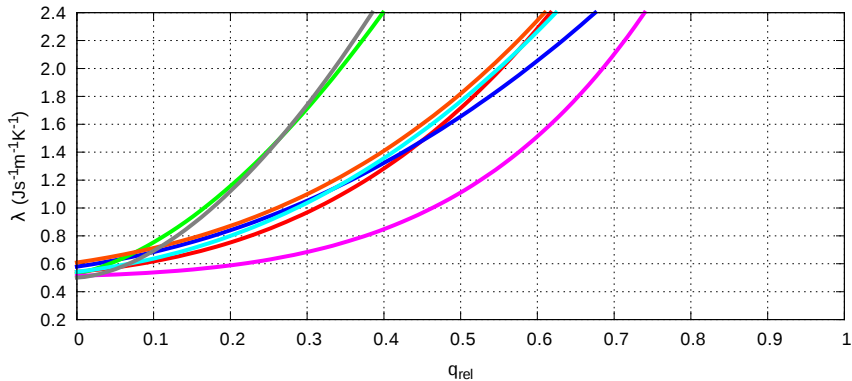


sandy clay loam  
silty loam  
sand

clay  
loam  
peat

cracky rock

Dynamic thermal conductivity of soil  $\lambda(\Psi)=0.5+1400\exp(-6-\lg(\Psi))$

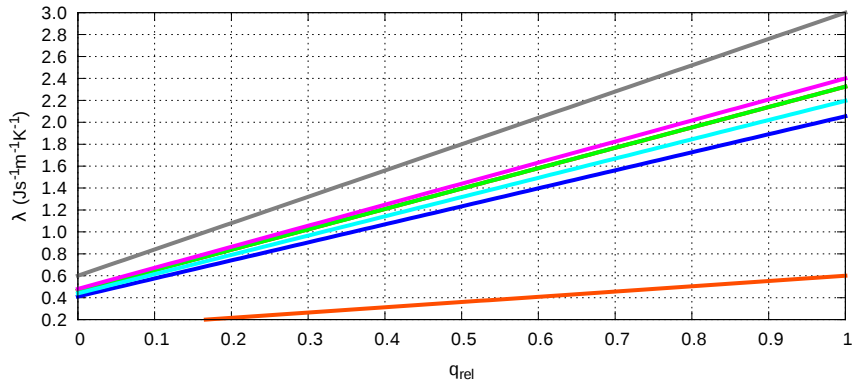


sandy clay loam  
silty loam  
sand

clay  
loam  
peat

cracky rock

$$\text{Dynamic thermal conductivity of soil } \lambda(q_{\text{rel}}) = (\rho \cdot 1.e^{-3 \cdot 1.2}) \cdot (q_{\text{rel}}) + \rho \cdot 1.e^{-3 \cdot 0.3}$$



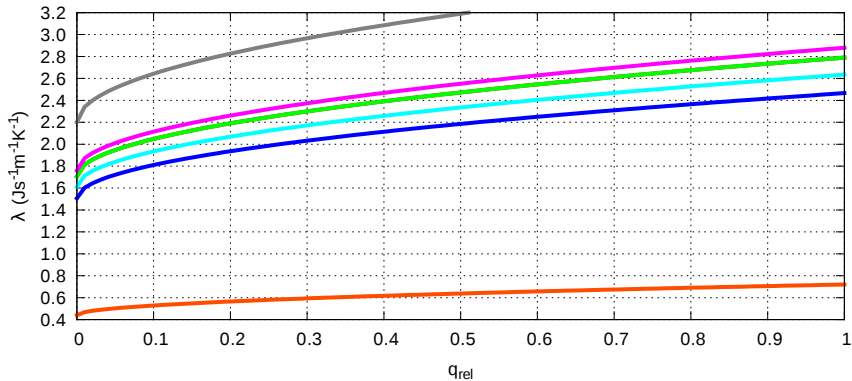
sandy clay loam  
silty loam  
sand

clay  
loam  
peat

cracky rock



Dynamic thermal conductivity of soil  $\lambda(q_{rel}) = (\rho \cdot 1.e^{-3 \cdot 0.7}) \cdot (q_{rel})^{0.5} + \rho \cdot 1.e^{-3 \cdot 1.1}$

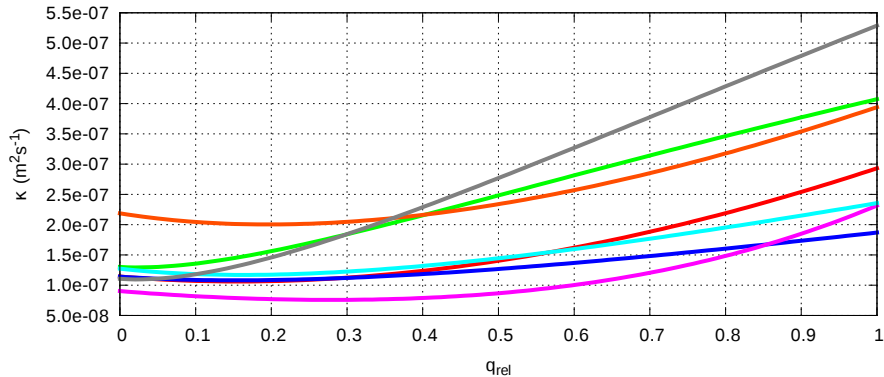


sandy clay loam  
silty loam  
sand

clay  
loam  
peat

cracky rock

Kinematic thermal conductivity of soil  $\kappa(\Psi)=(0.2+300\exp(-6-\lg(\Psi)))/(C_g\rho_g)$

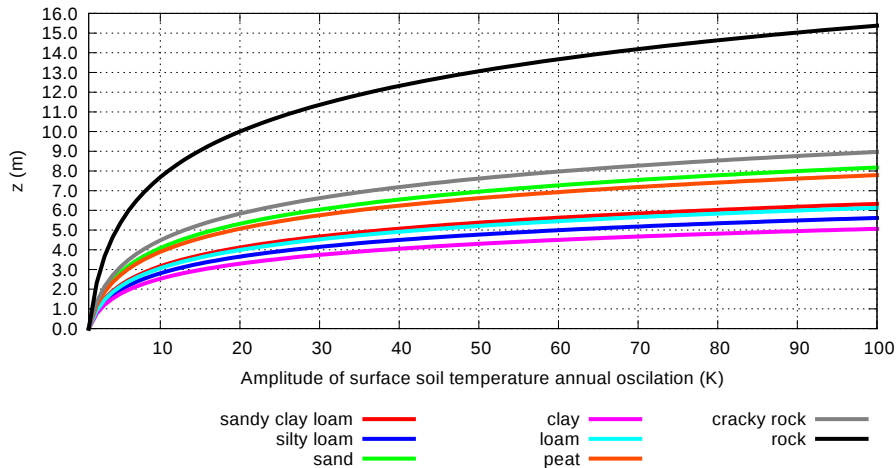


sandy clay loam  
silty loam  
sand

clay  
loam  
peat

cracky rock

Depth where amplitude of soil temperature annual oscillation equal 1 K:  $z = -\ln((1/A_0)^2)/(2(\pi/\kappa/\Pi)^{0.5})$



Depth where amplitude of soil temperature annual oscillation equal 0.1 K:  $z = -\ln((0.1/A_0)^2)/(2(\pi/\kappa/\Pi)^{0.5})$

