Topics
Fourier’s law and applications (temperature-dependent thermal conductivity, shear heating)
Steady-state spherical heat conduction (in a shell, with advection, with heat production)
Time-dependent heat conduction (Stefan problem, thermal inertia)
Heating during accretion
Numerical approaches

Equations

\[ F = -k \frac{dT}{dz} \]
\[ \frac{dT}{Dt} = \frac{\partial T}{\partial t} + u \cdot \nabla T = k \nabla^2 T + \frac{H}{\rho C_p} \quad t - d^2/k \]

Numbers

\( k \sim 3 \text{ Wm}^{-1}\text{K}^{-1} \quad \kappa \sim 10^{-6} \text{ m}^2\text{s}^{-1} \quad H \sim 3 \times 10^{-12} \text{ W kg}^{-1} \) (Earth, present-day)

\(^{26}\text{Al}\) decay: 3 MeV per atom, \( t_{1/2} \sim 0.7 \text{ Myr} \)

\( C_p \sim 1 \text{ kJ kg}^{-1}\text{K}^{-1} \) (rock) \( \sim 2 \text{ kJ kg}^{-1}\text{K}^{-1} \) (ice), \( L \sim 0.3 \text{ MJ kg}^{-1} \) (rock/ice)

References