Geothermal Temperature Field @model

@wikipedia

Motivation

In some specific subsurface applications which require the knowledge of subsurface temperature distributions the assumption of the Constant Areal Geothermal Temperature Profile is not valid and the problem requires a proper 3D modelling solution.

Outputs

$T_G(t, \mathbf{r})$	Along-hole Geothermal Temperature Profile
$G_T(\mathbf{r})$	Geothermal Temperature Gradient

Inputs

t	Local Calendar Time
$\mathbf{r}$	Position vector
$z(l)$	Wellbore trajectory True Vertical Depth Sub-Sea (TVDss)
$\mathbf{j}(x, y, z = z_{ref})$	Earth's Heat Flux at some reference depth $z = z_{ref}$ as function of $(x,\ y)$
$q(\mathbf{r})$	Volumetric density of heat sources distributed throughout the subsurface rock volume
$T_s(t, x, y)$	Surface temperature based on weather reports
$\lambda_e(\mathbf{r})$	Subsurface Thermal Conductivity profile as function of position vector
$a_e(\mathbf{r})$	Subsurface Thermal diffusivity profile as function of position vector

where

l	Measured Depth of wellbore trajectory with reference to Earth's surface ($l = 0$)
$z_s = z(l = 0)$	TVDss of the Earth's surface in a given location. In case the Earth's surface is at sea level then $z_s = 0$

Assumptions

Equations

(1)	$$\rho_e \, c_e \frac{\partial T_G}{\partial t} + \nabla \left(\lambda_e \nabla T_G \right) = q(\mathbf{r})$$	(2)	$$T_G(t, x, y, z = z_s) = T_s(t, x, y)$$	(3)	$$\left[\lambda_e \nabla T_G \right]_{z=z_{ref}} = \mathbf{j}(x, y, z = z_{ref})$$
(4)	$$G_T(\mathbf{r}) = \frac{j_z(\mathbf{r})}{\lambda_e(\mathbf{r})}$$				

See Also

Geology / Geothermal Temperature Field

[Constant Areal Geothermal Temperature Profile @model] [Geothermal Temperature Gradient]

References

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