HYDROTHERM

Model Uses   HYDROTHERM is a finite-difference model used for 3-dimensional modeling of pure-water flow and temperature.

Major Categories	Hydrology and Water Use	
Minor Categories	Temperature; Flow	**Technical Difficulty Level** Intermediate
Model Type	Physical Model	**Geographic in Nature?** No

Abstract
Quantitative modeling of magmatic-hydrothermal systems has been hampered by the lack of publicly available models for multiphase, high-temperature flow. The HYDROTHERM model described here is a finite-difference model for three-dimensional, multiphase flow of pure water and heat over a temperature range of 0 to 1,200 degrees Celsius and a pressure range of 0.5 to 10,000 bars. HYDROTHERM solves numerical approximations to mass- and energy-balance equations that are posed in terms of pressure and enthalpy. Major assumptions are that the rock matrix can be treated as a porous medium; that water and rock are in thermal equilibrium; and that capillary pressure is negligible.

HYDROTHERM allows one- and two-dimensional radial simulations as well as one-, two-, and three-dimensional simulations in Cartesian coordinates. The program structure is modular to allow easy modification.

Future Developments
Unknown

Model Limitations
Unknown

Model Features
- Supports one, two and three dimensional simulations in Cartesian Coordinates
- Allows for one, two and three dimensional radial simulations
- Supports modeling for a wide range of temperatures and pressures
- Solves numerical approximations to mass and energy-balance equations

Required Data Types
The input file consists of a template with input values in order to simplify entry of input parameters. Initial conditions are values of the independent variables, pressure and enthalpy, at the initial problem time. Model runs may be initiated as new runs or as continuations of previous runs. The most common boundary conditions are constant pressure/enthalpy and (or) controlled flux. Values of porosity, x-, y-, and z-permeability, thermal conductivity, rock heat capacity, density, and compressibility must be specified either by rock type or for every finite-difference block.

Model Outputs
HYDROTHERM produces 2 to 8 output files, depending on the user's choice of options.
- HTout0 provides a reformatted copy of the input file and tracks progress of the simulation run.
- HTout1 captures fundamental information about the solution, including any or all of pressure, enthalpy, temperature, saturation, and residual mass and energy fluxes.
- HTout2 and HTout3 include any or all of fluid density, viscosity, x- and z-velocities, and "potentials".
- HTout4 lists values for rock properties that can vary with temperature.
- HTout5 contains fluxes for constant blocks, sources, and sinks.
- HTout6 includes pressure, enthalpy, temperature, and saturation values for selected finite-difference blocks in a format convenient for plotting time histories.
- HTpickup contains the continuously updated pressure/enthalpy solution needed to initialize

continuation runs. If rock compressibility is non-zero, the initial pressure and porosity values stored in

- HTinitPn are also needed to initialize continuation runs.

Hardware Requirements
None noted

Software Requirements
None noted

Cost, Licensing and Availability
Free – available from link below.

Source
US Geological Survey

Source URL
http://water.usgs.gov/software/hydrotherm.html

Supported Platforms

DOS	☐	**UNIX**	☒
Windows	☐	**Macintosh**	☐