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Contribution ID: **627**

Type: **Poster (+) Presentation**

Data-Driven Finite Element Method, Energy Conservation approach for temperature, water isotope ($\delta D, \delta^{18}O$), and $[SiO_2]_{sat.}$ conc. distributions of the Culex Basin terrestrial hydrothermal system-Yellowstone, WY.

Tuesday, 1 June 2021 19:00 (1 hour)

The thermal energy distribution of the Yellowstone terrestrial hydrothermal system is driven by a mantle-derived magmatic plume which has both Iron-Magnesium rich and Aluminum-Silicate rich phases and supplies thermal energy to the surface (Crough, 1978). The Yellowstone hydrothermal system is in steady-state within neighborhood of geologic time (10's Ka) and steady-state diffusive nature predominates as the hydrothermal system marches closer towards eruption(Faust, C.R. and Mercer, J.W., 1977). The Yellowstone Plateau Volcanic Field (YPVF) with area on the order of 90,000km^2 is the location of numerous active thermal areas. Since the domains observed during field reconnaissance (2019 and 2020) were relatively small (\approx $1.6km^2$) compared to the overall area impacted by thermal energy within the global system (i.e. 90,000km^2), care was taken to ensure energy minimization $1/2|| \bigtriangledown (u)||^2 \approx 0$ within the spatial domain was satisfied during numerical model's implementation of the coupled set of nonlinear hydrodynamic governing euqations (i.e. advection-diffusion-reaction) for the observed domain (i.e. Cule Basin). The FEniCS-Dolfin-PETSc numerical libraries were used in the implementaiton of numerical simulations of spatial distributions for heat, water isotopes (i.e. $\delta D, \delta^{18}O$), and saturation silica (SiO_2) concentration estimations of the fluid-rock interface observed from Culex Basin hydrothermal features. Energy distributions, thermal and chemical gradient($\bigtriangledown(u)$)/numerical flux ($-K \bigtriangledown (u)$) fields estimated within the observed fluid-rock interface domain (Ω_{CB}) are the result of the local buoyancy forces (Smith and Chapman, 1983).

If the locally observed hydrothermal systems at Yellowstone interact as energy conservative space time balances, that minimize the distribution of spatial potential energy in the observed phases, then this could be numerical evidence that the global Yellowstone hydrothermal system is in steady-state diffusive energy flux. This would imply that the fluid-rock interface of a terrestrial hydrothermal system is driven by buoyancy forces which determine fluid velocity fields and thus the elliptic plane of thermal energy distribution decoupled from the physical ground surface (Smith and Chapman, 1983). The finite element numerical results of the nonlinear Lagrange-Galerkin diffusive model for variables measured during field reconnaissance will be discussed for temperature based estimations, and measured spatial distributions and associated flux fields (Sorey et al., 1978).

On terrestrial hydrothermal systems found on Earth, this approach could reduce the amount of exploration drilling needed during geothermal development. Less drilling during said geothermal development could reduces the cost ($$)*ontheorderofhundredsofthousandsofdollars.Additionallylessdrillingcouldreducetheenvironmentalimpactinthesurroun*
Galerkinmethodspresented, terrestrialhydrothermalsystemmodelscouldbeusedtocomparethedatacollectedfromotherterrestr

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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Presenter: Mr SORENSEN II, Anthony P. (Washington State University-School of the Environment)

Session Classification: Poster +

Track Classification: (MS7) Mathematical and numerical methods for multi-scale multi-physics, non-linear coupled processes