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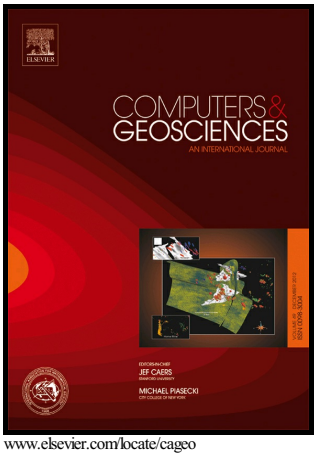

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GENERATING ONE-COLUMN GRIDS WITH FRACTAL FLOW DIMENSION

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ABSTRACT

The grid generation capability built into the numerical simulator TOUGH for multi-phase fluid and heat flow through geologic media can create one-column grids with linear or radial geometry, corresponding to one-dimensional or two-dimensional radial flow, respectively. The integral-finite-difference-method that TOUGH employs for spatial discretization makes it very simple to generalize the grid-generation algorithm from integer to non-integer (fractal) flow dimension. Here the grid-generation algorithm is generalized to create one-column grids with fractal flow dimension ranging from less than 1 to 3. The fractal grid generation method is verified by comparing numerical simulation results to an analytical solution for a generalized Theis solution for integer and non-integer flow dimensions between 0.4 and 3. It is then applied to examine gas production decline curves from hydraulically fractured shale that is modeled as a fractal-dimensioned fracture network with flow dimensions between 0.25 and 3. Grids with fractal flow dimension are useful for representing flow through fracture networks or highly heterogeneous geologic media with fractal geometry, and may be particularly useful for inverse methods.