How to make a static steady-state gravity-capillary equilibrium using TOUGH2/EOS7C

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Step 1. Single column, water-table "boundary condition"

<u>Instructions:</u>

Make or extract a 1D column of grid blocks (and appropriate vertical connections) for use as the MESH file in this first step. See input file gcinp01 for some example MESHMAKER input to make a 2D grid (MESH03). Edit the MESH file to assign a single grid block the rock type "wt" (for water table) at the elevation that you want the water table to be. This single grid block should be assigned a volume of 1.e50 m^3. The other grid blocks should be rock type res01 for reservoir (high-permeability material). Call this MESH file MESH01.

Edit the input file so it has three rock types, res01, wt, and botbnd.

Rock wt should have all phases perfectly mobile, and zero capillary pressure.

Note that the initial conditions in the PARAM block specifiy fully liquid-saturated conditions (X5 = 1.e-5).

Edit an INCON file to specify conditions for the single water-table grid block and give this block a liquid saturation of 0.5. Call this INCON01.

Copy MESH01 to MESH. Copy INCON01 to INCON. Run the single vertical column using the input file gcinp01.

This run should be fast (it is a 1D column) and should stop running with time steps of order 10^11 s or larger.

Step 2. Single column, constant conditions at the bottom boundary.

<u>Instructions:</u>

Edit the MESH01 file by assigning the water-table grid block back to res01 and give it normal volume. Make the bottom grid block rock type botbnd with 1.e50 m^3 volume. Call it MESH02.

Note that the rock types wt and botbnd have heat capacities of 1.e5 J/(kg C) (to make these materials ignored in calculating mass balances).

Copy the SAVE file from Step1 to INCON02. Delete the last two lines and add a new blank line at the bottom with at least three spaces (blank characters) in it.

Copy MESH02 to MESH. Copy INCON02 to INCON. Run the single vertical column using the input file gcinp01 (same file as in Step 1).

This run should be very fast (1D) and should stop running with time steps of order 10^11 s or larger.

Step 3. Full domain, constant conditions along the bottom.

Instructions:

Edit the full full 2D or 3D MESH file to make the bottom layer have grid blocks with 1.e50 m^3 volume and be of rock type botbnd. Call this MESH03.

Copy SAVE file from Step 2 to INCON, and edit this INCON file to replicate the single column conditions as many times as necessary to create the full 2D or 3D domain. The grid block names do not have to be correct. You can simply replicate the entire column n times to correspond to a full MESH with n columns. Delete the last two lines and add a final line with at least three blank spaces. Call this file INCON03.

Edit the input file by changing the S in START to x (i.e., START becomes xTART). This is done so that the code will ignore grid-block names in INCON and just read in the initial conditions in the order they are listed in the MESH file. Call this input file gcinp03.

Copy INCON03 to INCON. Copy MESH03 to MESH.

Run the full domain (MESH) using the input file gcinp03. This run should be fast and get to very large time steps indicating steady-state conditions. Copy SAVE file to INCON04, and delete the last two lines of INCON04, and add a final line with at least three spaces (blank characters).

This new file, INCON04, is your static steady-state INCON file with gravity-capillary equilibrium and a water table at the location you specified.

Note, as an optional approach, after copying INCON03 to INCON, and MESH03 to MESH, you could edit the input file to run one single time step of length 1.e-9 s. If you choose this option, the code will not run any time steps and instead will simply create a usable SAVE file with the correct grid-block names assigned with their uniform column-by-column properties that you specified in the INCON file. You can copy SAVE to INCON04, and edit the last lines as above, and use this as your static steady-state INCON file.