

$$\Omega_i = \{j_1, j_2, j_3, j_4\}$$

Fig. 1 Space discretization around the control-volume  $i$  (for a Cartesian grid)

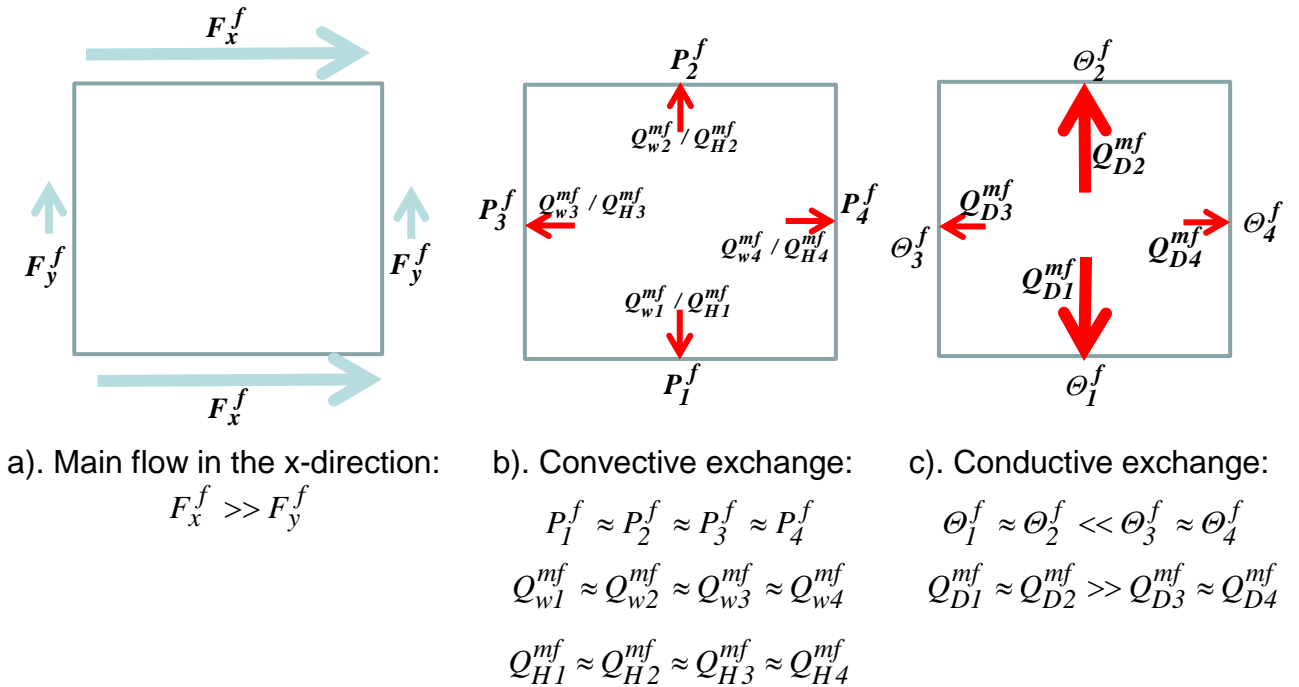
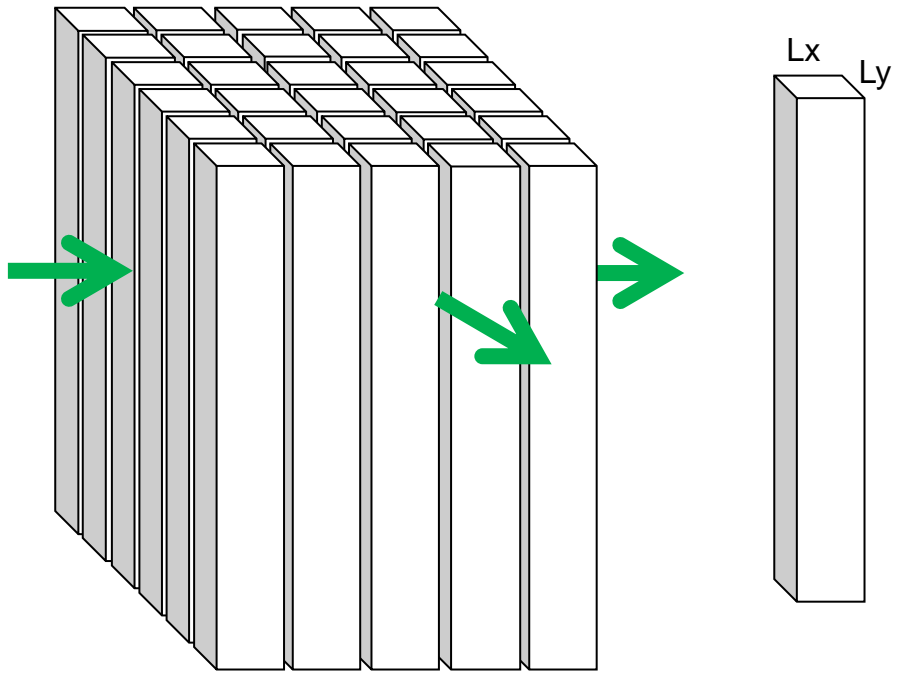


Fig. 2 Matrix-fracture exchange around a matrix block for convective and conductive flows



**Fig. 3 Idealized 2-Dimensional matrix-fracture exchange**

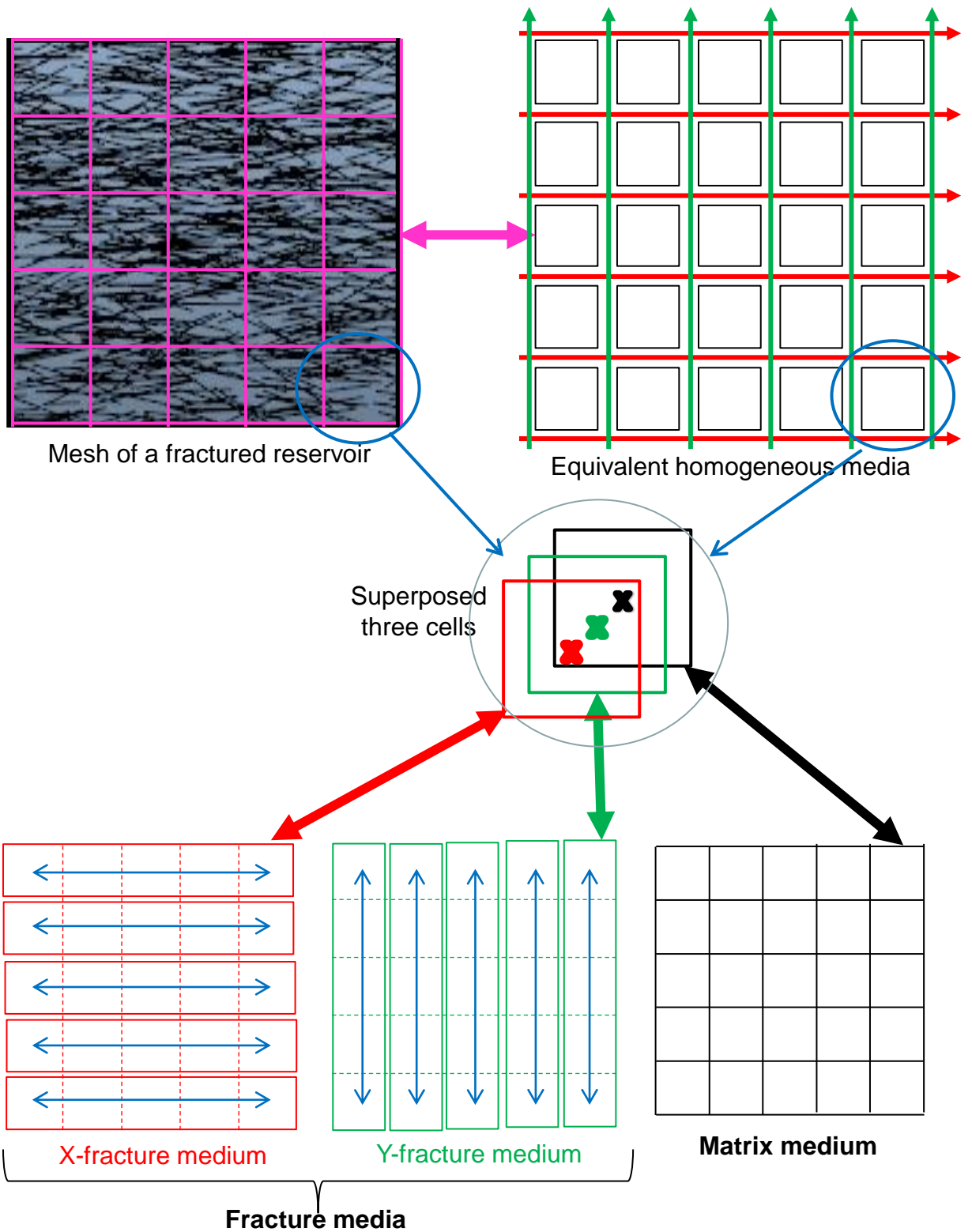
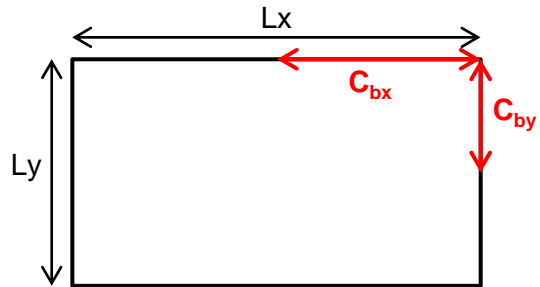
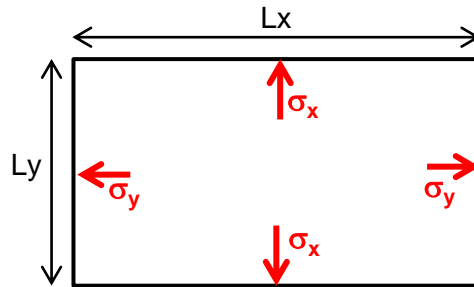


Fig. 4 Dual-porosity and dual-fracture model

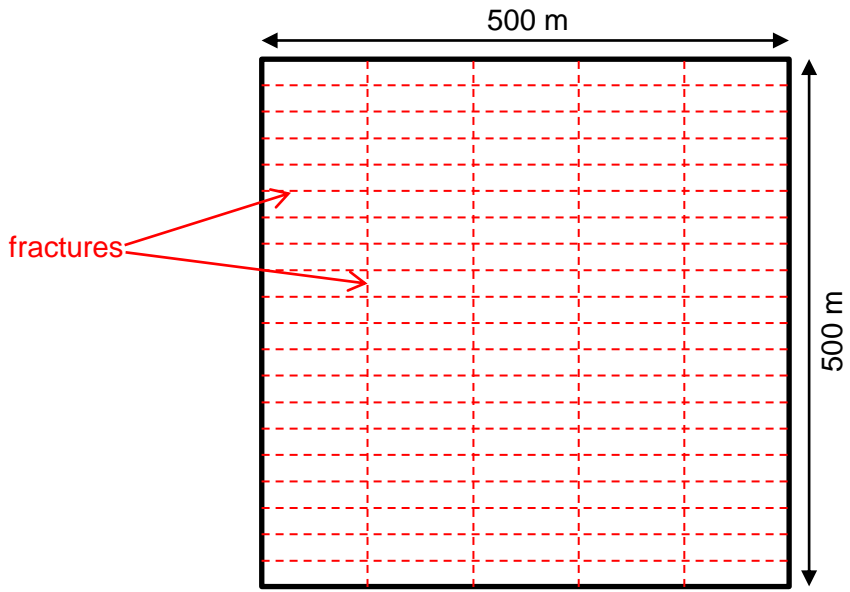


Geometric coefficient calculation around a matrix block

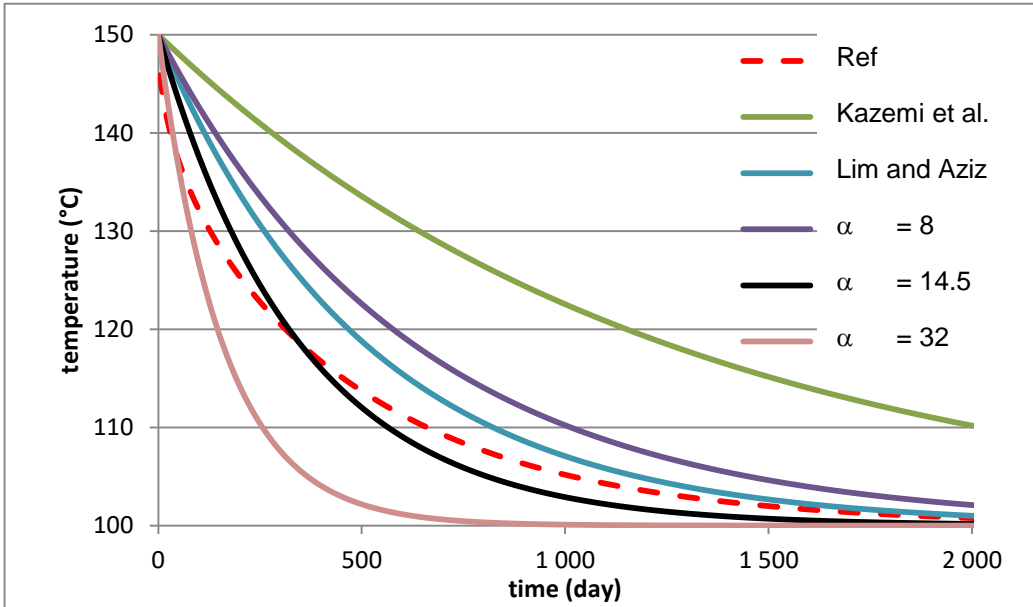
**Fig. 5 Conductive connection between two fractured media**



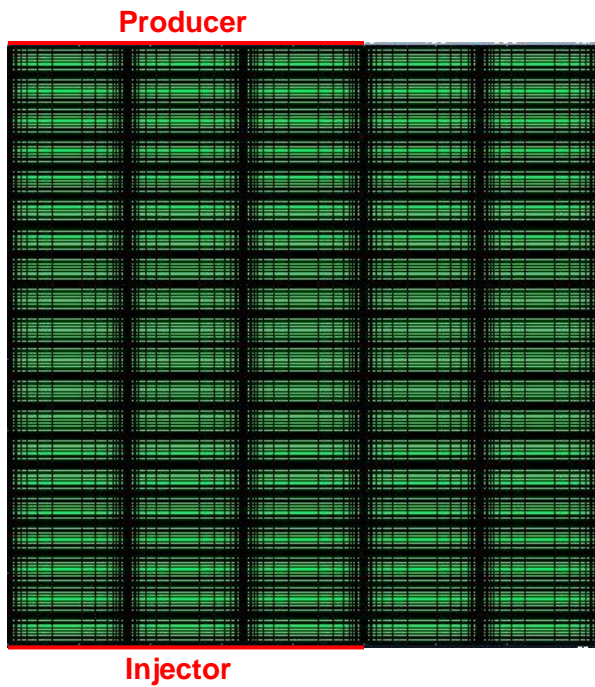
**Fig. 6 Shape factor for exchanges between the matrix and the two fractured media**



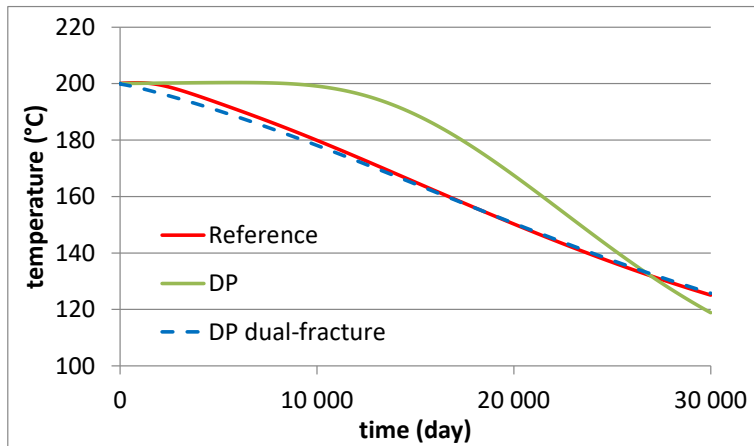
**Fig. 7 Simulation domain with the matrix block of 100x25 m**



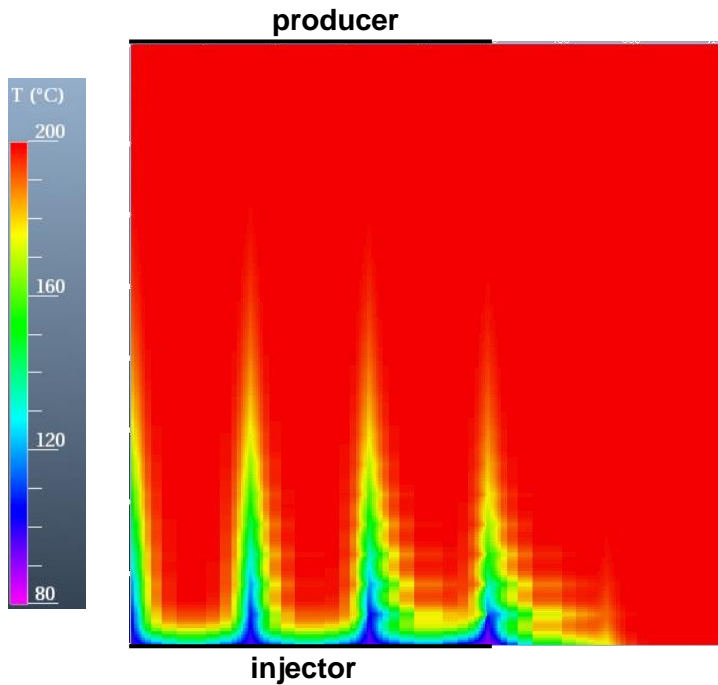
**Fig. 8 Comparison of shape factors on a single matrix block**



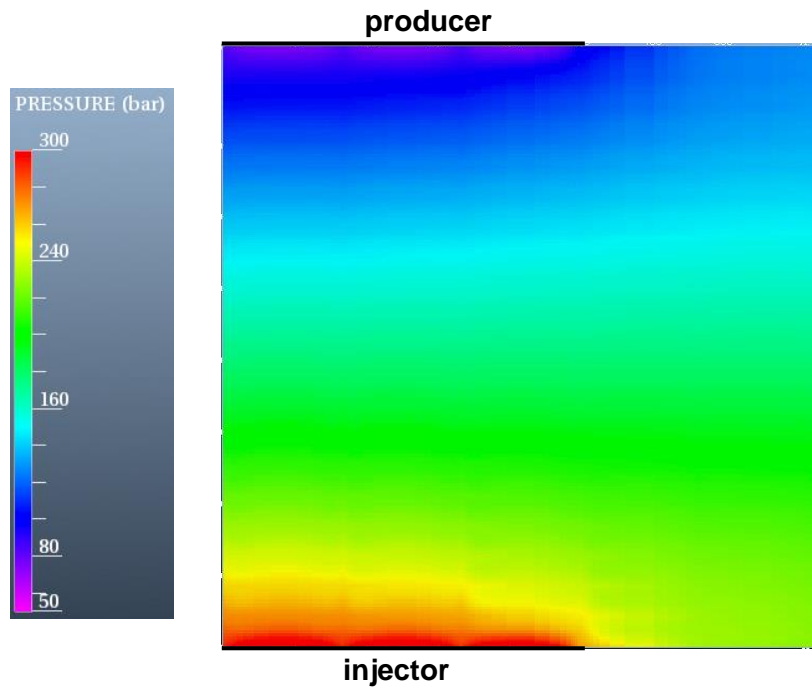
**Fig. 9 Horizontal doublet with fine grid around the fractures for the reference solution simulation**



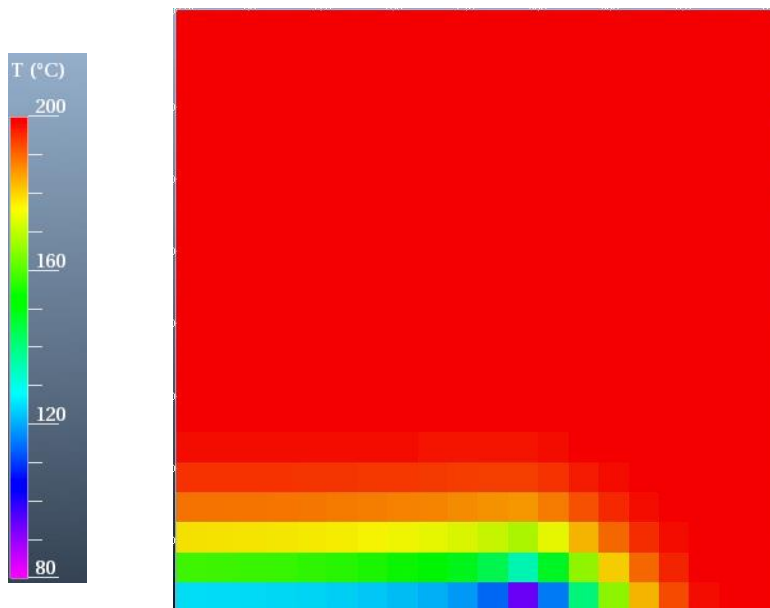
**Fig. 10 Produced water temperature**



**Fig. 11 Temperature map of the reference solution at 1000 days for the horizontal doublet**

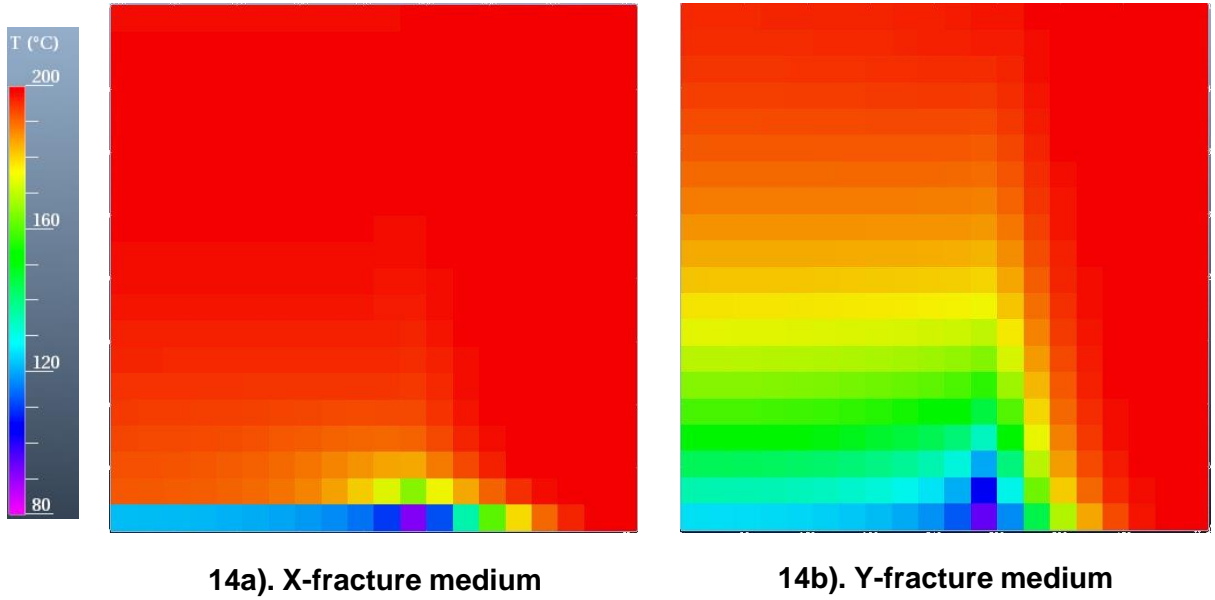


**Fig. 12 Pressure map of the reference solution at 1000 days**

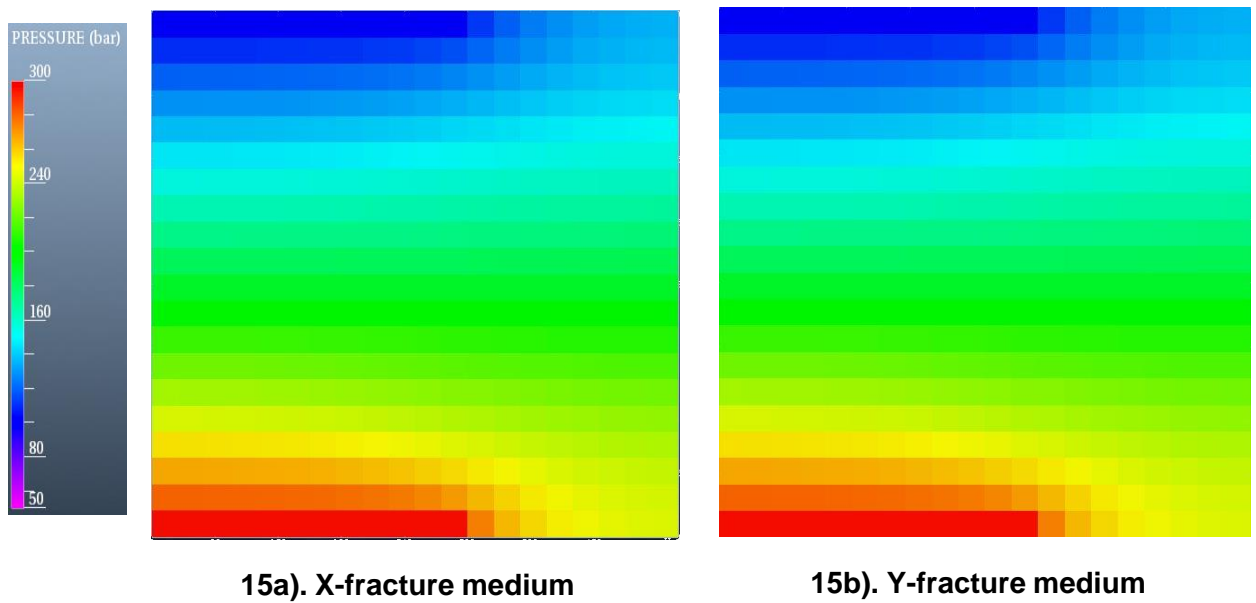


**Fig. 13 Temperature map in the fracture cells of the standard dual-porosity model at 1000 days**

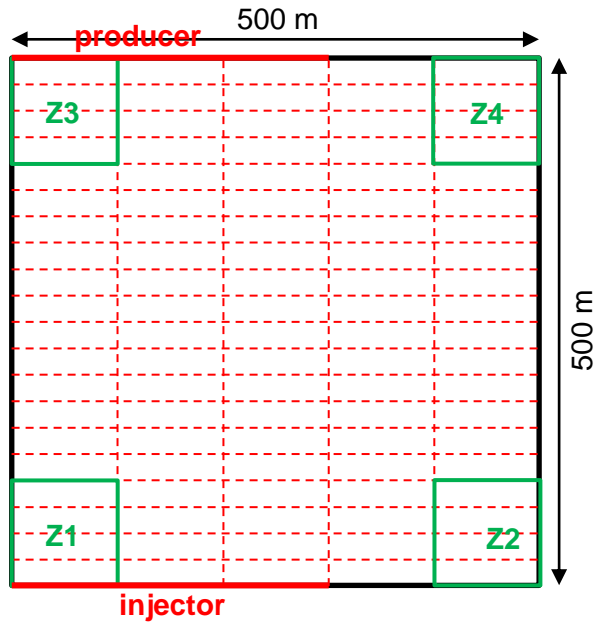




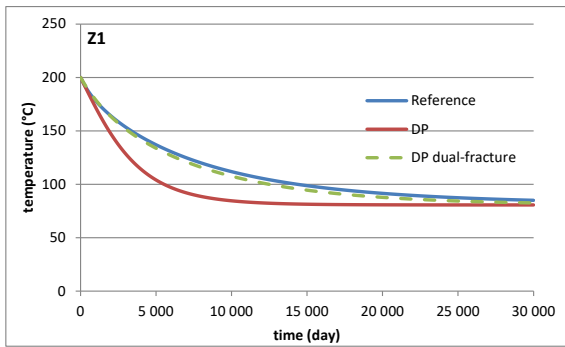
**Fig. 14 Temperature maps of the dual-porosity and dual-fracture model at 1000 days**



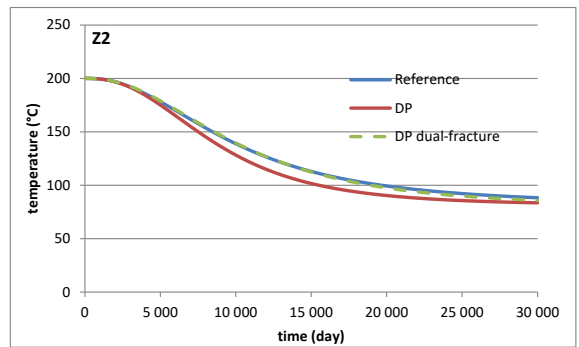
**Fig. 15 Pressure maps of the dual-porosity and dual-fracture model at 1000 days**



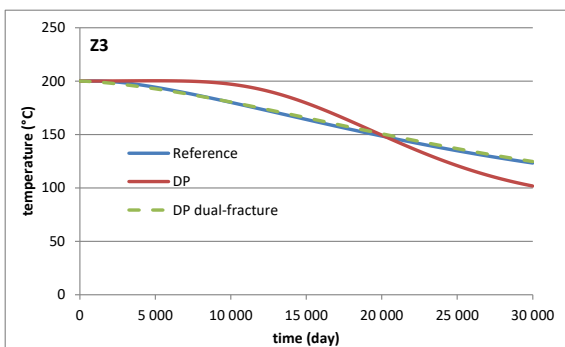
16a). The considered four zones near the corners



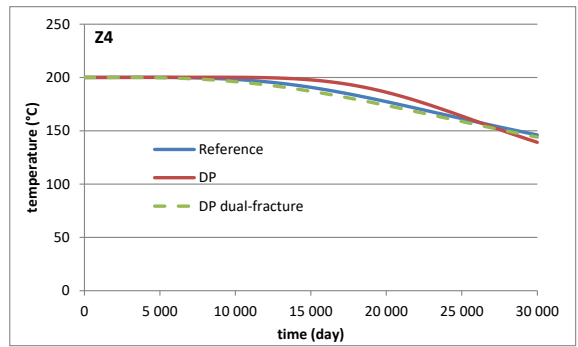
16b). Temperature in Zone Z1



16c). Temperature in Zone Z2

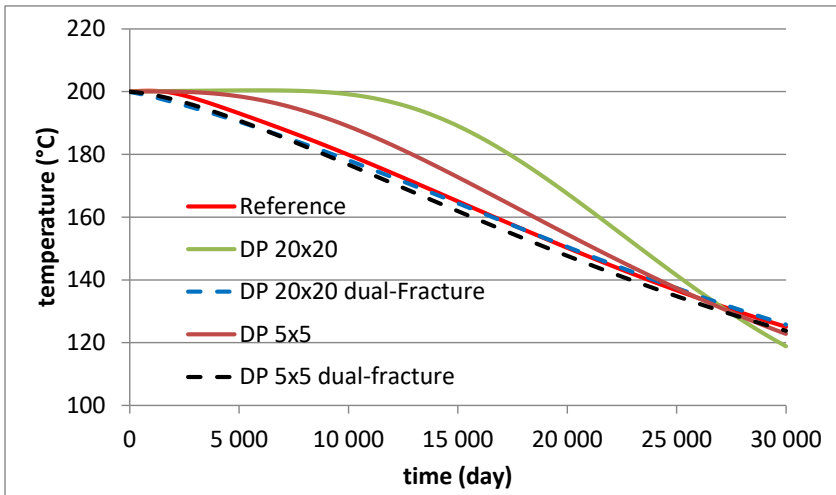


16d). Temperature in Zone Z3

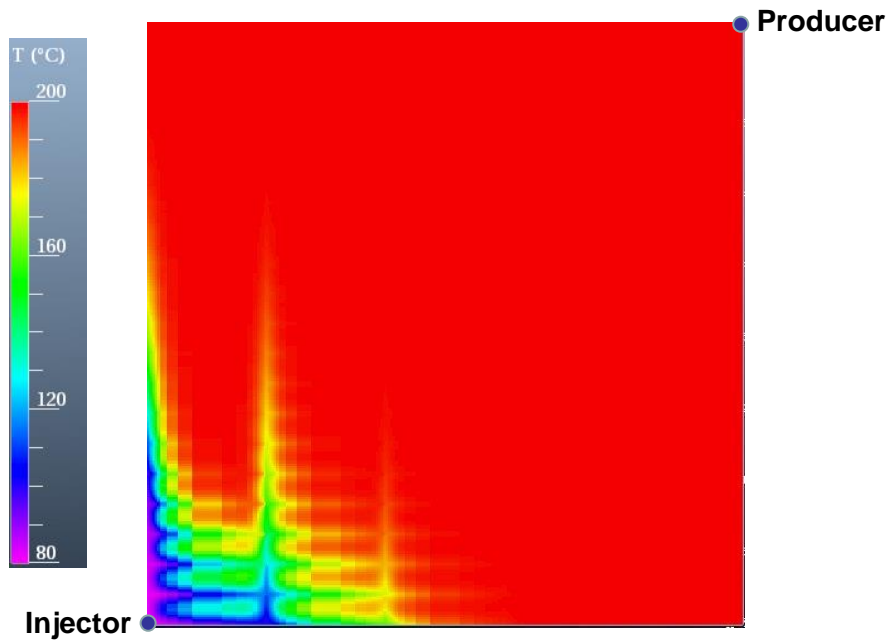


16e). Temperature in Zone Z4

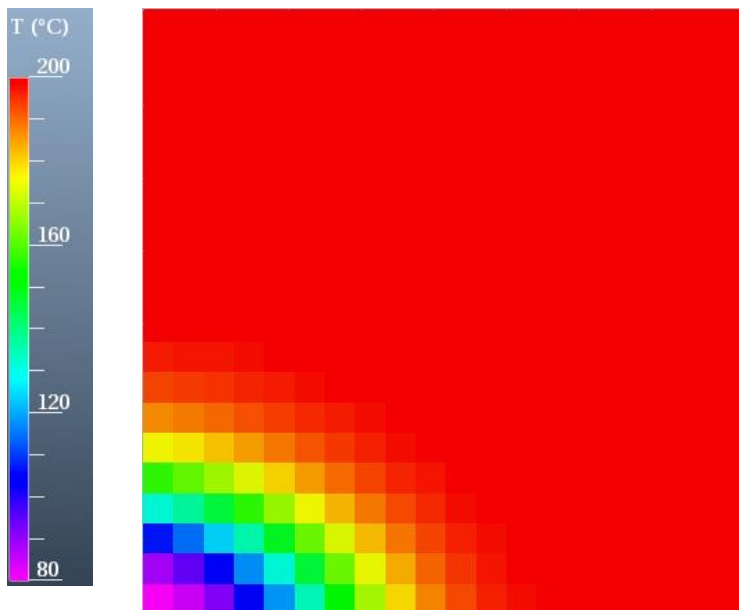
Fig. 16 Average temperature in the four zones in the matrix medium near the corner



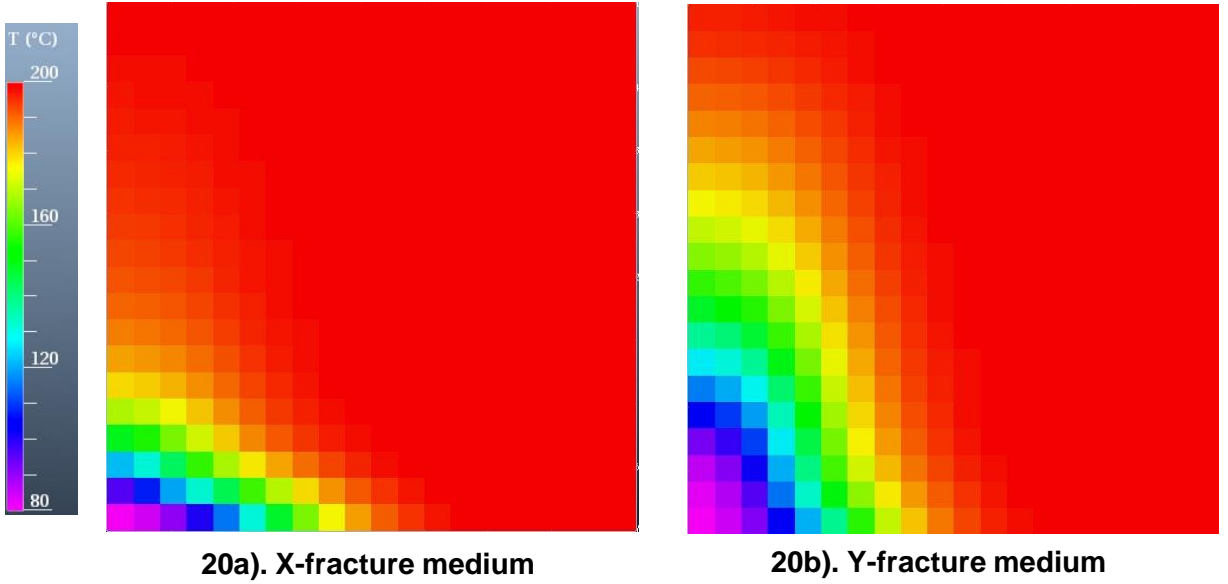
**Fig. 17 Produced water temperature simulated with 5x5 grid cells at 1000 days with the horizontal doublet**



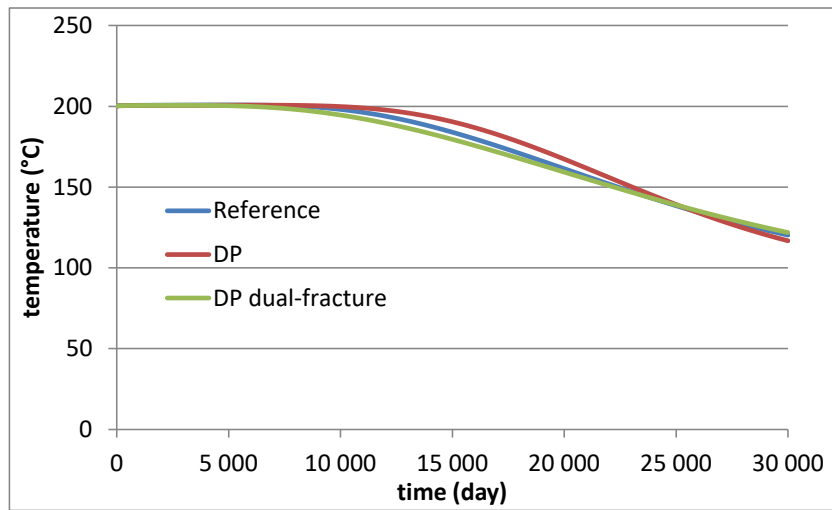
**Fig. 18** Temperature map of the reference solution at 1000 days with the vertical doublet



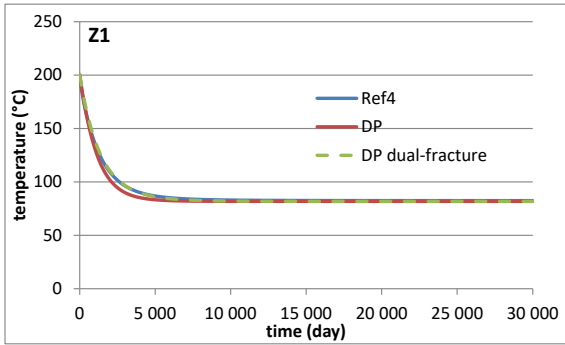
**Fig. 19** Temperature map of the standard dual-porosity simulation at 1000 days with the vertical doublet



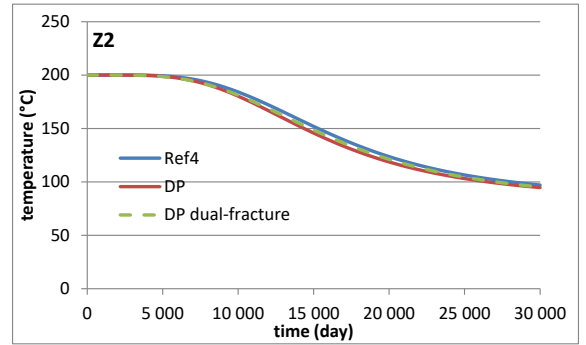
**Fig. 20** Temperature maps of the dual-fracture model at 1000 days for the vertical doublet



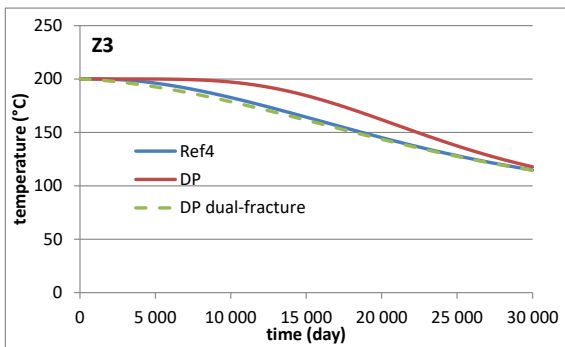
**Fig. 21** Produced water temperature at the production well



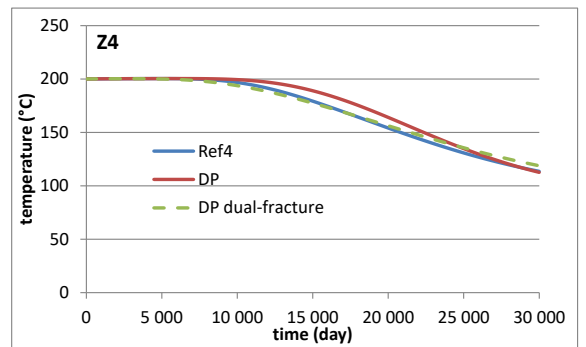
**22a). Temperature in Zone Z1**



**22b). Temperature in Zone Z2**



**22c). Temperature in Zone Z3**



**22d). Temperature in Zone Z4**

**Fig. 22 Average temperature in the four zones of the matrix medium near the corner with the vertical doublet**