Article:

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Supplementary material

Table S1 Nomenclature

Symbol	Units	Definition	Symbol	Units	Definition
Φ	-	Total hydraulic head	K_{ij}	m s^{-1}	Hydraulic conductivity tensor
v	m s^{-1}	Apparent seepage velocity	g	m s^{-2}	Gravitational acceleration
k_{ij}	m^2	Permeability tensor	ν	m^2 s^{-1}	Kinematic viscosity of fluid
δ_{ij}	-	Kronecker's delta	c_1	-	Crack density at the percolation threshold
λ	-	Connectivity	F_0	-	Dimensionless crack density (=tr F_{ij})
P_{ij}	m^2	Tensor related to crack geometry with aperture	τ	-	Tortuosity
ρ	m^{-3}	Number of Cracks per unit volume	L	m	Flow path length
r	m	Crack radius	a	m	Straight-line distance
t	m	Crack aperture	β	-	Constrictivity
n_i, n_j	-	Direction cosines of $\boldsymbol{n}$	A	-	Cross-sectional area
$E(\boldsymbol{n}, r, t)$	-	Density function of n, r, t	T_{ij}	-	Crack network parameter
N_{ij}	-	Fabric tensor	Λ_{ij}	-	Modified correction factor
$m(\boldsymbol{q})$	m^{-1}	Crack number per unit length of intersected scan line	V	m^3	Volume
t_0	m^{-1}	Initial aperture of crack	$m^{(V)}$	-	Total number of cracks in volume
σ'_n	Pa	Effective normal stress	s	m^2	Crack surface area
γ'	Nm^{-3}	Submerged unit weight	AI	-	Anisotropy index of crack orientation (0<AI<1.41)
H	m	Mechanical parameter of crack	$J_2^{(\hat{F})}$	-	Second invariant of the deviatoric tensor of F_{ij}
S_0	m^{-1}	Crack surface area of all cracks per unit volume	$\rho_{3-D,c}$	-	Dimensionless crack density based on excluded volume

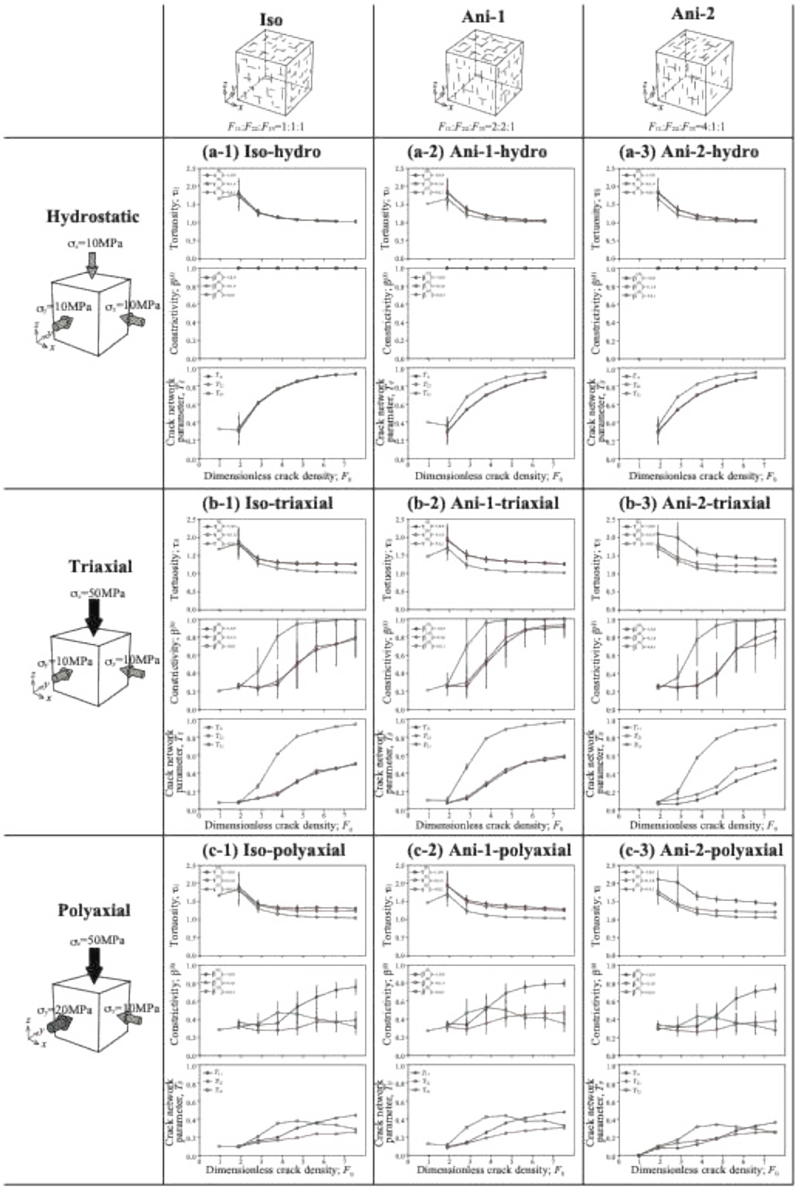
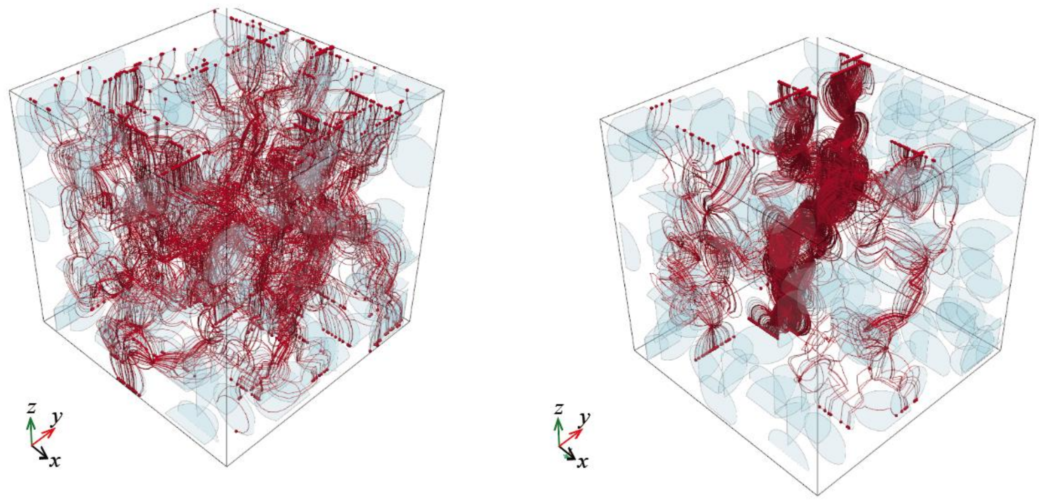


Fig. S1

Fig. S1 Dependency of tortuosity, $\tau^{(k)}$, constrictivity, $\beta^{(k)}$, and crack network parameter, T_{ij}, on dimensionless crack density in each model. (a-1) to (a-3) are under hydrostatic conditions, (b-1) to (b-3) are under conventional triaxial conditions, and (c-1) to (c-3) are under polyaxial conditions. Each dataset represents the average values of 100 instances of crack models, plotted for each direction, with error bars indicating the standard deviation. At $F_0 = 0.97$, there may be no percolating flow path, in which case the value on the vertical axis is 0. Additionally, since constrictivity means the influence of bottlenecks, it equals 1.0 under hydrostatic conditions where the aperture of all cracks is uniform. The format of the figure is the same as Fig. 10.



(a) Iso-hydro-450 (b) Iso-triaxial-450

Fig. S2 Particle-tracking trajectories for the same DFN-based crack model under (a) hydrostatic and (b) triaxial stress conditions. The numbers of injected particles were 200 and 400 for the hydrostatic and triaxial cases, respectively. Inflow and outflow boundary conditions are assigned to planes perpendicular to the *z*-axis.