

A novel shear damage model of the shear deformation and failure process of gas hydrate-bearing sediments

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Micro-mechanism of shear deformation

- GHBSs (Fig. 1) are composed of GH particles, sand particles, methane gas, and water.
- The mechanical characteristics of the microscopic components and the interaction between them predominantly determine the macroscopic mechanical behavior of the sediments.(Tab. 2)

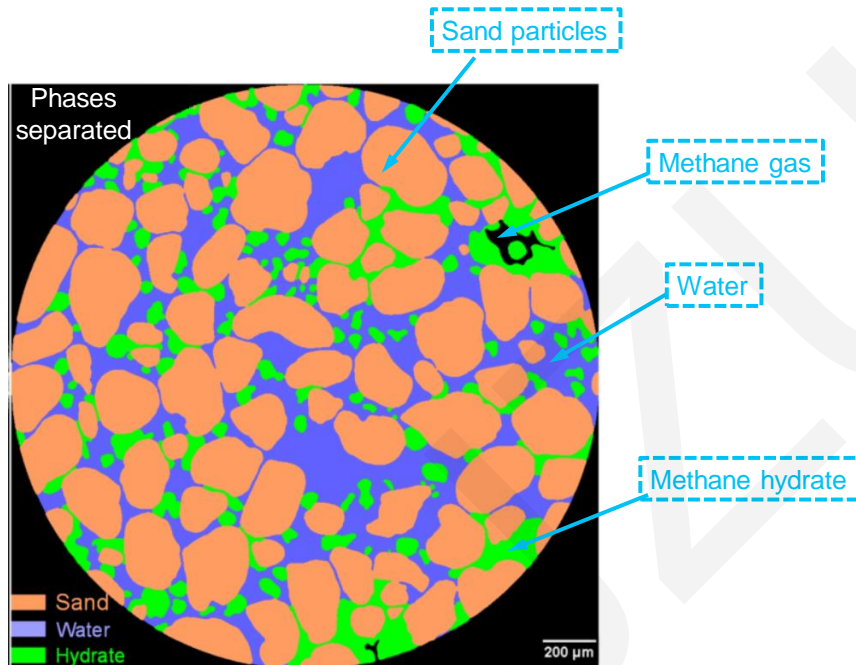


Fig. 1 CT results of GHBSs

S_{GH}	Item	Initial state	Mechanism in movement	
			Slip	Rotation
0%				
<25%	Pore filling			
>40%	Grain coating			
>40%	Cementing			

Tab. 2 Particle-scale mechanisms of GHBSs under shearing

Shear damage model for GHBSs

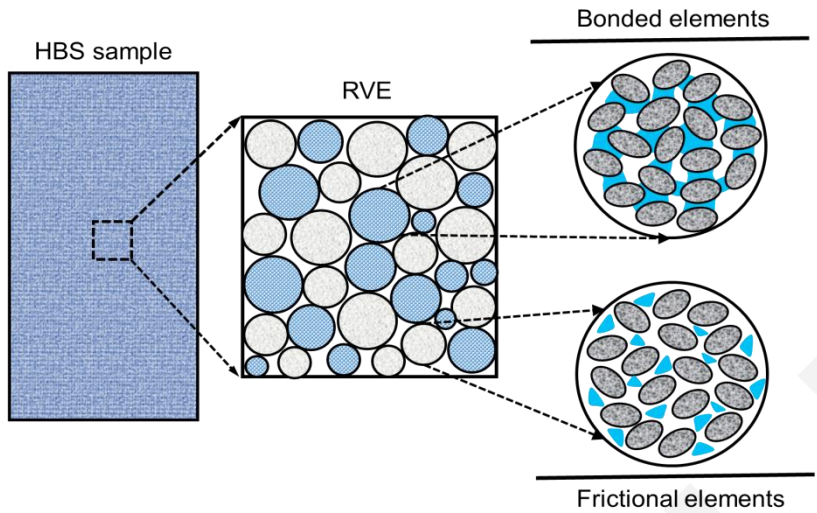


Fig.2 Structure model of GHBSs

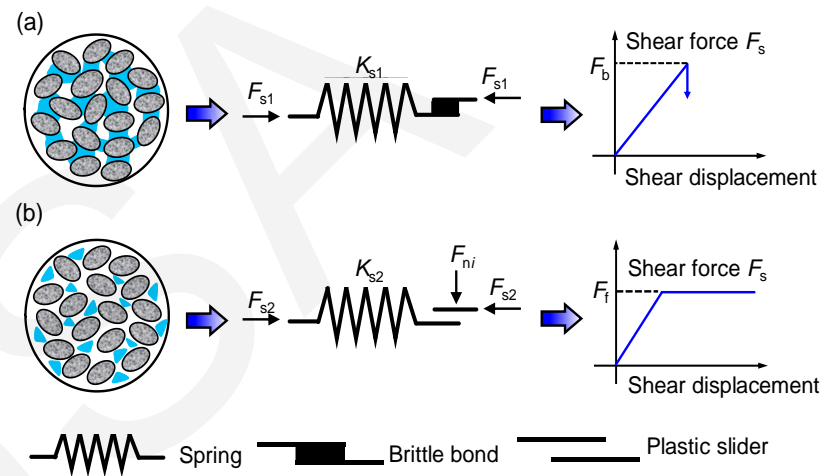


Fig. 3 Mechanical response of RVE

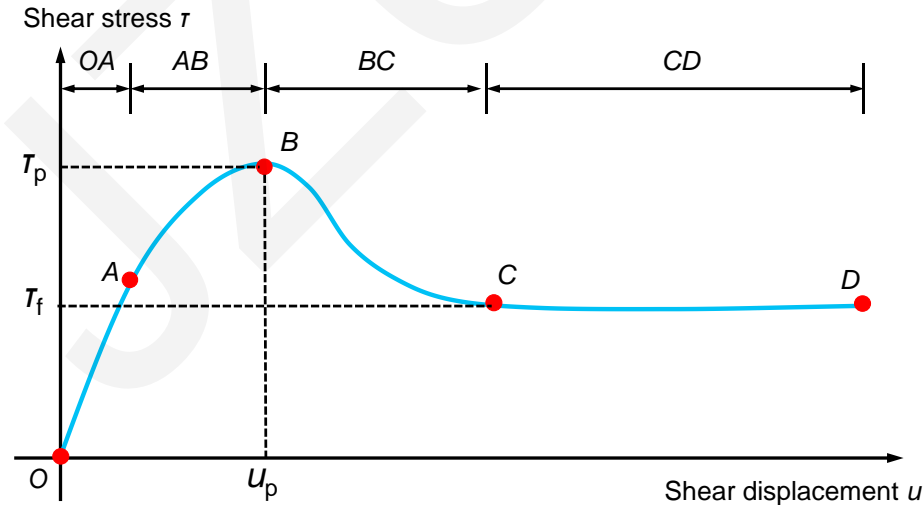


Fig. 4 Representative shear constitutive relationship of GHBSs

Model verification

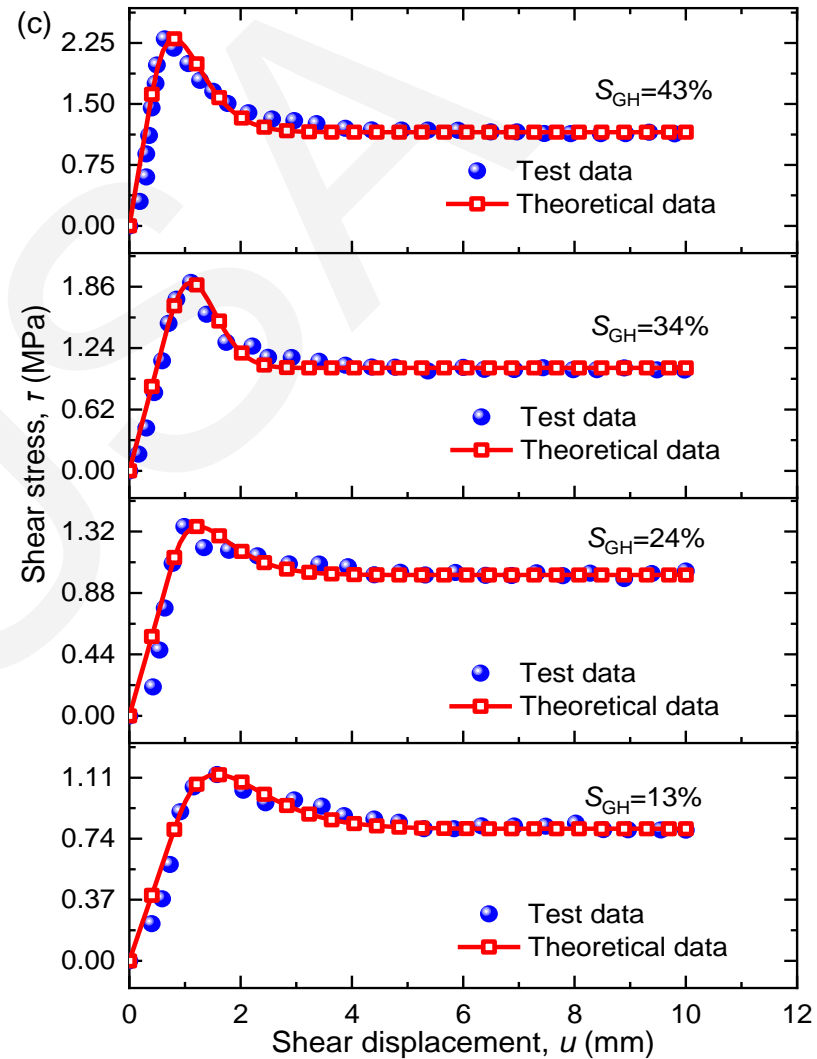
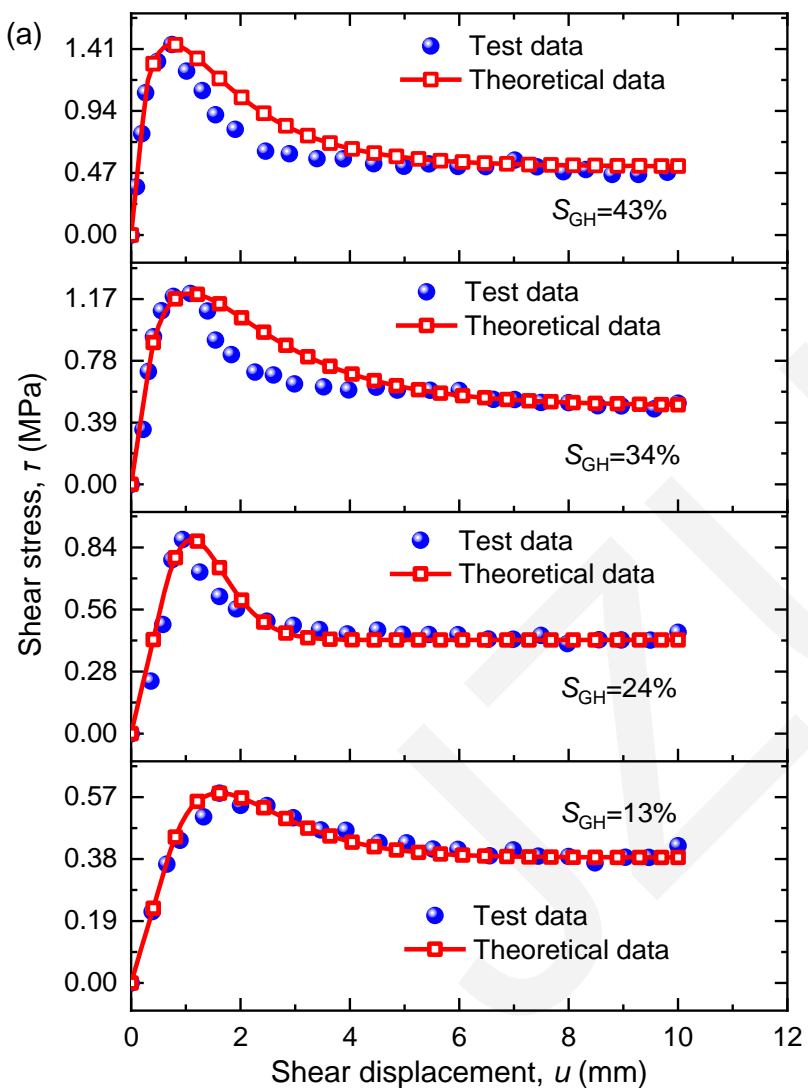


Fig.5 Comparisons between experimental and predicted results for GHBSs

Parametric analysis

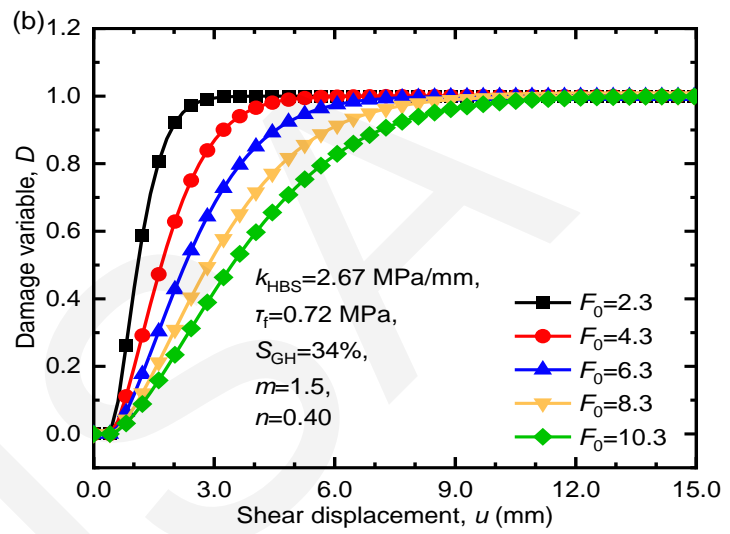
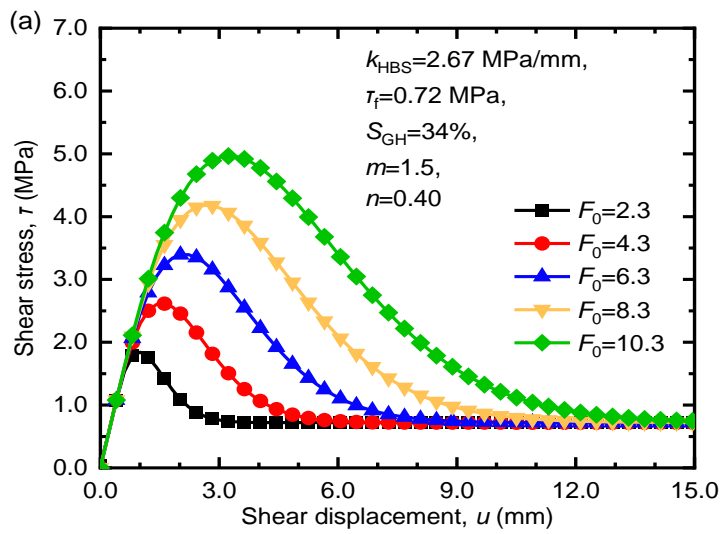


Fig. 5 Influence of model parameter F_0 on the shear response curves and damage evolution of GHBSs: (a) shear stress–displacement curves; (b) damage variable curves

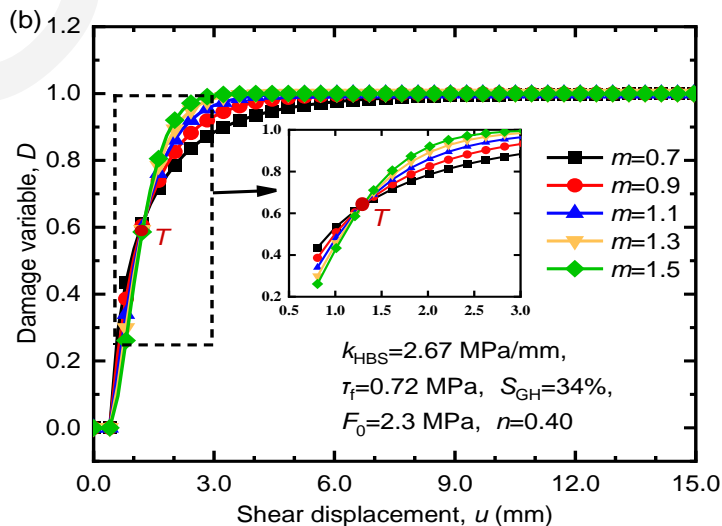
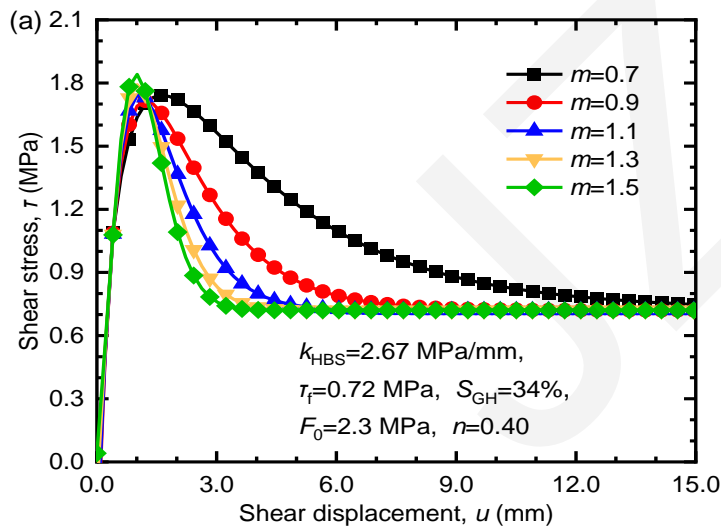


Fig. 6 Influence of model parameter m on the shear response curves and damage evolution of GHBSs: (a) shear stress–displacement curves; (b) damage variable curves

Damage evolution

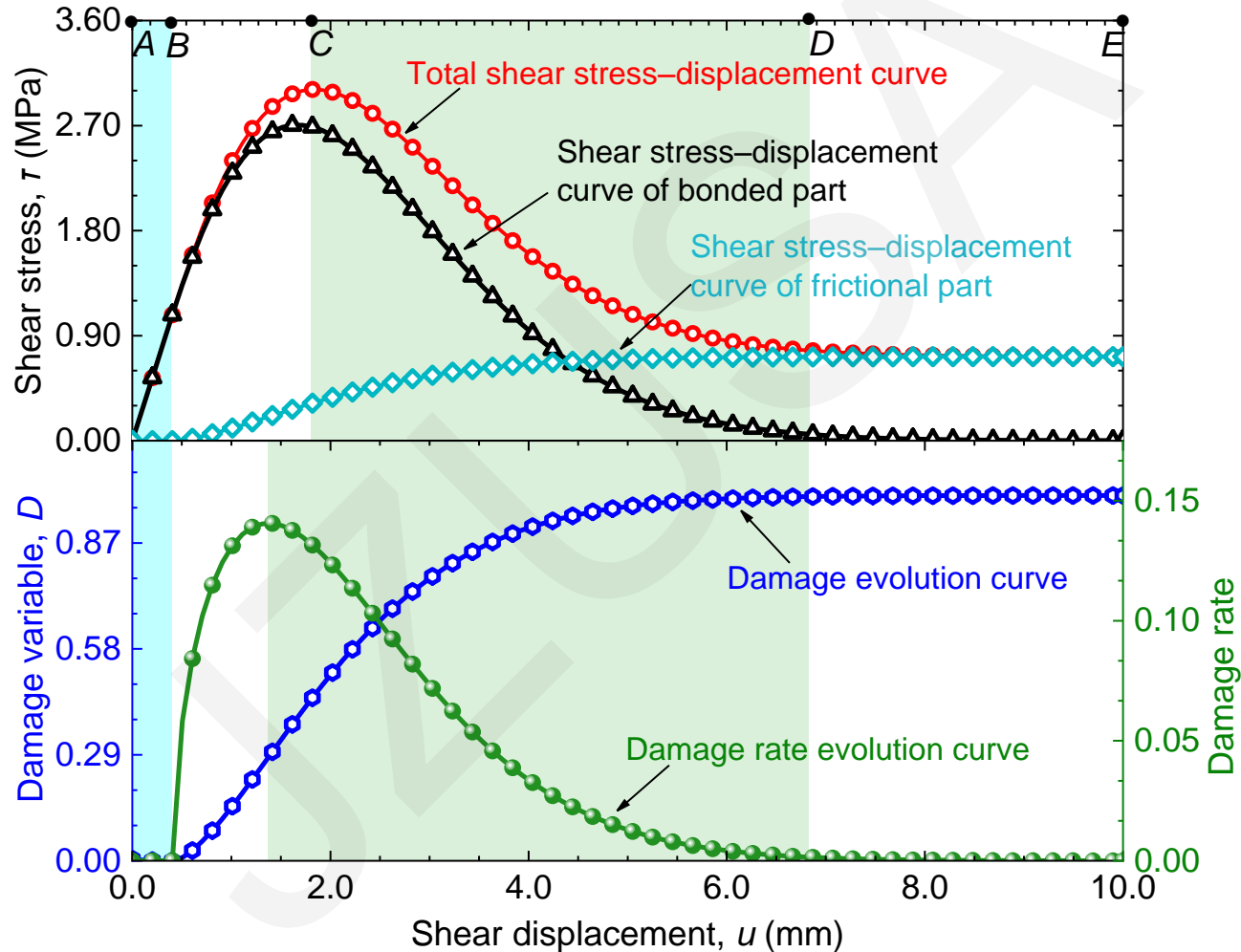


Fig. 8 Shear stress partition and damage evolution of GHBSs under shearing process