Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

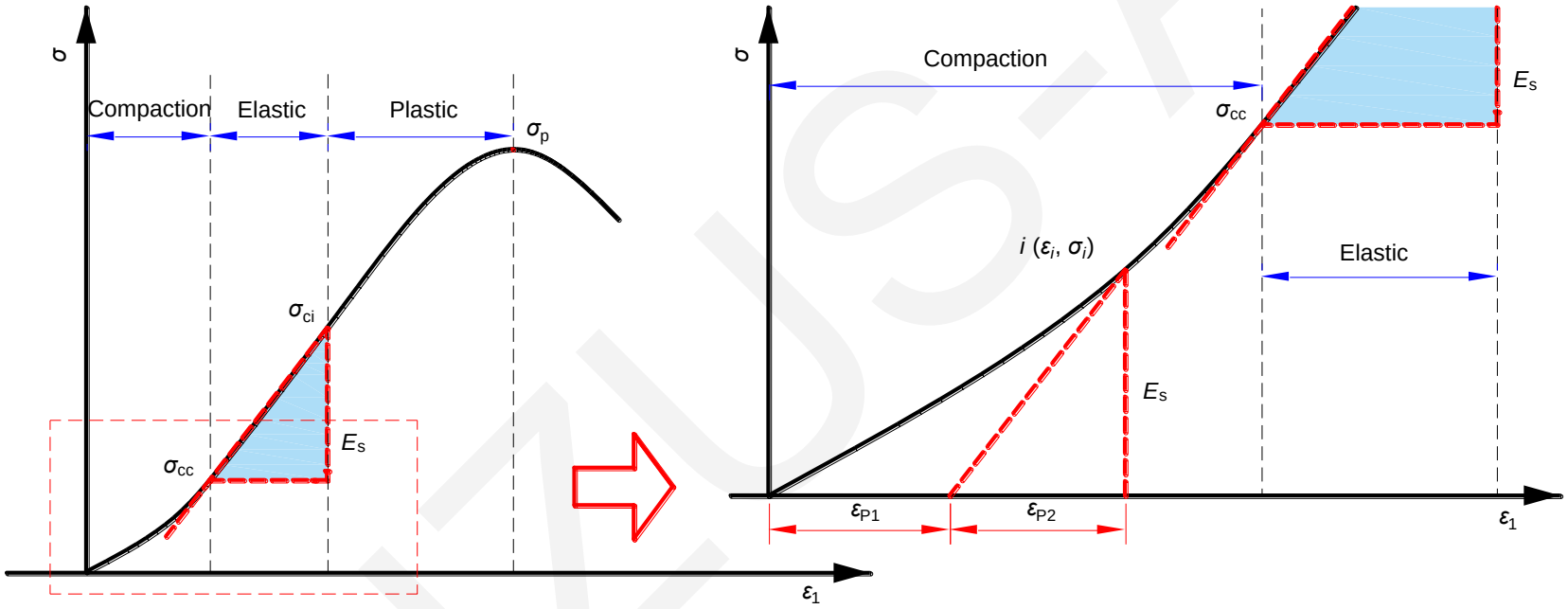
Evolution mechanism and quantitative characterization of initial micro-cracks in marble under triaxial compression

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Model establishment

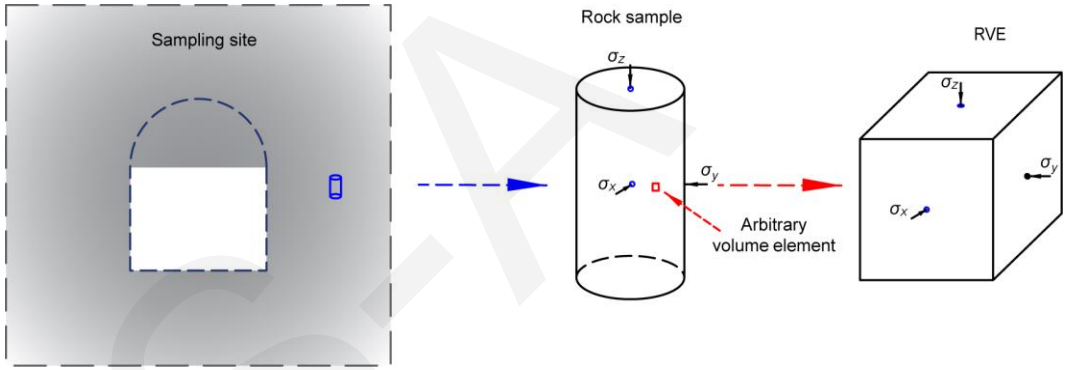
- **Pre-peak stage division of stress-strain curve**



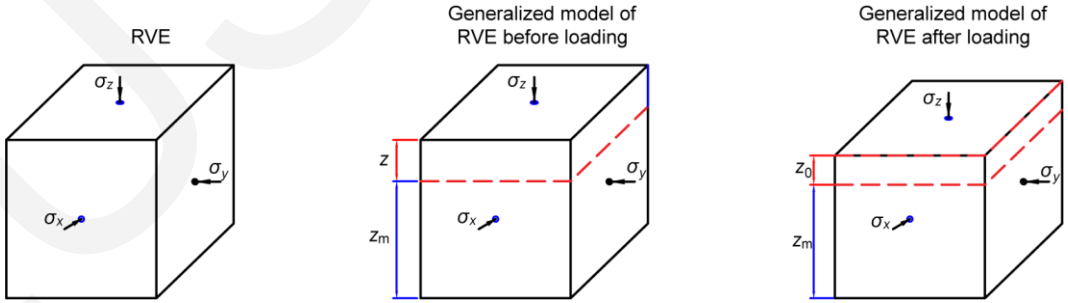
- **The strains ε of rock at the compaction and linear elastic stage both have two components: the partial strain ε_{P1} of the matrix and the partial strain ε_{P2} of the cracks.**

Model establishment

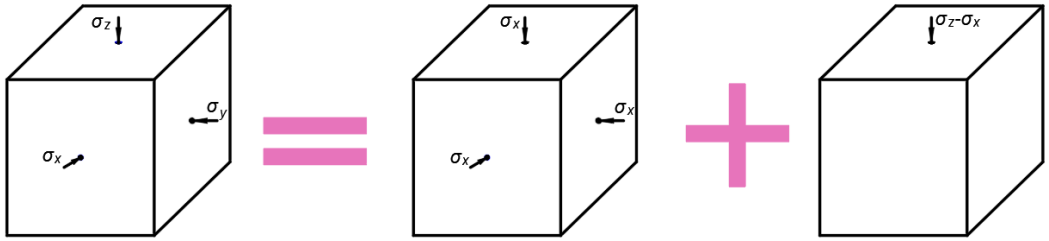
- The sampling process and corresponding representative volume element (RVE)



- Deformation characteristics of sample under the external load

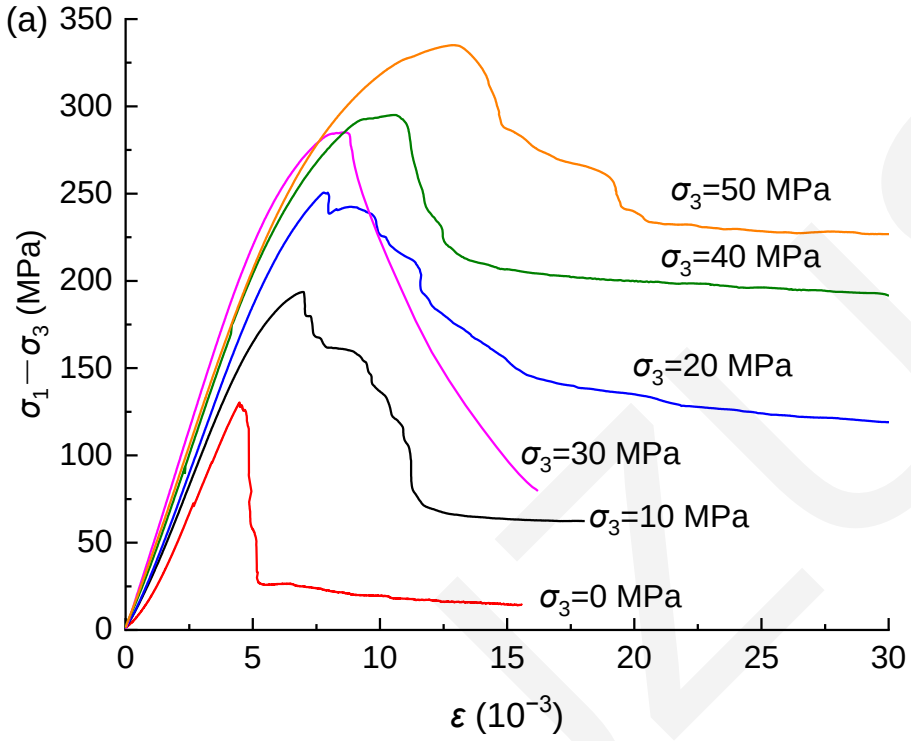


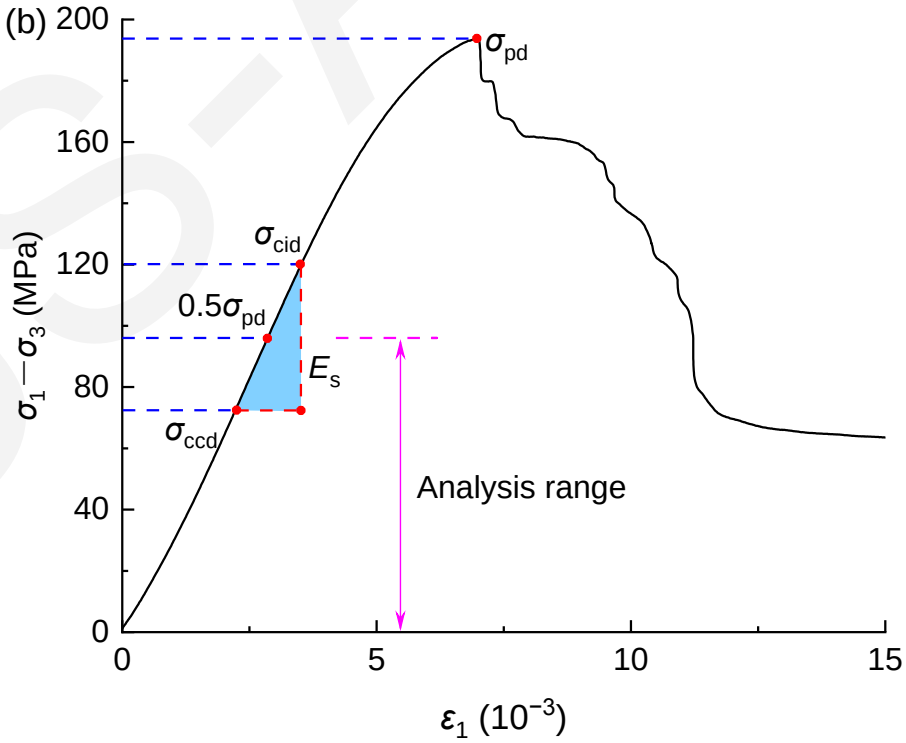
- Decomposition of conventional triaxial compression sample



Results-Model validation

■ (a) Deviatoric stress–axial strain curves of triaxial compression marble samples

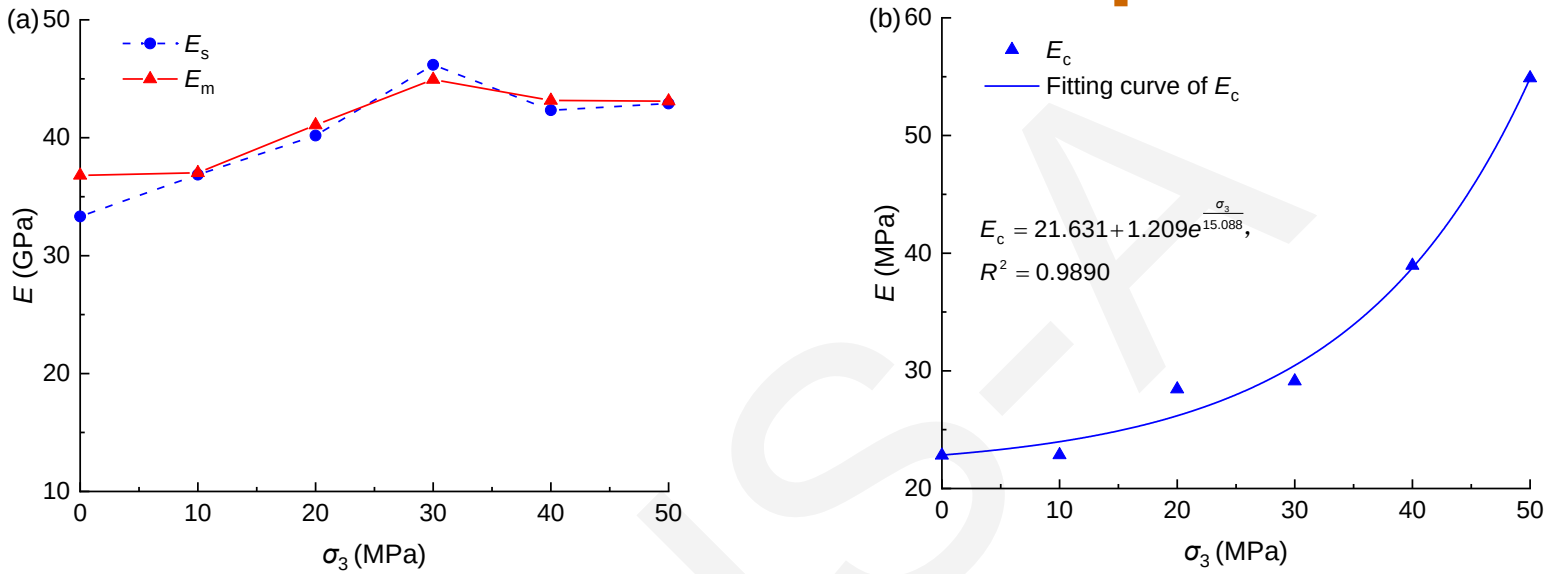




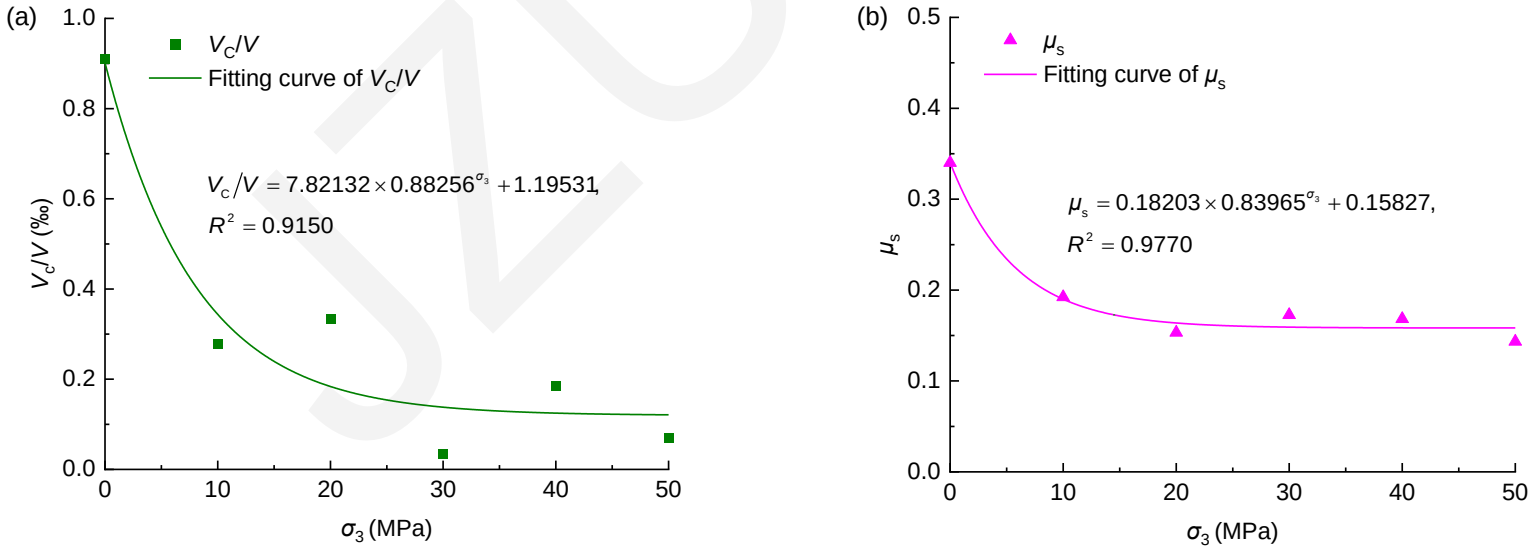
■ (b) Determination of the model analysis range

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Results-Variation of model parameters

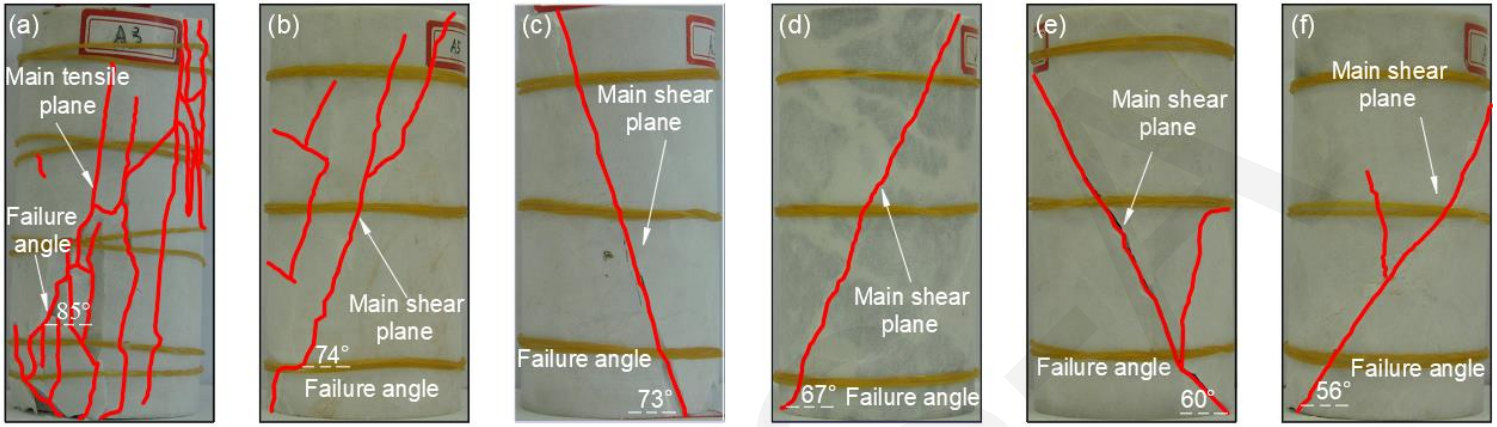


Influence of the confining pressure σ_3 on sample modulus parameters: (a) sample elastic modulus E_s and matrix elastic modulus E_m; (b) crack elastic modulus E_c

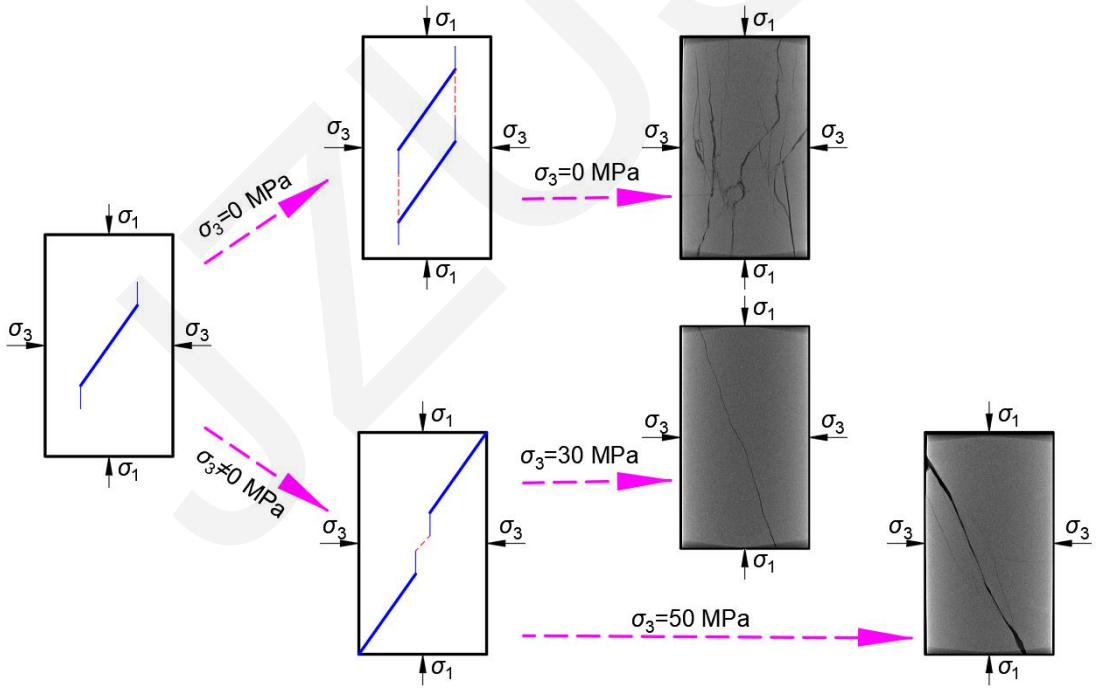


Variation of porosity V_C/V (a) and Poisson's ratio of the sample μ_s (b) with confining pressure σ_3

Results-Failure characteristics



Failure characteristics of triaxial compression marble sample: (a) σ_3=0 MPa; (b) σ_3=10 MPa; (c) σ_3=20 MPa; (d) σ_3=30 MPa; (e) σ_3=40 MPa; (f) σ_3=50 MPa



Mesoscopic crack propagation mode of triaxial compression sample

Conclusions

- In this paper, a quantitative analysis model for the proportion of initial micro-cracks in rock is established. The physical significance of the parameters is clear and easy to determine.
- The fitting range for accurate analysis of initial micro-cracks in rock is experimentally determined, and the influence of confining pressure on model parameter evolution of marble samples is revealed.
- Combined with micro-CT scanning technology, the failure characteristics of the loaded rock samples are discussed and analyzed.

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