

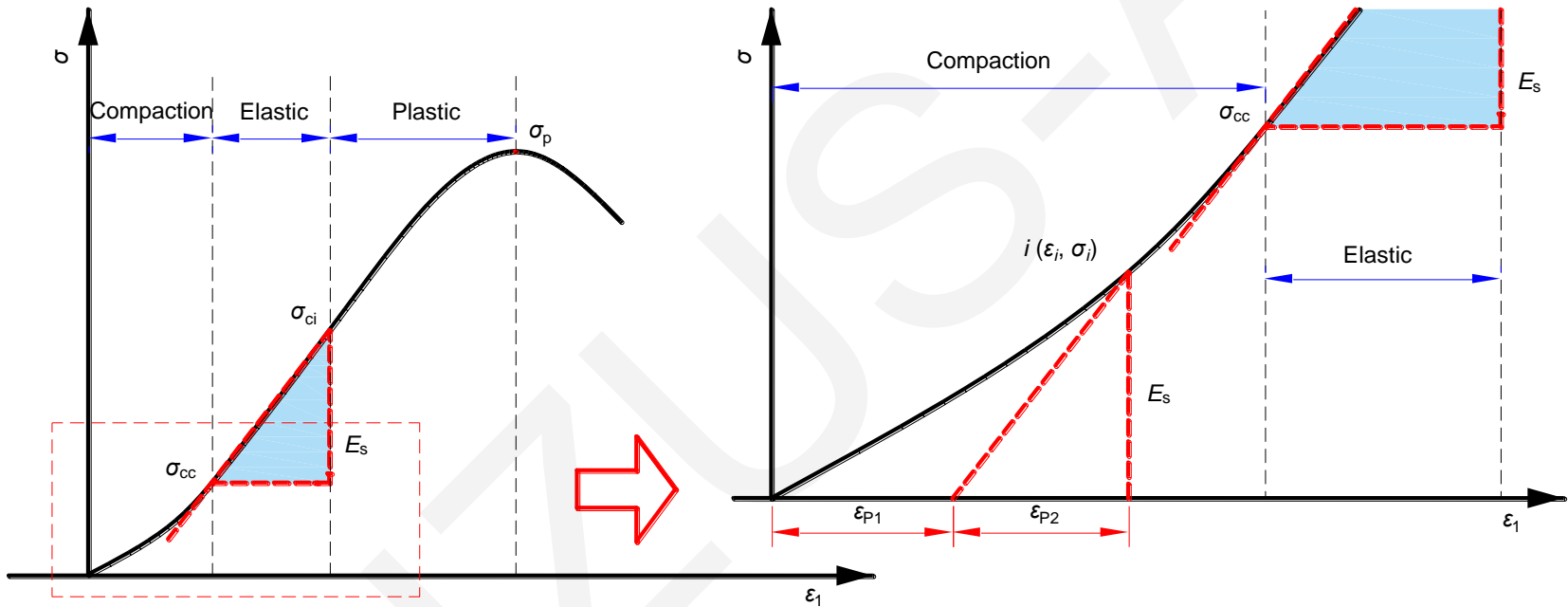
Evolution mechanism and quantitative characterization of initial micro-cracks in marble under triaxial compression

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Cite this as: Zhiliang WANG, Songyu LI, Jianguo WANG, Ao LI, Weixiang WANG, Chenchen FENG, Jingjing FU, 2024. Evolution mechanism and quantitative characterization of initial micro-cracks in marble under triaxial compression. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 25(7):586-595. <https://doi.org/10.1631/jzus.A2300159>

Model establishment

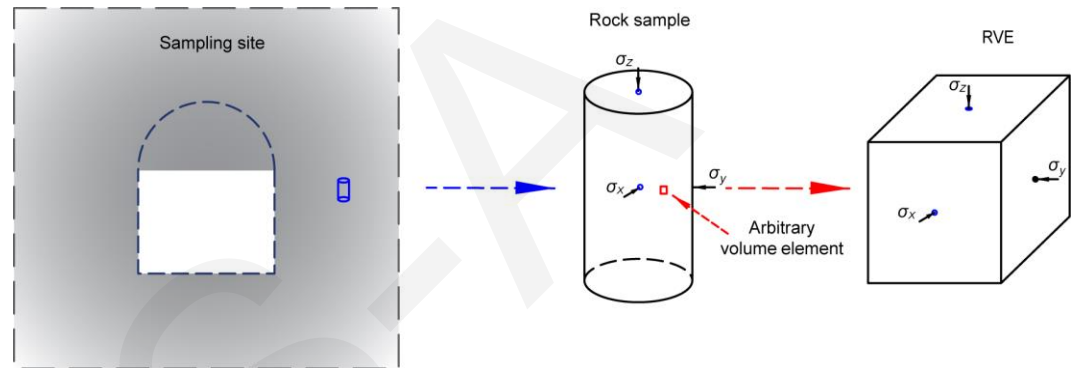
■ Pre-peak stage division of stress-strain curve



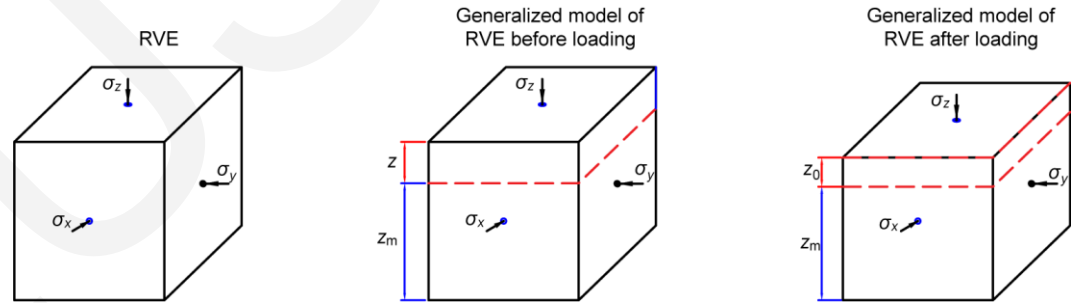
- The strains ϵ of rock at the compaction and linear elastic stage both have two components: the partial strain ϵ_{p1} of the matrix and the partial strain ϵ_{p2} of the cracks.

Model establishment

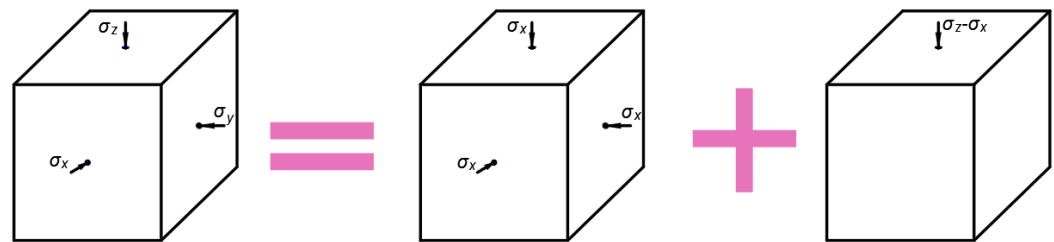
■ The sampling process and corresponding representative volume element (RVE)



■ Deformation characteristics of sample under the external load

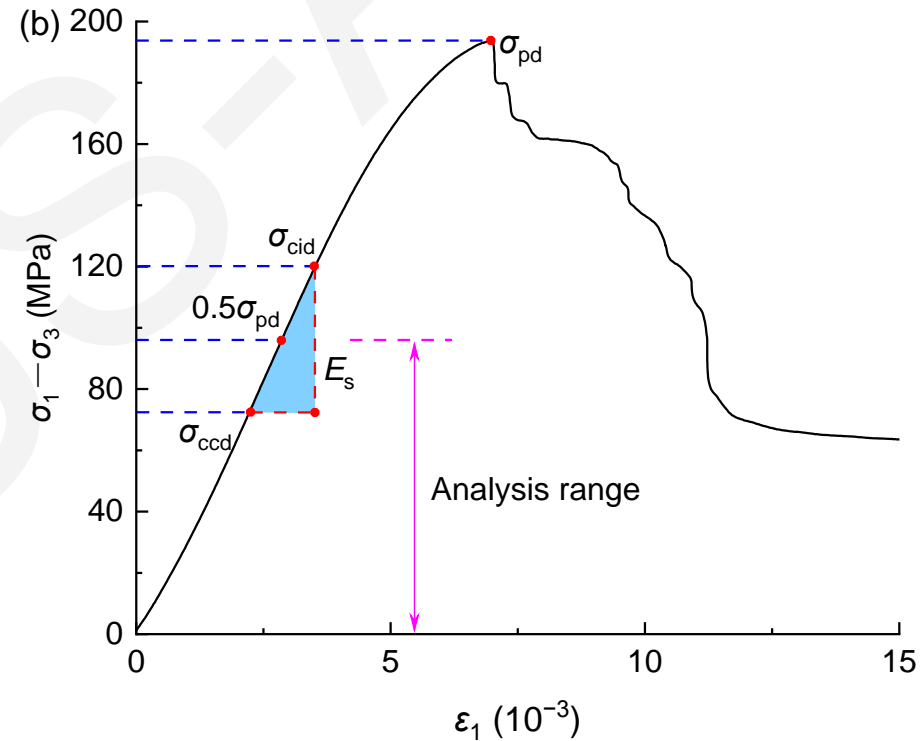
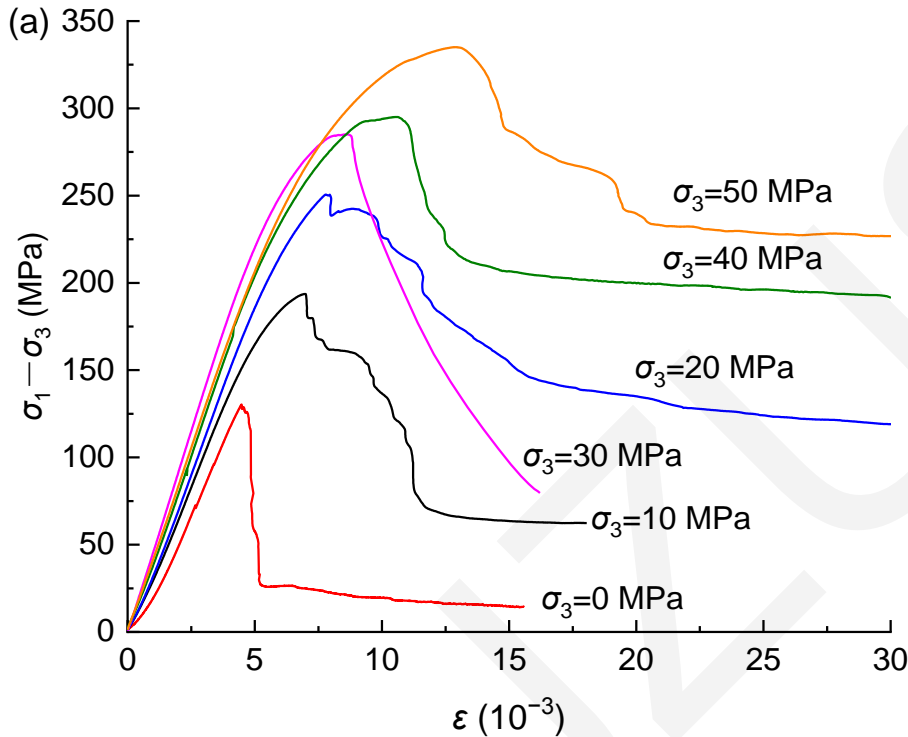


■ Decomposition of conventional triaxial compression sample



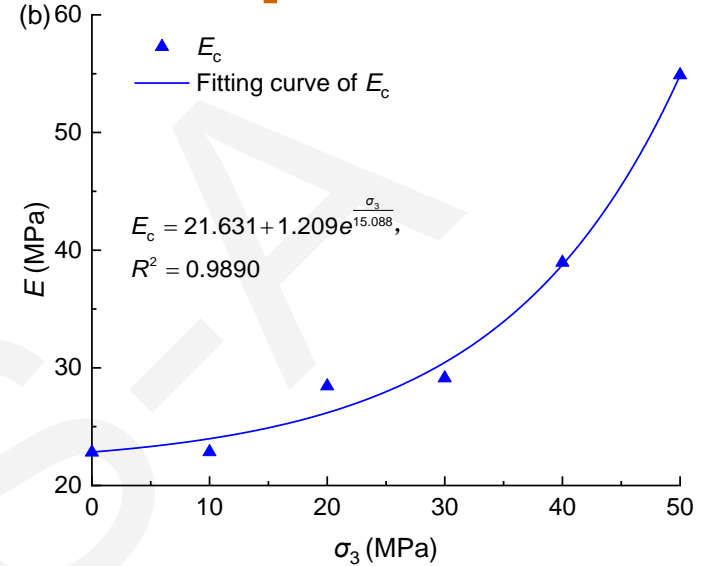
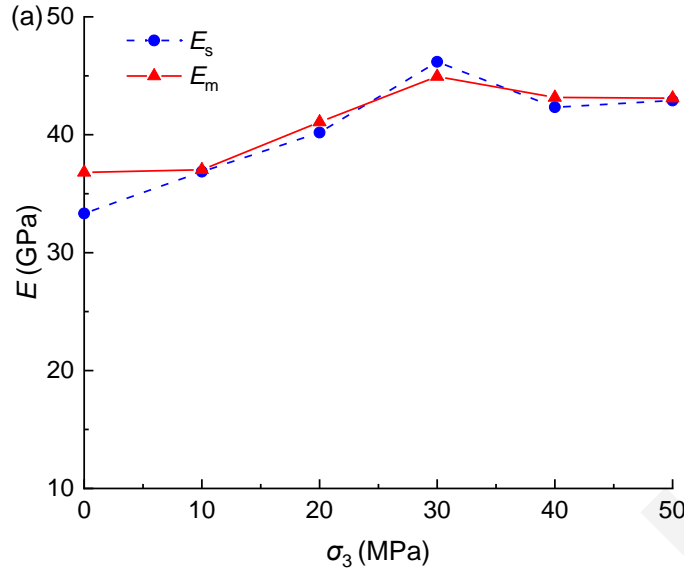
Results-Model validation

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

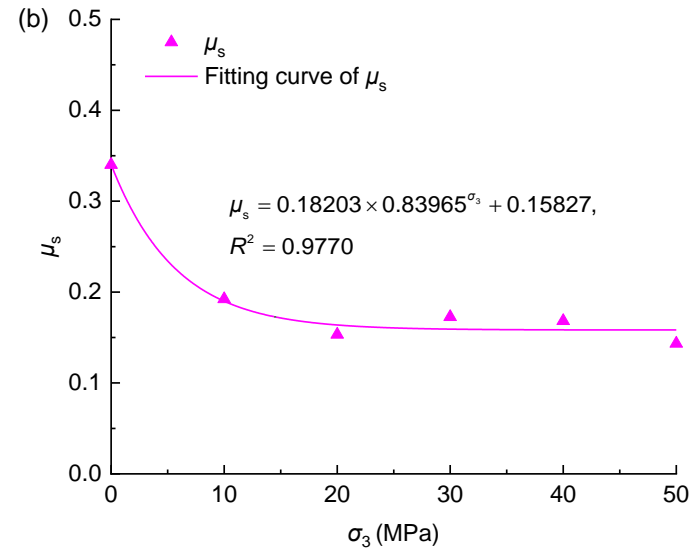
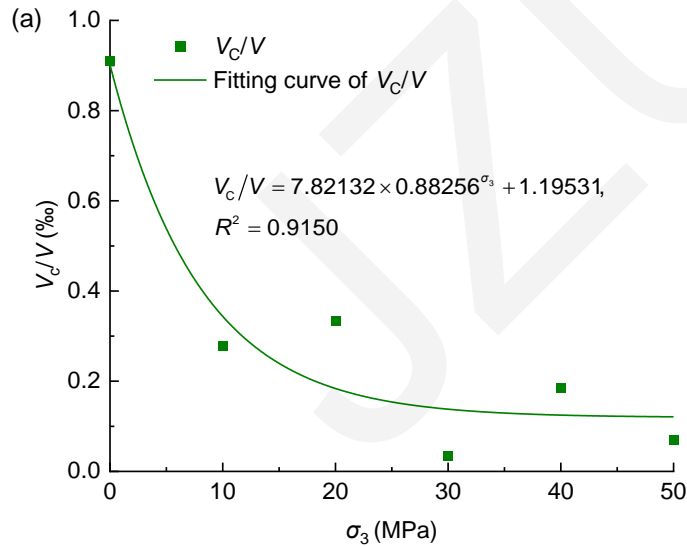


- (b) Determination of the model analysis range

Results-Variation of model parameters

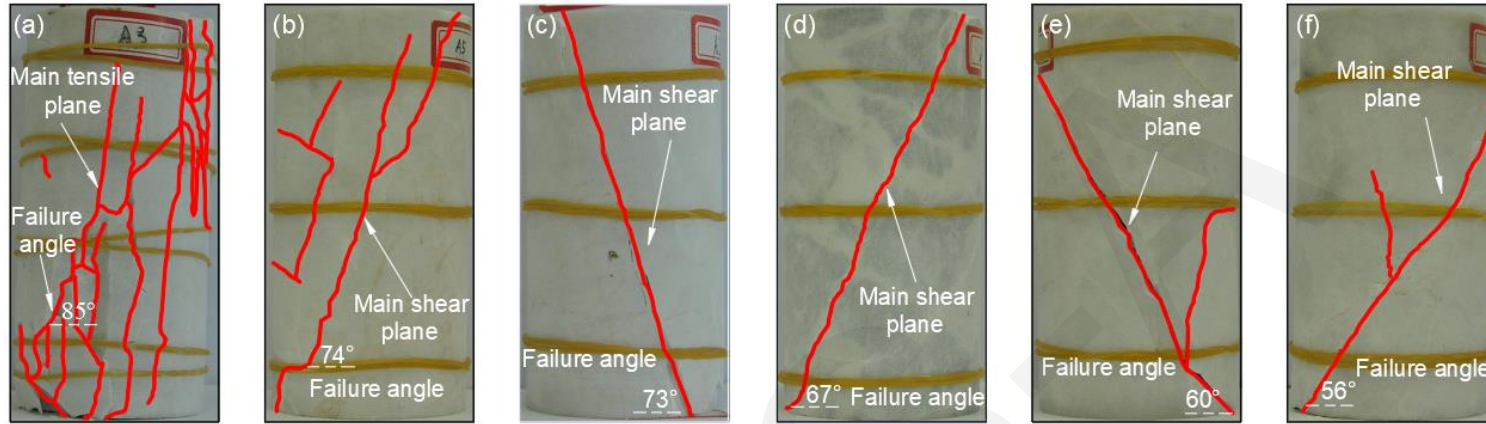


Influence of the confining pressure σ_3 on sample modulus parameters: (a) sample elastic modulus E_s and matrix elastic modulus E_m ; (b) crack elastic modulus E_c

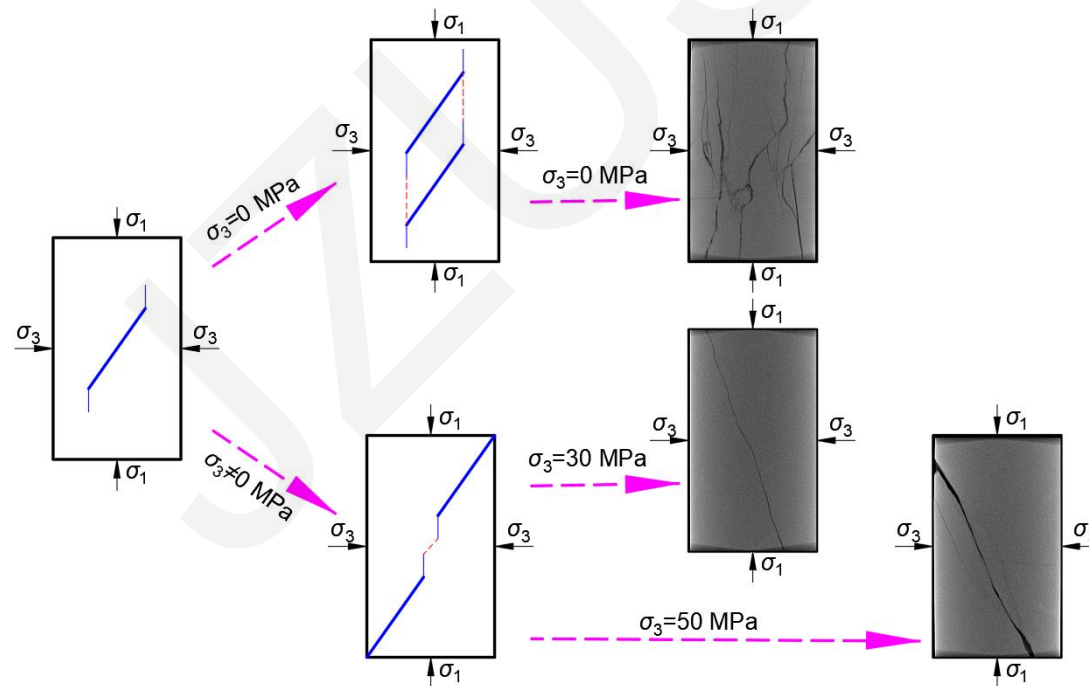


Variation of porosity V_c/V (a) and Poisson's ratio of the sample μ_s (b) with confining pressure σ_3

Results-Failure characteristics



Failure characteristics of triaxial compression marble sample: (a) $\sigma_3=0$ MPa; (b) $\sigma_3=10$ MPa; (c) $\sigma_3=20$ MPa; (d) $\sigma_3=30$ MPa; (e) $\sigma_3=40$ MPa; (f) $\sigma_3=50$ 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.