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Relation between formation of echelon faults and stress fields in rock mass-Simulation using MPS method-

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Echelon faults are a group of cracks and faults which have a certain angle to the main shear faults caused by earthquakes and crustal deformation. In Japan, they can be observed off the coast of Izu Peninsula. The mechanism and formation of the echelon faults are not well investigated, and there still remains an important geophysical subject to look into. In this study, we try to simulate the formation of echelon faults to investigate the nucleation conditions by the MPS (Moving Particle Semi-implicit) method which is a particle method developed for incompressible flow analysis. Particle interaction models for differential operators are prepared in this method. The government equations of elastic structures are interpreted into interactions between particles. In the finite difference and the finite element method, the failure at faults or cracks would not be well simulated when the displacement becomes large or the grid-based structure is broken. Particle methods are free from this difficulty. We simulate uniaxial and triaxial compression of 2D rectangle elastic structure. In the triaxial compression, we change the cohesion and the confining pressure to investigate the relation to the form of echelon faults. Our results show that the conjugate faults or cracks are generated with higher density as the cohesion and the confining pressure becomes higher. This suggests that we could estimate the magnitude and the direction of stress in rocks from the distribution of echelon faults.

Keywords: echelon, particle method, MPS method, compression test