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粒子モデルにおける弾性特性及び浸透率の関係に関する研究
Relationship between seismic velocity and permeability on granular rock model

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Fluid flow in a rock pore is of great importance in subsurface development, e.g., petroleum engineering and carbon dioxide capture and storage. Permeability, which shows how easily fluid can pass through rock mass, is one of the most important indicators to evaluate fluid flow in porous media. Since permeability can be measured by laboratory experiments and well logging, permeability in a large-scale reservoir must be predicted by other information. In this study, we focus on seismic velocity as information to predict permeability because it is the most trusted parameter in subsurface exploration. In order to predict permeability from seismic velocity, the relationship between permeability and seismic velocity must be revealed.

These two parameters are not directly connected to each other. Pore geometry of rock mass could be a bridge between them because it is mainly governing fluid flow and seismic velocity. However, the geometry is very complicated. For a general discussion, we adopted granular rock models including a lot of spherical grains whose size distribution is assumed to be Gaussian. The permeability and seismic velocity are numerically computed from these rock models. The permeability is calculated by lattice Boltzmann method, which is one of the computational fluid dynamic methods and well-suited for simulation under complicated fluid-solid boundary condition. The homogenization by finite element method is adopted for the calculation of seismic velocity.

It is demonstrated that the sorting parameter is governing the seismic velocity and permeability in this model. Sorting parameter is one of the most important parameters in the discussion of grain size distribution. This is an indicator which shows the standard deviation of grain-size. The result of this research shows the relationship between permeability and seismic velocity granular rock models by the bridge of grain sorting.

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